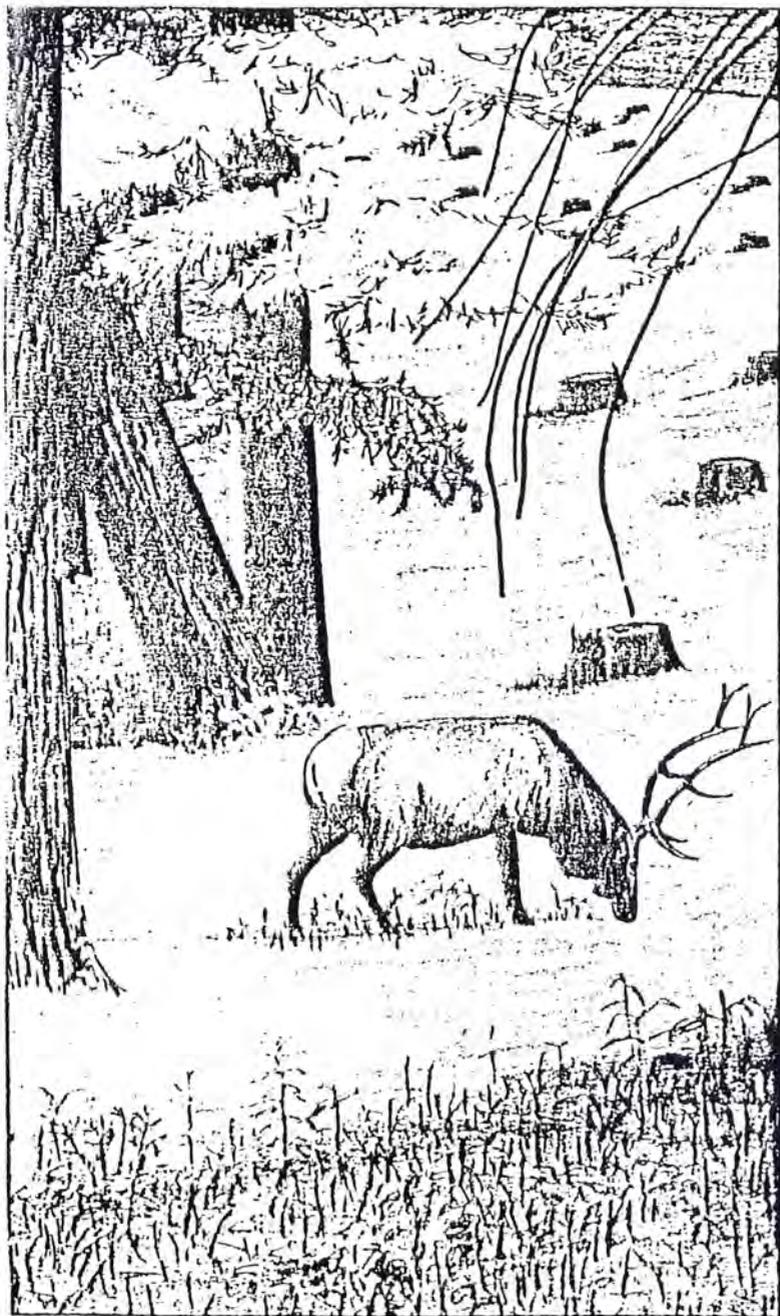

Forestry Materials



Forest Types and Treatments

Americans are looking to their forests today for more benefits than ever before—recreation, watershed protection, wildlife, timber, wilderness. Foresters are often able to enhance production of these benefits. This book features forestry techniques that are helping to achieve the American dream for the forest.

The story is for landowners, which means it is for everyone. Millions of Americans own individual tracts of woodland, many have shares in companies that manage forests, and all own the public lands managed by government agencies.

The forestry profession exists to help all these landowners obtain the benefits they want from forests; but forests have limits. Like all living things, trees are restricted in what they can do and where they can exist. A tree that needs well-drained soil cannot thrive in a marsh. If seeds require bare soil for germination, no amount of urging will get a seedling established on a pile of leaves. The following pages describe the ways in which stands of trees can be grown under commonly occurring forest conditions in the United States.

Originating, growing, and tending stands of trees is called silviculture (*silva* is the Latin word for forest). Without exaggeration, silviculture is the heartbeat of forestry. It is essential when humans wish to manage the forests—to accelerate the production of wildlife, timber, forage, or to increase recreation and watershed values. Of course, some benefits—wilderness, a prime example—require that trees be left alone to pursue their own destiny. And on almost any land, whether tree-covered or bare, nature will practice her own silviculture. She may take hundreds or thousands of years to do it, though, and she will do it without consulting humans as to their preferences. Whether they like to admit it or not, landowners often become impatient with nature's way. Then silviculture must be practiced; but in serving landowner purposes, foresters must still work within the natural conditions imposed by a tree species and by its required environment.

The great number of tree species found in the United States—multiplied by all the possible growing conditions and all the stand histories—yields an infinite variety of forest scenes. Since it is not feasi-

ble to consider all possibilities at once, foresters think in terms of forest types. Evolutionary pressures, growth requirements, and stand histories cause certain tree species to occur together. In the eastern United States, for example, oaks and hickories are often found growing together. Foresters call this association the oak-hickory forest type.

Naming types after dominant trees should not obscure the fact that a forest of any type is actually a community of hundreds of plant and animal species. The entire community is strongly influenced by the species, size, age, and density of trees overhead. What happens to one individual in a community influences others. Competition for light, nutrients, water, food, and shelter is often intense. For example, if lightning kills a large tree in a dense forest, conditions are changed for many species. Woodpeckers find food and make nesting holes in the dead tree, young trees and shrubs thrive in the direct sunlight of the newly created opening, and ground-dwelling animals consume some of the new growth on these plants.

A stand of old trees may appear to be timeless, but all forests are constantly changing. Change is most obvious in young stands where the trees are growing rapidly. Such stands are ideal habitat for certain species of wildlife. As the trees grow larger, environmental conditions become so altered that some species of wildlife no longer thrive there, while other wildlife species may find the new conditions excellent. As the stand continues to age, still other wildlife species are favored in the continuously changing environment. These dynamic changes are natural in all forests. They cannot be prevented. They can only be accelerated or slowed by human activities.

This book covers nine of the most important forest types in the United States. It begins with the spruce-fir type in the Northeast; moves through the northern hardwoods and oak-hickory types; down the coast to the southern bottomland hardwoods and loblolly pine; then west through the lodgepole and interior ponderosa pines; on to the coastal Douglas-fir; and north to conclude in the Sitka spruce-western hemlock type.

Methods for establishing seedlings and culturing trees through maturity and harvest are described for each type. Depending on the type, the soil, and the landowner's objectives, foresters will prescribe treatments in various combinations called silvicultural systems.

Silvicultural Systems

The main—but not the only—treatments making up silvicultural systems, involve the cutting or felling of trees. Cuttings are commonly divided into those that help to reproduce forest stands (reproduction or harvest cuttings) and those that maintain vigor and desired composition, and structure of the stands in terms of tree species, ages, and size classes (intermediate cuttings).

Reproduction cuttings have such a great influence on the character

and management of the new stand—and the forest as a whole—that silvicultural systems are generally named after them. The major systems used in the United States are clearcutting, seed-tree, shelterwood, single-tree selection, and group selection. Each system includes reproduction cuttings to establish seedlings and intermediate treatments to culture the developing stand.

The clearcutting, seed-tree, and shelterwood systems produce trees

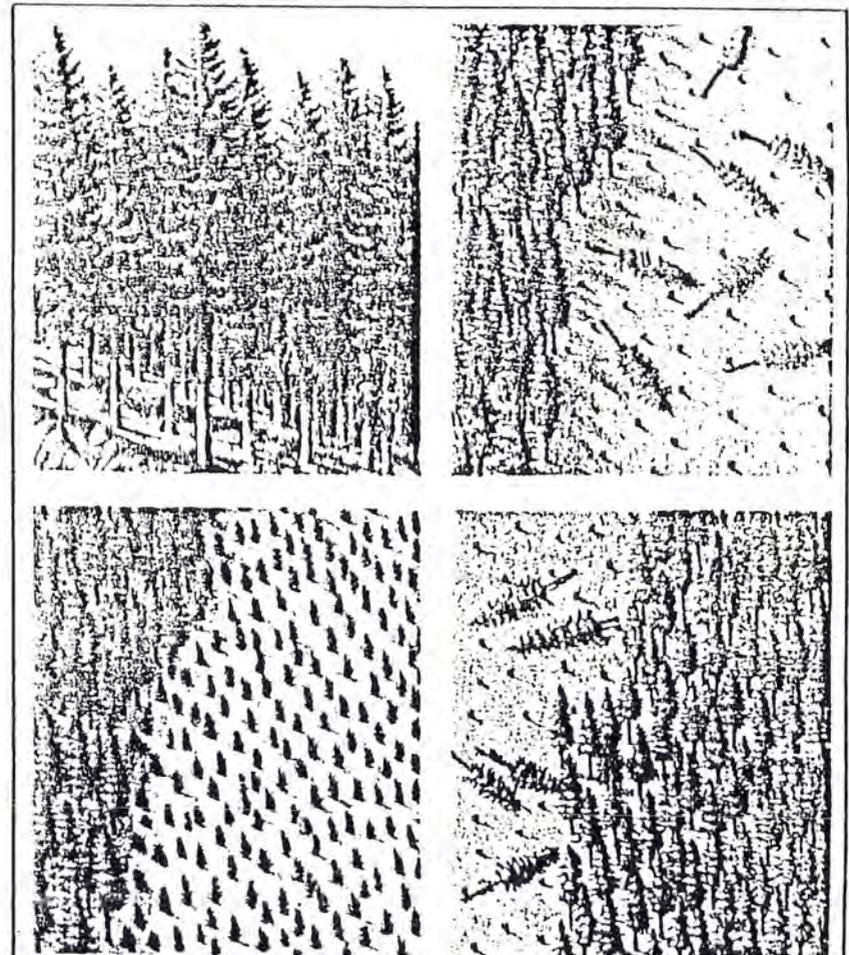


Figure 1. Clearcutting. Part of a mature stand is cut, removing all trees. A new stand arises from seeds of surrounding trees or from sprouts sent up by roots or stumps. Seedlings may also be planted or seeds broadcast. When the new trees are well on their way in the unobstructed light of the clearing, a neighboring stand of mature trees is cut in turn. (The illustration is from *The Secret Life of the Forest* by Richard M. Ketchum, copyright 1970 by American Heritage Press, and is used with the permission of McGraw-Hill Book Company.)

that are of approximately equal age, but may or may not be equal in size. These stands are called even-aged. The single-tree and group selection systems produce and maintain stands containing trees of many ages, and thus are termed uneven-aged.

Brief descriptions of the five major silvicultural systems follow. Information on their applicability will be found in the chapters on the forest types.

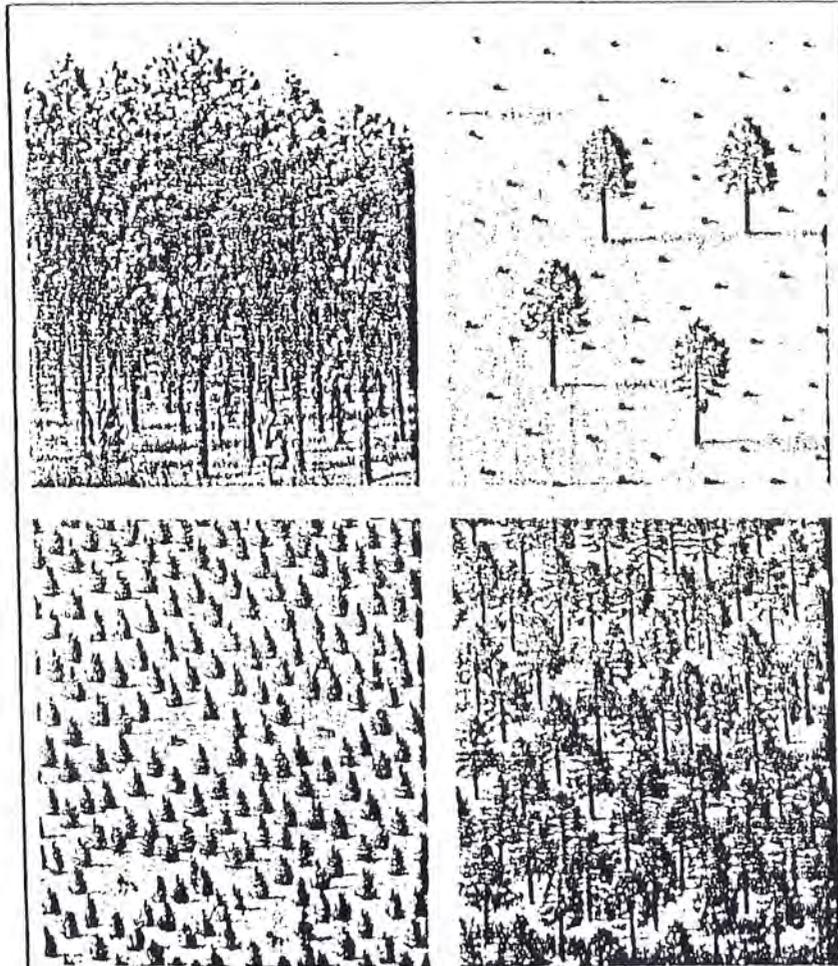


Figure 2. Seed-tree System. The mature stand is logged, but enough trees are left to reseed the area. The seed trees usually are large and valuable, and may be harvested when they have fulfilled their purpose. Like clearcutting, the system favors light-demanding species. (The illustration is from *The Secret Life of the Forest* by Richard M. Ketchum, copyright 1970 by American Heritage Press, and is used with the permission of McGraw-Hill Book Company.)

Clearcutting is the harvesting, in one operation, of all trees in a stand or on an area, with the expectation that a new even-aged stand will become established (*figure 1*). The new stand may develop by natural processes from seeds of adjacent stands, from seeds stored in the forest floor or still attached to branches in the tops of harvested trees, or from stump or root sprouts of cut trees. Another natural source of young trees is advance reproduction—young seedlings already established when the old trees are harvested. In many cases a clearcut area is regenerated by broadcast scattering of seeds or planting of seedlings. With clearcutting, as well as other reproduction cuttings, some type of site preparation is often necessary to remove logging debris and competing plants before the new stand can be established.

Many people believe that clearcutting destroys wildlife habitat. While this may be true for species requiring mature forest, stand removal actually creates habitat for wildlife species that satisfy part or all of their life requirements in low vegetation and brush with little or no overhead shade.

In a single stand, it is impossible to create ideal conditions for all wildlife species inhabiting a forest type. It is possible to do so in a sizable forest by providing a variety of stand conditions in different portions of the forest. Some areas can contain mature trees ready for harvest, others seedlings, and others middle-aged trees.

The **seed-tree system** requires leaving a few good seed-producing trees per acre when the mature stand is logged (*figure 2*). These trees provide the seed that is needed to regenerate a new even-aged stand. The seed trees are usually—not always—harvested after the crop of new young trees has become established.

The **shelterwood system** entails a series of partial cuttings over a period of years in the mature stand. Early cuttings improve the vigor and seed production of the remaining trees and prepare the site for new seedlings. The trees that are retained produce seed and also shelter for the young seedlings (*figure 3*). Subsequent cuttings harvest the shelterwood trees and allow the regeneration to develop as an even-aged stand.

The **single-tree selection system** differs from the three just described in that it creates and maintains an uneven-aged stand. Foresters examine a stand and judge each tree on its merit. Individual trees are, in this way, harvested as they mature (*figure 4*). Seedlings or sprouts grow up in the spaces thus created. Periodic harvesting and regeneration results in a stand that contains trees of many ages and of many sizes. Because relatively few trees are harvested at any one time, and because the forest floor is generally shaded, this system favors species that can thrive in low light.

The **group selection system** requires harvest of small groups rather than individual trees. The openings created resemble miniature clearcuts, but with the major difference that the resulting regeneration occupies too small an area to be considered an even-aged stand: As in the single-tree system, thinning and harvest cuttings are done at the same time. The new

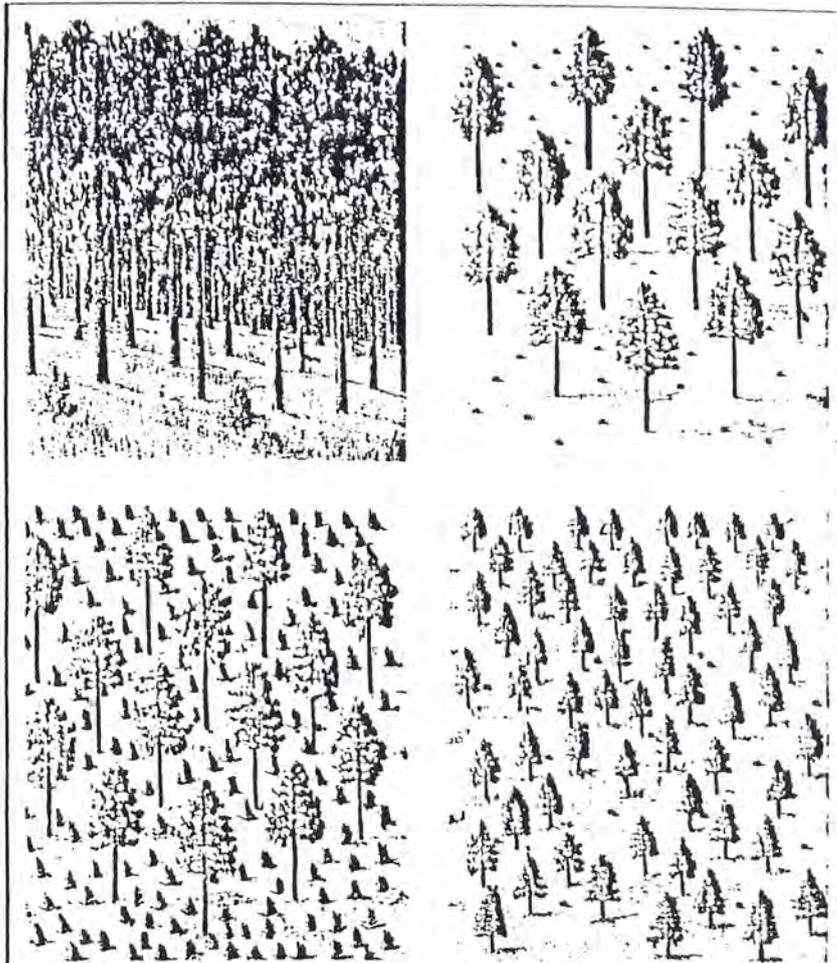


Figure 3. Shelterwood System. A mature stand is partially cut, leaving some of the better trees of desired species to grow, cast seed, and provide shade and perhaps other shelter for the new stand. Usually more trees are left per acre than in the seed-tree system. These shelter trees will be harvested after seedlings have become established and no longer need protection.

trees that come up in these small openings are regarded as parts of a larger stand that contains trees of many ages. In either selection system, frequent harvests are needed to maintain a proper balance of tree age, classes and sizes.

Intermediate Cuttings

To grow best, a tree needs a place in the sun and some soil of its own. If the stand is too dense, the forester may prescribe a thinning to relieve competition and to accelerate growth of the trees that remain. If the cut

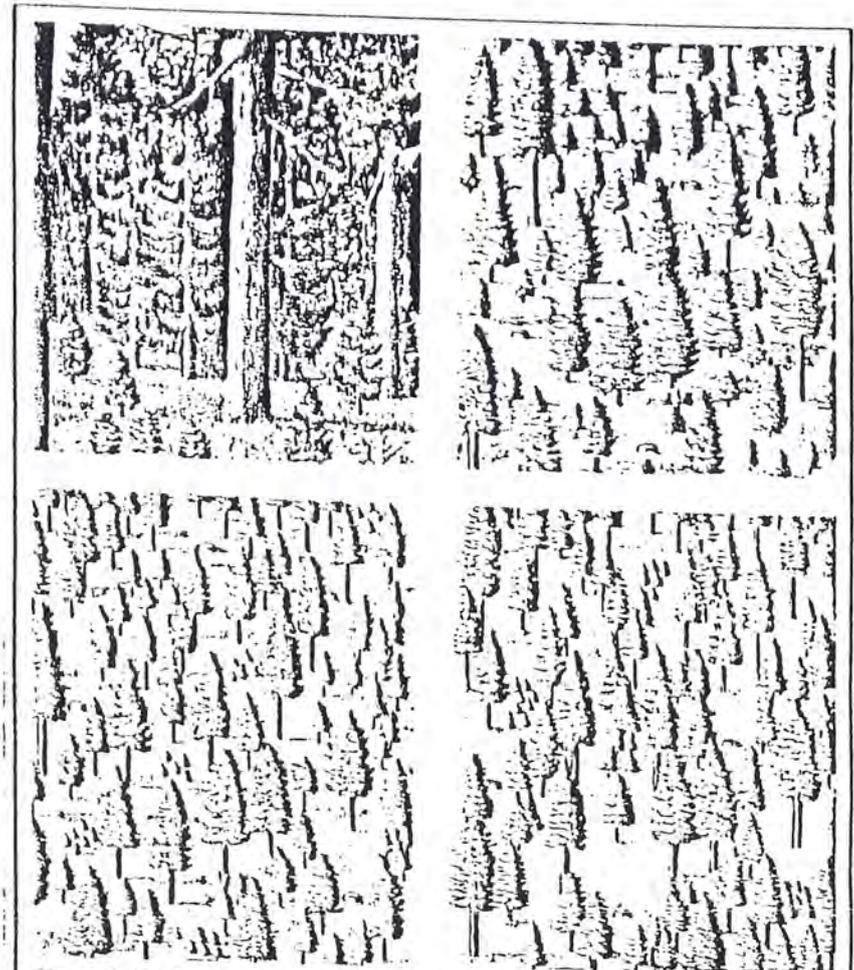


Figure 4. Single-tree Selection System. Cuts are made more often than in other systems, but since the entire stand is never removed, appearances are not much affected. Undesirable trees are removed, overly dense areas are thinned, and mature trees are harvested during each cut. Seedlings of shade-tolerant species develop wherever they can find room. The stand contains trees of many ages.

trees are too small to be sold, the thinning is called precommercial.

In a stand containing a mixture of desirable and undesirable trees, an improvement cutting may be made to favor the desirable ones. The choice of trees to remove will depend on the owner's desire for timber, wildlife habitat, aesthetic appeal, or recreation. Many species of minor timber importance produce nuts and fruits of great value to wildlife.

Natural catastrophes such as windstorms, ice storms, and fires sometimes wreak havoc in forest stands. Salvage cuttings are prescribed to utilize damaged trees and reduce the economic loss. If some trees in a

land are damaged by insects or disease, the forester may recommend a sanitation cut to remove the infested or infected trees that pose a threat to neighboring healthy trees.

Intermediate cuttings can be distinguished from reproduction cuttings by their purpose. Reproduction cuttings create a new stand, while intermediate cuttings culture an existing stand. Most, though not all, intermediate cuttings are thinnings made to remove trees that crowd or restrict growth of better trees. In the single-tree and group selection systems, as noted, intermediate cuttings are generally accomplished simultaneously with reproduction cuttings. In the other three systems, intermediate cuts are made separately, and even though seedlings may become established in the openings, no attempt is made to nurture them to salable size.

Choosing a Silvicultural System

The authors do not suggest any single silvicultural system as best for any single forest type. Rather they discuss benefits and limitations associated with the use of each system in each forest type. Their hope is that such information will help readers in all walks of life to understand and to participate in—public forums on forestry. Perhaps the book will also be of value to students considering forestry careers. It is not intended to be a do-it-yourself book. The authors believe that choosing and applying a silvicultural system is a task for a professional forester, one familiar with local conditions and landowner objectives.

The benefits of a managed forest are influenced by the silvicultural system that is applied. Streamflow, quality of wildlife habitat, amount of age for livestock, aesthetic appeal, and recreation potential, as well as fiber production, may be affected. The choice of a system depends on characteristics of the tree species that make up the forest type, the features of the site on which the trees are grown, and the objectives and desires of the owner. A forester can tell an owner what benefits are possible. Once the owner has defined his desires, a forester can apply a silvicultural system that provides the best mix of benefits.

The characteristics of the tree species¹ in the forest determine the range of alternative treatments a forester can prescribe. Chief among characteristics to be considered are species tolerance to shade, susceptibility to windthrow, adaptability to soil and moisture conditions, ability to withstand flooding, and vulnerability to insects, disease, and fire. For example, a species needing full sunlight will not grow well under shade of a tree canopy. A species with a shallow root system should generally be regenerated by the seed-tree system because the seed

¹ Names of tree species in this book follow the *Checklist of United States Trees (Live and Naturalized)* by E. L. Little, Jr. 1979. USDA Agriculture Handbook Washington, D.C.

trees might be blown down by wind before a new stand could become established.

When a forester talks about site, he includes all the physical, chemical, climatic, and biological features of an area that influence forest regeneration and growth. Site factors affect not only the growth of trees but also the sensitivity of the area to soil compaction, erosion, and stream sedimentation. In choosing and applying a silvicultural system, the forester must evaluate the erosion hazard, slope, drainage, and fertility of a site.

No matter which silvicultural system is chosen, wildlife will be affected. The effects may be for better or worse, slight or drastic, brief or enduring, depending on the forest type, the silvicultural system, the site, the conditions in adjacent stands, and other factors.

For example, single-tree selection maintains an almost complete canopy and usually has only small and brief effects on the wildlife species that thrive in a mature forest. Such cutting, however, does little for wildlife species that require open and brushy habitat. Clearcutting, by contrast, favors these species but eliminates the mature-forest habitats. To favor all wildlife, a forester must provide the different conditions required by individual species in different portions of the forest. Consultation with wildlife experts is often needed to determine habitat requirements.

The value of a stand as a wildlife habitat is influenced not only by tree species, but by their age, size, form, and health. Old trees have stout limbs on which heavy birds can nest. Bare branches provide roosts. Rotten spots can be hollowed into nests. Large dead trees (snags) are particularly important and should be left standing whenever possible. They provide habitat for hole-nesting and insect-eating wildlife.

A forester must always be guided by owner objectives: The desires and financial resources of clients vary widely. Small tracts may be owned for many reasons including timber production, private hunting, and family recreation. Most small-tract owners desire a mixture of benefits. Public forests are usually managed for optimal production of multiple benefits, and procedures developed on public lands are often applicable on small private tracts. Most large private tracts are owned primarily for timber production.

It is the forester's job to inform the landowner-client of the choices in silviculture. Even where the primary desire is for one purpose, the owner may come to see advantages in the production of other benefits. It is often possible, for example, to improve conditions for wildlife with little sacrifice in timber growth.

Prescribing an appropriate silvicultural system is a complex professional decision—a decision based on many factors which may vary in degree and change with time. Choosing and applying a system for a forest stand, therefore, requires both knowledge and judgment. It is here that forestry becomes art—with biology and ecology providing the paints—landowners, the canvas—and foresters, the design.

Multiple Use



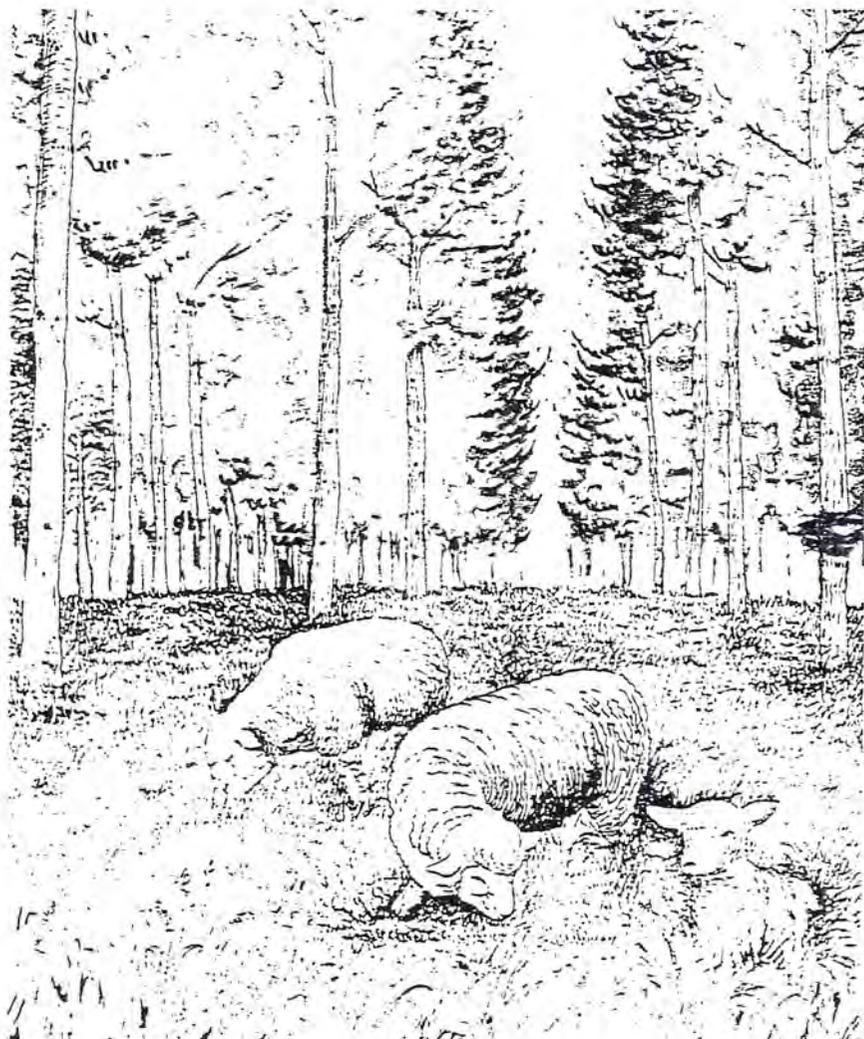
Agro-Forestry: Growing Trees, Forage, and Livestock Together

For a lot of forest landowners the major obstacle to starting a new forest is the long wait for mature trees. "I can't afford to plant trees and wait 30 to 40 years for an income," is a complaint many landowners voice. It's a realistic complaint, too! No matter how great the final return on a tree-planting investment, income during the intervening years is virtually non-existent.

"Show me a way to maintain an annual income from my property while I wait for those trees to mature, and I'll plant them." is the challenge coming from ranchers and other woodland owners. Agro-forestry could be an answer.

Agro-forestry involves planting widely spaced trees into pasture to attain the best combination of pasture growth and timber quality. It provides an annual income from livestock production, while the trees are maturing. This combined production could result in a greater profit than does either forest or pasture production alone.

This concept—combining forage and tree production on the same land to obtain greater profit—may sound too good to be true. But preliminary results from research in New Zealand, Australia, and Oregon indicate that it is possible.



These are not the only locations where forest grazing is being tested. Forest grazing with cattle has been a common practice in the southeastern United States for several years.

Note, however, that there are two different agro-forestry production systems—a producer can plant trees into existing pasture or attempt to establish forage plants under an existing timber stand.

This publication describes the system in which a producer plants timber seedlings into an established pasture to maximize the land resource with multiple crops. While experience has shown that forage can be established under existing timber stands, this system is less desirable and more limiting. Do not confuse it with our description here.

Agro-forestry down under

Agro-forestry has been investigated most thoroughly in New Zealand and Australia. Both countries have extensive acreages consisting of research installations and private holdings.

One of the largest research studies began in 1973 on a 230-acre installation near Rotorua, New Zealand. Here, Monterey pine was planted on pasture at various stocking densities to research the best combination of livestock and trees for maximum financial return from the land. Here are some results of this research.

Grazing. Approximately 20 percent of the grazing potential can be obtained in the first year after planting; 40 percent, in the second year; and 50 percent, in the third year.

No grazing is recommended until trees are approximately 3 feet tall. For the first 2 years, while trees are within browsing range, hay may be cut between the rows on suitable terrain, or lambs can be grazed. (Areas with poor tree growth may still require restricted grazing after 3 years.)

Protection. Experiments using mechanical guards to protect young



Figure 1a.—An agro-forestry demonstration area near Roseburg, Oregon. The alternate rows of knobcone-Monterey pine (KMX) and Douglas-fir are 3 years old.

trees from damage have been successful, but costly. An alternative is to plant taller seedlings to reduce the period of vulnerability to livestock.

Thinning. A typical planting consists of 300 to 500 trees, thinned to 82 trees per acre when the trees are 10 feet tall. Thinning is done to leave only the fastest-growing crop tree specimens and to minimize shading of the pasture.

Pruning. As the trees mature, pruning the lower branches (in five stages) to a height of 26 to 36 feet prevents knots in wood and produces more veneer, clear boards, and good quality framing material. This also reduces shade and improves pasture production.

Livestock performance. Weight gain and wool quality are affected little by densities up to 41 trees per acre. However, performance declines when the density is more than 82 trees per acre (in comparison to performance on a pasture with no trees).

Although researchers in New Zealand have not completed an entire rotation of tree growth, their preliminary findings indicate there are no insurmountable barriers to grazing under Monterey pine forests, provided the final crop objective is not more than 82 trees per acre.

Agro-forestry in Oregon

In 1979, an agro-forestry demonstration was started near Roseburg in western Oregon. As shown in figures 1a and 1b, native 2-year-old Douglas-fir and 1-year-old knobcone-Monterey pine (KMX) seedlings were planted. (Similar research also began in the fall of 1982 at Oregon State University in Corvallis, using Douglas-fir.)

KMX is a hybrid (an offspring of two different plant species) that incorporates the cold hardiness of knobcone pine with the fast growth of Monterey pine. Monterey pine is found naturally only in a small belt between San Francisco and Santa Barbara, California, but it is an important forest tree elsewhere in the world. Knobcone pine occurs in a broader area—from southern

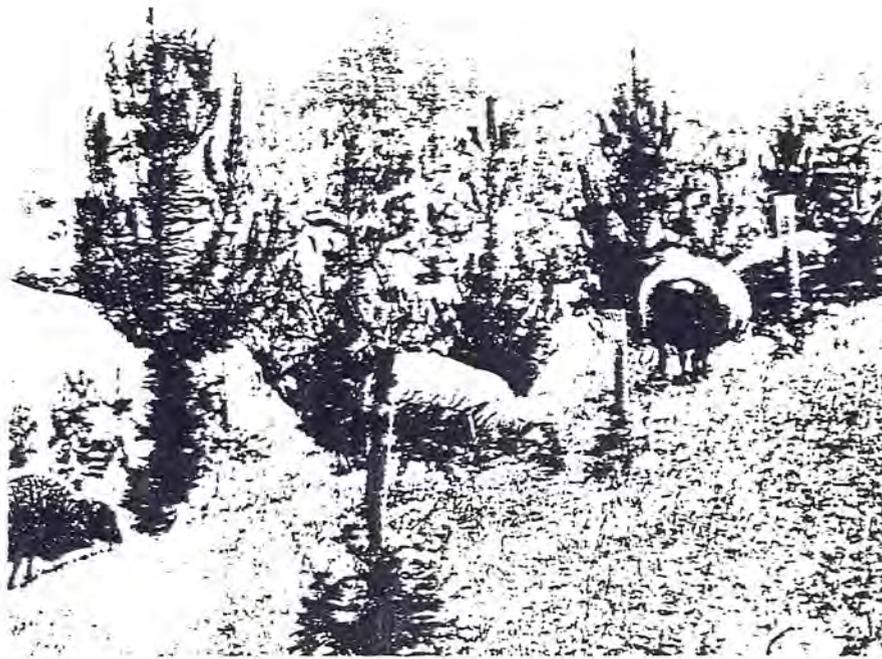


Figure 1b. — The knobcone-Monterey pine (KMX) is twice as tall as the Douglas-fir row in the foreground. Because of the slower growth of Douglas-fir, terminal shoot protection is necessary at this vulnerable size.

Oregon to Los Angeles at elevations up to 5,000 feet.

The two species were planted at 12 by 12 foot spacings in alternate rows on an improved subclover and ryegrass pasture in excellent condition. Even though the Douglas-fir seedlings were 2 years old, the 1-year-old KMX were of comparable size. Grazing trials with sheep have been conducted during the first 3 years of plantation growth with the following results:

Grazing. Sheep will feed on seedlings, even when planted in improved pasture. (Grazing trials were conducted in the spring before tree budbreak.) It appears that grazing should be avoided until trees are 3 feet tall and out of browsing range.

Browsing. Douglas-fir usually sustain more damage than KMX and seem to be the preferred browse. You can avoid browsing damage with mechanical devices (Vexar tubes supported with wood stakes or chicken wire cages); however, these methods are expensive. Less costly, and less effective, is BGR (Big Game Repellent)—you apply it to the trees just before grazing.

Herbicides. These should be used in the first 2 years after spring grazing to eliminate competing vegetation around each tree and conserve moisture during the summer growing season. Their purpose is to insure maximum tree survival and get trees above the height that is vulnerable to sheep.

Douglas-fir. After three growing seasons, the average height of KMX is just over 6 feet, twice that of the Douglas-fir. The slower growth of Douglas-fir limits the amount of grazing during the third year. Full grazing potential is expected during the fourth year.

Pruning. Although pruning has not been necessary to this point, it appears it will be essential to maintain pasture growth. Theoretically, the KMX should be ready to harvest within 20 to 25 years, leaving the Douglas-fir to mature at approximately 40 years of age. During that time, it is necessary to maintain productive pasture for as many years as possible by tree

thinning, and possibly by pruning lower branches.

While pruning has not been a recommended forestry practice in the Pacific Northwest, it appears that in the context of agro-forestry, it will be important.

Spacing. The initial 12 by 12 foot spacing (300 trees per acre) will have to be increased as the trees mature. Optimum spacing for Douglas-fir and KMX in pasture is not known at the present time.

Judging from the results of the research cited, the benefits of agro-forestry are promising; however, you should consider carefully both its advantages and disadvantages before trying it on your property.

Advantages of agro-forestry

Multiple use. There is more production from an acre of land and potentially more net profit. Product diversity could help stabilize your income—being able to sell logs when livestock prices are low and to retain standing trees when livestock prices are high, strengthens your cash flow and provides more marketing options.

Ecological benefits. These are significant. Legume plants in the forage crop (subterranean clover) capture nitrogen from the air that exists in the soil and convert it to a form of nitrogen that facilitates greater plant growth.

Livestock. Sheep or cattle can harvest the forage growing under the trees and provide salable material (meat and wool) from it. They also contribute to faster tree growth by converting plant material into dung and urine. The nitrogen in these byproducts is then available as plant food for both trees and pasture.

Fertilizer. This costs less because nitrogen fertilizer is not necessary. Nitrogen comes from the forage crop (clover) through nitrogen fixation.

You must apply phosphorus and sulfur as necessary, but they tend to be low-cost fertilizers and have low-energy requirements for production.

You won't need to apply them as often once soil nutrients have been built up—the ecological system requires lower energy inputs to maintain soil fertility.

Soil fertility. Agro-forestry minimizes depletion of soil nutrients. The products you intend to sell—livestock or trees, or both—don't require that you add much fertilizer to the soil.

When you harvest the trees, you may leave some or all of the foliage on the site. High in nutrient content, this waste material helps replenish the soil. This nutrient cycling system minimizes soil depletion, making for low fertilizer costs.

Grazing. Sheep can control much of the competing vegetation (brush, grass, etc.), and can reduce moisture stress on established trees. This provides easier access through the trees when culturing. It also improves tree growth and reduces the concern of wildfire.

The grazing loss from the maturing trees is offset by the returns from the timber crop.

Environment. Agro-forestry creates an area with visual appeal (trees growing in a pasture are esthetically pleasing). It also encourages birds, but few rodents. In addition, the trees moderate climatic extremes at ground level, which may increase livestock performance with greater weight gains and better wool quality.

Disadvantages of agro-forestry

Investment. There is an obvious reduction in grazing potential as the trees mature—increasing canopy reduces the available light and limits pasture growth. Investments in tree thinning and pruning will be necessary to slow this process and maintain forage for as long as possible. Also, you may need to invest in fencing to control grazing livestock.

Restricted grazing. There are limitations in pasture use during the first 2 to 3 years while the tree

seedlings are more susceptible to browsing damage.

Management. Agriculture and forestry management require some modification under the concept of agro-forestry. Therefore, management will probably be more complicated, and you may need to acquire new skills.

Alternative crops

Don't limit the agro-forestry concept to trees and livestock. Where terrain is suitable, alternative cropping between rows of trees is possible.

A wheat crop has been grown successfully between rows of first-year KMX seedlings in Douglas County, Oregon. The only problem encountered was the right tree spacing at the edges of the field—harvesting equipment needed more space to maneuver than was allowed.

Some final questions

There are still many questions concerning agro-forestry that need to be answered. Test areas need to be established. Refinement of optimum spacing and yield of the various tree species, forage types, and livestock all need to be determined.

The most crucial question must still be answered: At what level of tree stocking can we expect the best combination of animal and timber production to derive the highest net profit?

Summary

Although the concept of agro-forestry is still in its infancy in the Pacific Northwest, New Zealand research shows it to be technically feasible. On suitable sites, it promises higher financial returns than from pasture grazing alone.

The ultimate goal of agro-forestry is increased production—of both wood fiber and red meat. Demand for wood in the United States is predicted to double by the year 2000. The compatibility of tree crops with livestock could provide a key to meeting this demand.

The Oregon State University Extension Service provides education and information based on timely research to help Oregonians solve problems and develop skills related to youth, family, community, farm, forest, energy, and marine resources.

Extension's forestry program improves Oregonians' knowledge of forest resources and their options for expanding benefits from these resources. This educational program assists forest owners, managers, processors, and users in understanding small woodland production and management and use of all forest lands. Priority subjects are reforestation, growth, management, harvesting, processing and use of wood, protection of soil and water, and other multiple uses and values.

This publication was prepared by Robert S. Logan, Douglas County Extension agent, Oregon State University. It is one of a series of publications developed for the Extension Woodland Workbook.

The Woodland Workbook is a collection of 40 publications in a 3-ring binder, prepared by the Oregon State University Extension Service specifically for owners and managers of private, nonindustrial woodlands. For information about how to order and for a current list of titles and prices, write Bulletin Mailing Office, OSU, Corvallis 97331, or inquire at your county office of the OSU Extension Service.

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Forest Measurements

Tools for Measuring Your Forest

As a landowner, you frequently may want to measure property boundaries, ground slope, standing timber size, and log volume. You need tools for each of these tasks.

You can measure forests and forest products most efficiently and precisely with the aid of sophisticated, and often expensive, instruments. However, you can make most necessary measurements with a few simple and inexpensive tools.

This publication discusses only those tools that are readily available and appropriate for a landowner with basic measurement skills. On page 7, you will find a list of the tools that compares the accuracy and convenience of each for various measurement tasks.

The tools—and how they work

Abney hand level (abney). This delicate instrument consists of a sighting tube and a level bubble with attached scales. The scales are usually graduated in degrees or percent. The abney measures vertical angles and is useful for determining ground slope, road grade, and tree height (see figures 1 and 2).

Angle gauge. A mechanical or optical device for selecting trees in variable plot sampling. The most common is a wedge prism—a precisely ground glass wedge that is

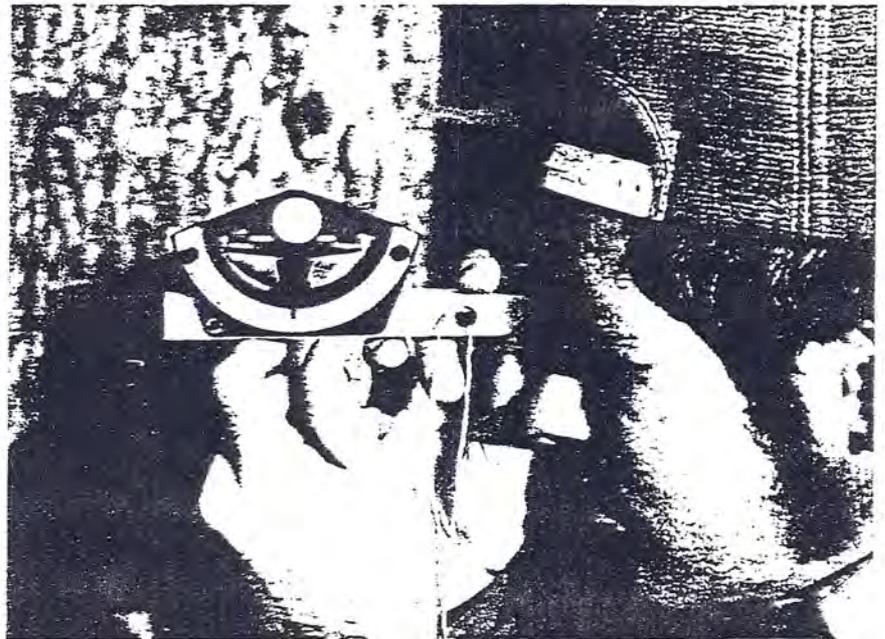


Figure 1.—To use an abney level, sight an object through the telescope and move the level bubble to the center position. The number on the scale is the correct reading.

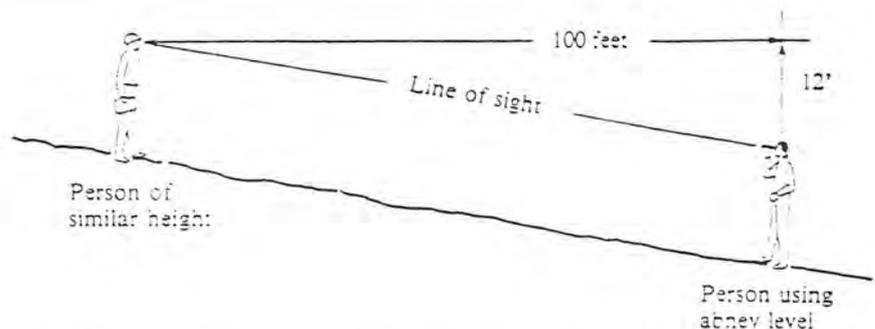


Figure 2.—Measuring the slope of a hill with an abney. (The reading is -12 on a percent scale.) Both people are the same height so the lower person can sight at the eyes of the upper person.

calibrated in basal area factors (BAF) (see figure 3). You need different BAF prisms for different diameter classes of timber.

Biltmore stick. One of several similar sticks or other devices to aid you in making simple but crude estimates of tree height and diameter (see figures 4 and 5). You can purchase or make one easily.

Clinometer. A rugged hand-held instrument for measuring vertical angles. Most models have both degree and percent scales. You can use clinometers for the same tasks as abney levels; however, they provide less precise readings (see figures 6, 7, and 8).

Compass. A hand-held compass is a relatively rugged instrument that measures horizontal angles or direction (see figure 9). You can make more precise readings when you place the compass on a solid, nonferrous object.

Diameter tape. A steel tape that measures the circumference of a tree. It is calibrated to permit direct tree diameter readings (see figure 10).

Increment borer. A hand-operated drill with a hollow bit that extracts a wood core from the stem of a tree (see figure 11). Borers vary in length, but the maximum sampling depth is about 16 inches. This is adequate for conveniently determining the age of trees up to about 30 inches in diameter (including the bark). The wood core also provides a record of a tree's diameter growth in previous years.

Figure 3.—(right) A wedge prism—one of the angle gauges available for estimating the basal area of a stand of trees.

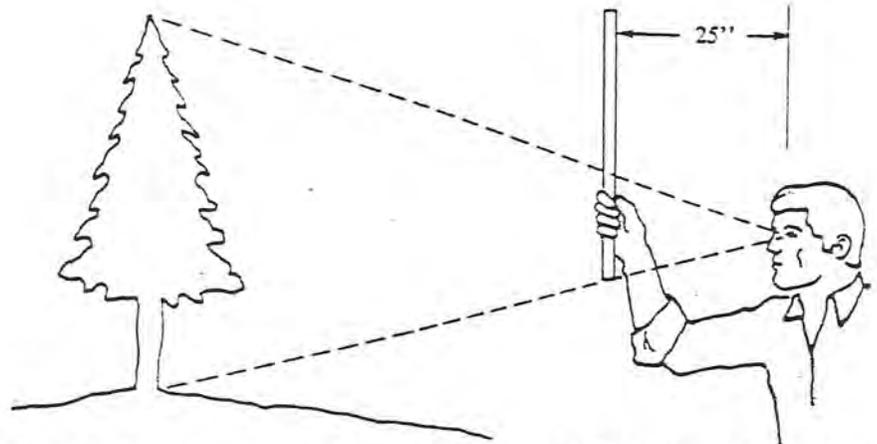
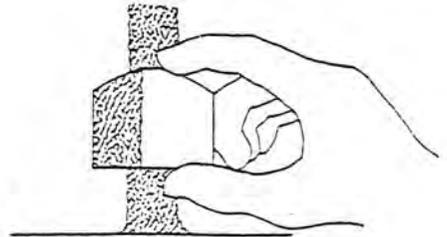


Figure 4.—Measuring tree height with a Biltmore stick. Most sticks are made to be held 25 inches from the eye—any other distance causes incorrect readings.

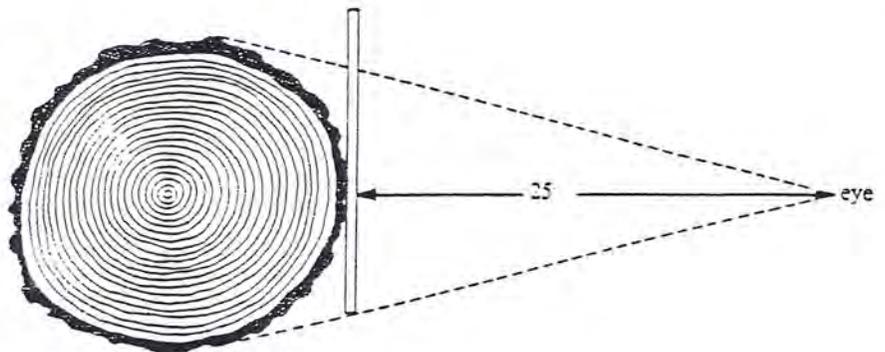


Figure 5.—Measuring tree diameter with a Biltmore stick.

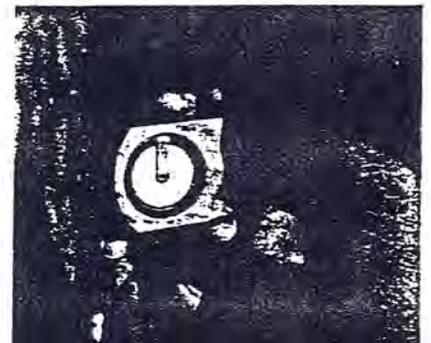


Figure 6.—(right) The clinometer has a sighting hole and a suspended circular scale.

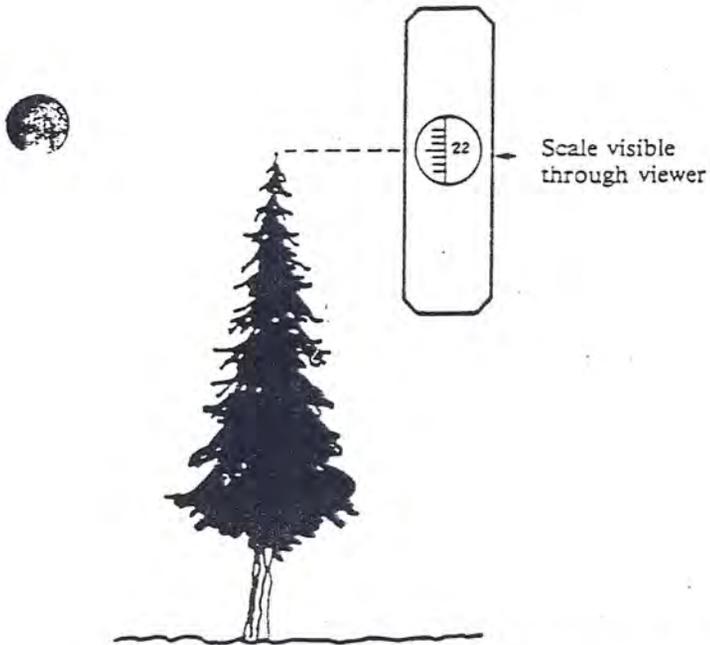


Figure 7.—Viewing a tree top with a clinometer. (View the tree with the left eye and read the clinometer scale with the right eye.)

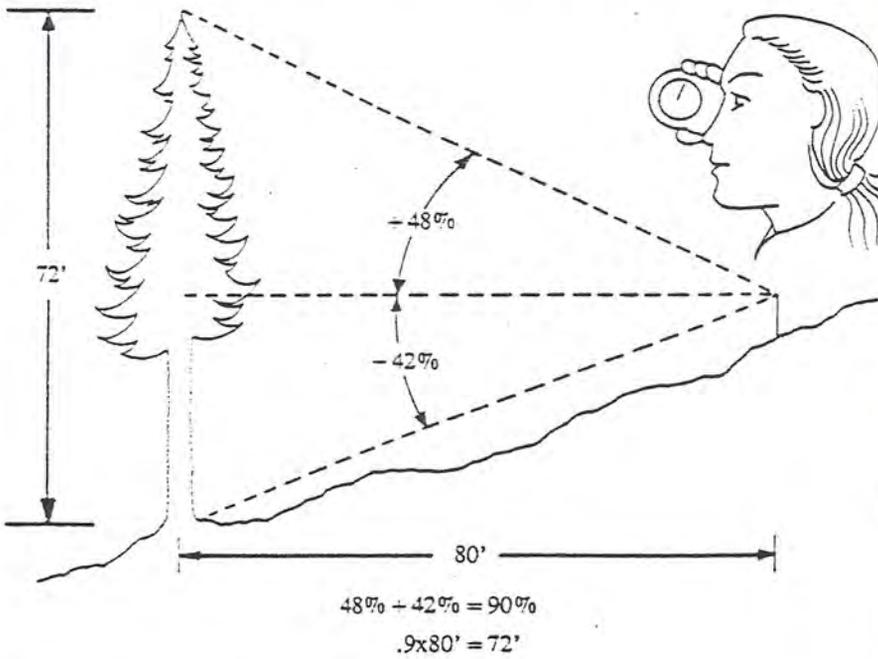


Figure 8.—Estimating tree height with a clinometer.

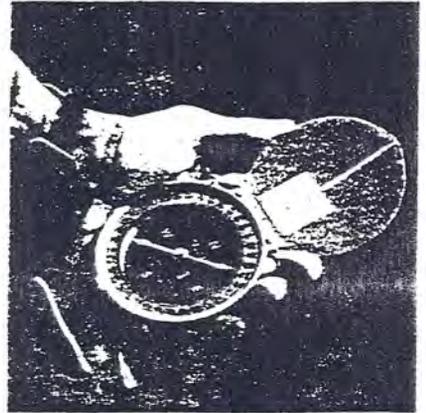
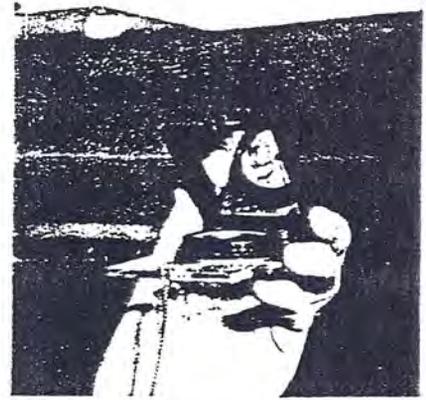


Figure 9.—(both photographs above) Hand compasses typical of the models available.



Figure 10.—Measuring tree diameter with a diameter tape.

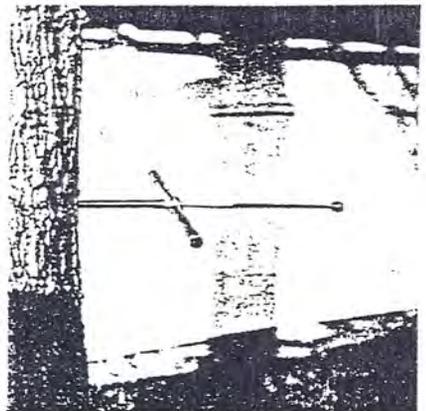


Figure 11.—Increment borer extracting a core sample from a tree.

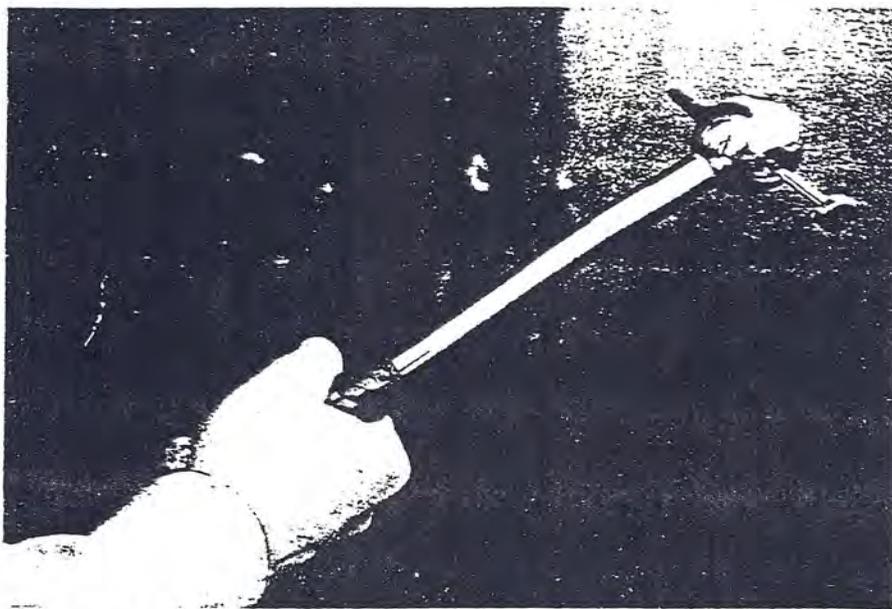


Figure 12.—An increment hammer is used to obtain a sample of a tree's outer inch.

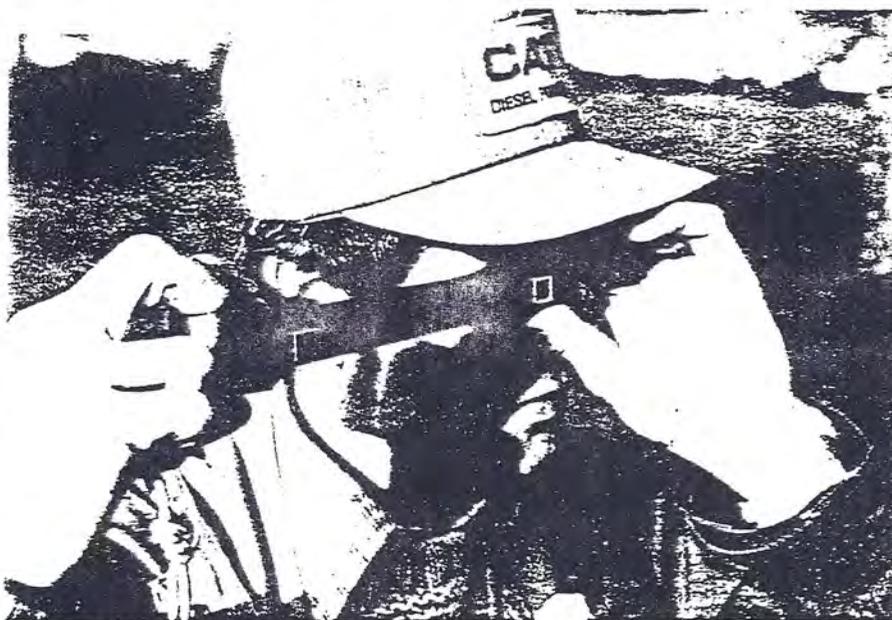


Figure 13.—A rangefinder is useful for estimating distance.

Increment hammer. A hammerlike tool with a hollow bit that you drive into the tree by impact. The short core sample provides a record of recent growth, which is limited to the outer inch of the tree (see figure 12).

Log volume table. A single sheet or an entire book that lists log volumes for each log length and

small-end diameter (see table 1). The tables are available in board-foot and cubic-foot measurements. Oregon State University Extension Service Circular 1127, *Measuring Timber Products Harvested from Your Woodland* (in press, 1983), also contains a log volume table.

Pacing. This is a skill rather than a tool, but it can be—and commonly is—substituted for tools when horizontal distance measurements do not need to be precise.

Rangefinder. A convenient optical device, this tool provides horizontal measurements that are more precise than most pacing, but less precise than taping. Rangefinders are particularly useful for a person working alone (see figure 13).

Tape. A narrow, flexible band or strip that measures linear distance. Tapes are made of modern materials to resist rust, wear, breakage, and length change. The most convenient tape for forestry use is the 50- or 75-foot "logger's tape," which hooks on a belt and rewinds automatically when not in use.

Topographic map. A map that shows terrain (ridges, draws, and flat areas) by contour lines. The contour lines indicate locations of equal elevation and make it possible to measure the slope of the ground from the map. Widely spaced contour lines indicate flat or gentle ground; closely spaced lines indicate steep ground.

Tree volume tables. Single sheets or books of tables that list the wood volume of trees in board or cubic feet, or both (see table 2). The tables are based on the height of the entire tree or a specified portion (total stem, stem to a 4-inch minimum top, stem to a 6-inch minimum top, etc.), and diameter at breast height (d.b.h.).

(Text continues on page 7)

Table 1.—Log volume table; Scribner log rule, board-foot volume

		Log length (feet)																																																									
		8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40																									
Small-end diameter of log (inches)	4	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20																			
	5	10	10	10	10	10	10	10	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20																		
	6	10	10	10	10	10	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20																
	7	10	10	10	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20																
	8	10	10	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20															
	9	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20														
	10	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20													
	11	30	30	40	40	40	40	50	50	60	70	70	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80													
	12	40	40	50	50	60	60	70	70	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80												
	13	50	50	60	70	70	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80											
	14	60	60	70	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80										
	15	70	80	90	100	110	120	120	130	140	150	160	170	180	190	200	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500	510											
	16	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560									
	17	90	100	120	130	140	150	160	170	180	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590	600								
	18	110	120	130	150	160	170	180	200	210	230	240	250	270	280	290	300	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590	600	610	620	630	640								
	19	120	130	150	160	180	190	210	230	240	250	270	280	300	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590	600	610	620	630	640	650	660	670	680							
	20	140	160	170	190	210	230	240	250	260	280	300	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590	600	610	620	630	640	650	660	670	680	690	700							
21	160	170	180	210	230	250	270	290	300	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750						
22	170	190	210	230	250	270	290	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750							
23	190	210	240	260	280	310	330	350	360	380	390	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790	800	810							
24	200	230	250	280	300	330	350	360	380	390	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790	800	810	820	830						
25	230	260	280	320	340	370	400	430	460	490	520	540	570	600	630	660	690	720	750	770	800	830	860	890	920	950	980	1000	1030	1060	1090	1120	1150	1180	1210	1240	1270	1300	1330	1360	1390	1420	1450	1480	1510	1540	1570	1600	1630	1660									
26	250	280	310	340	370	410	440	470	500	530	560	590	620	650	680	710	740	770	800	830	860	890	920	950	980	1010	1040	1070	1100	1130	1160	1190	1220	1250	1280	1310	1340	1370	1400	1430	1460	1490	1520	1550	1580	1610	1640	1670	1700	1730	1760	1790	1820	1850	1880	1910	1940	1970	2000

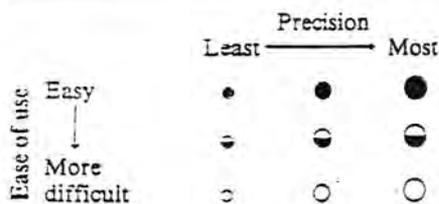
Table 2.—Example of a tree volume table^a

TOTAL TREE CU. FT. VOLUME						D B H	VOLUME TO A 4 INCH TOP IN CUBIC FEET			VOLUME TO A 6 INCH TOP												D B H			
INCLUDING TOP AND STUMP			INCLUDING TOP ONLY				VOL	V/BA	GH	CUBIC FEET			BOARD FEET SCRIBNER						BOARD FEET INTERNATIONAL 1/4						
VOL	V/BA	GH	VOL	V/BA	GH					VOL	V/BA	GH	16 FOOT LOGS			32 FOOT LOGS			16 FOOT LOGS						
													VOL	V/BA	GH	VOL	V/BA	GH	VOL	V/BA	GH		VOL	V/BA	GH
0.3	14.6	0.3	0.3	13.0	0.3	2																		2	
1.0	20.1	1.0	0.9	18.6	0.9	3																			3
2.2	25.6	1.5	2.1	24.1	1.4	4																			4
4.0	29.1	2.0	3.8	27.8	1.9	5	2.0	14.4	2.2																5
6.2	31.5	2.5	5.9	30.3	2.4	6	4.4	22.2	2.6																6
8.9	33.2	2.9	8.6	32.0	2.8	7	7.2	26.9	3.1	2.7	10.2	3.3	9.	33.9	12.1	7.	27.5	9.9	15.	54.6	17.9				7
12.0	34.5	3.4	11.6	33.3	3.3	8	10.5	30.0	3.5	6.4	18.3	4.0	24.	68.5	17.4	19.	55.7	14.2	35.	100.6	22.9				8
15.7	35.5	3.9	15.2	34.3	3.8	9	14.2	32.1	3.9	10.7	24.3	4.6	44.	98.6	21.7	35.	80.2	17.7	60.	135.9	26.8				9
19.0	36.3	4.4	19.2	35.1	4.2	10	18.3	33.6	4.4	15.5	28.4	5.0	67.	123.1	25.3	55.	100.1	20.6	88.	162.2	29.9				10
24.7	37.0	4.8	23.6	35.8	4.7	11	22.9	34.7	4.8	20.7	31.3	5.3	94.	142.4	28.4	76.	115.9	23.1	120.	181.6	32.0				11
29.5	37.5	5.3	28.5	36.3	5.1	12	27.9	35.5	5.2	26.1	33.3	5.7	124.	157.7	31.3	101.	128.4	25.5	154.	196.1	35.5				12
35.0	38.0	5.8	33.9	36.8	5.6	13	33.4	36.2	5.7	32.0	34.7	6.0	157.	169.9	34.1	127.	138.3	27.8	191.	207.1	38.3				13
41.0	38.4	6.2	39.7	37.1	6.0	14	39.3	36.7	6.1	38.1	35.7	6.3	192.	179.7	36.9	156.	146.4	30.2	231.	215.6	41.1				14
47.5	38.7	6.7	46.0	37.5	6.5	15	45.6	37.1	6.5	44.7	36.4	6.7	230.	187.8	39.8	188.	153.0	32.5	273.	222.5	43.9				15
54.4	39.0	7.2	52.7	37.7	6.9	16	52.3	37.5	7.0	51.5	36.9	7.1	272.	194.6	42.6	221.	158.6	34.9	318.	228.0	46.9				16
61.8	39.2	7.6	59.9	38.0	7.4	17	59.5	37.8	7.4	58.8	37.3	7.5	316.	200.3	45.6	258.	163.4	37.3	367.	232.7	49.9				17
69.7	39.4	8.1	67.5	38.2	7.8	18	67.2	38.0	7.9	66.5	37.6	7.9	363.	205.3	48.6	296.	167.6	39.8	418.	236.7	53.0				18
78.0	39.6	8.6	75.5	38.4	8.3	19	75.2	38.2	8.3	74.6	37.9	8.3	413.	209.7	51.6	337.	171.3	42.3	473.	240.1	56.2				19
86.8	39.8	9.0	84.0	38.5	8.7	20	83.8	38.4	8.7	83.1	38.1	8.7	466.	213.6	54.6	381.	174.5	44.8	531.	243.2	59.3				20
96.0	39.9	9.5	92.9	38.6	9.1	21	92.7	38.5	9.2	92.0	38.2	9.1	522.	217.0	57.6	427.	177.5	47.4	591.	245.9	62.5				21
105.7	40.0	9.9	102.3	38.8	9.6	22	102.1	38.7	9.6	101.3	38.4	9.6	581.	220.2	60.7	476.	180.2	50.0	655.	248.3	65.7				22
115.8	40.1	10.4	112.1	38.9	10.0	23	111.9	38.8	10.0	111.1	38.5	10.0	643.	223.0	63.7	527.	182.6	52.6	723.	250.5	68.9				23
126.4	40.2	10.8	122.4	38.9	10.5	24	122.1	38.9	10.5	121.3	38.6	10.4	709.	225.6	66.8	581.	184.9	55.2	793.	252.5	72.2				24
137.5	40.3	11.3	133.0	39.0	10.9	25	132.8	39.0	10.9	131.9	38.7	10.8	777.	227.9	69.8	637.	186.9	57.8	867.	254.4	75.4				25
148.9	40.4	11.7	144.2	39.1	11.3	26	144.0	39.0	11.3	142.9	38.8	11.3	848.	230.1	72.9	696.	188.9	60.4	944.	256.0	78.6				26
160.9	40.5	12.2	155.7	39.2	11.8	27	155.5	39.1	11.8	154.4	38.8	11.7	923.	232.1	75.9	758.	190.7	63.1	1024.	257.6	81.8				27
173.3	40.5	12.6	167.7	39.2	12.2	28	167.5	39.2	12.2	166.3	38.9	12.1	1000.	233.9	78.9	822.	192.3	65.7	1107.	259.0	84.9				28
186.1	40.6	13.1	180.1	39.3	12.6	29	179.9	39.2	12.7	178.7	39.0	12.6	1080.	235.5	81.9	899.	193.9	68.3	1194.	260.3	88.1				29
199.4	40.6	13.5	193.0	39.3	13.1	30	192.8	39.3	13.1	191.5	39.0	13.0	1164.	237.1	84.8	959.	195.3	70.8	1284.	261.5	91.3				30
213.1	40.7	14.0	206.3	39.4	13.5	31	206.1	39.3	13.5	204.7	39.0	13.4	1256.	238.5	87.7	1031.	196.7	73.4	1377.	262.6	94.5				31
227.3	40.7	14.4	220.0	39.4	14.0	32	219.9	39.4	14.0	218.3	39.1	13.9	1339.	239.8	90.7	1106.	198.0	76.0	1473.	263.7	97.6				32
242.0	40.7	14.9	234.2	39.4	14.4	33	234.0	39.4	14.4	232.4	39.1	14.3	1431.	241.0	93.5	1183.	199.2	78.5	1572.	264.6	100.7				33
257.1	40.8	15.3	248.8	39.5	14.8	34	248.6	39.4	14.8	246.9	39.2	14.7	1526.	242.1	96.4	1263.	200.3	81.1	1674.	265.5	103.9				34
272.6	40.8	15.8	263.9	39.5	15.3	35	263.7	39.5	15.3	261.8	39.2	15.2	1624.	243.1	99.1	1345.	201.3	83.7	1779.	266.3	106.9				35

^aTarif number 36.5 in *Comprehensive Tree-Volume Tarif Tables*, 3rd ed., State of Washington, Department of Natural Resources, October 1980.

Table 3.—Precision and convenience of tools for various tasks

Task to measure	Tools													
	Abney hand level	Angle gauge	Biltmore stick	Clinometer	Compass	Diameter tape	Increment borer	Increment hammer	Log volume table	Pacing	Range finder	Logger's tape	Topographic map	Tree volume table
Boundaries														
Horizontal angles					●									
Horizontal distance									●	○	●			
Road grade	◐			●									●	
Ground slope	◐			●									●	
Logs														
Diameter			◐			○						●		
Length												●		
Volume									●					
Trees														
Age								◐						
Basal area		◐				○								
Current growth							◐	●						
Diameter			●			◐								
Height														
Distance									●	●	◐			
Vertical angle	◐		◐	●										
Volume														○



Comparing the tools

Use table 3 to compare tools that you can use for the same tasks. First, check the key at the bottom. Note that the three sizes of circles indicate the degree of precision; the black-to-white range indicates degree of difficulty in use. Now find in the left column the factors you intend to measure—and consider all the tools shown on each line. Some are quick and easy to use—but yield rough results. Others are more difficult to use—and may or may not give precise results.

Select the tool that fits your need. For example, if you want to measure the grade of a road, you can choose among three tools: the abney hand level, the clinometer, and the topographic map.

The abney level shows a large circle (indicating high relative precision) that is half-black (indicating it is somewhat difficult to use).

The clinometer shows a middle-sized circle (it is quite precise) that is all black (it is easy to use).

The topographic map shows a small circle (least precise of the

three) that is half-black (relatively easy to use).

The tools discussed here are available from many sources. Some are stocked locally, but you can obtain others only from distant suppliers. You can browse tool and supply catalogs in many Extension Service offices.

Instructions may be included with a tool when you purchase it, but novices frequently need help with certain tools. Ask your Extension agent for additional publications or other sources of help.

The **Woodland Workbook** is a collection of more than 50 publications prepared by the Oregon State University Extension Service specifically for owners and managers of private, nonindustrial woodlands. The Workbook is organized into 10 sections containing information of long-range and day-to-day value for anyone interested in wise management, conservation, and use of woodland properties. The sections are Management Planning, Forest Measurements, Reforestation, Stand Management, Logging, Marketing Forest Products, Multiple Use, Forestry Issues, Business Management, and Woodland Assistance.

Although each woodland publication is intended to be complete in itself, you may wish to purchase the entire set of publications in a three-ring Woodland Workbook binder with tabbed dividers for each section. If you wish to purchase only the three-ring binder for filing copies of our woodland publications, you may obtain the binder and dividers as a package. Or you may purchase individual Workbook publications as you need them.

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This publication was prepared by Steve Woodard, Benton and Lane County Extension agent, Oregon State University. Use of trade names is for illustration only and does not constitute endorsement by the OSU Extension Service.

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The Woodland Workbook

Multiple Use



Enhancing Wildlife on Private Woodlands

D.S. deCalesta

Wildlife is an integral part of woodlands. Where there are forests, meadows, and streams, there is wildlife. Although it means many things to people, wildlife divides into three basic categories. The most common category is *game*—birds and mammals that one hunts for recreation, fur, and food.

Another category is *pest animals*—those that damage conifer seedlings, seeds, and, in some cases, larger trees.

A third, catchall category, attracting attention only recently, is *nongame species*. This includes songbirds, reptiles, amphibians, and other animals that are neither hunted nor cause problems.

Rather, they are observed by birdwatchers, photographers, hikers, and others involved in outdoor recreation. Rare or endangered species such as the bald eagle are usually included in this category.

One of the directing forces behind managing natural resources, particularly on small areas like woodlots, is the benefit. What sort of benefit(s) can you expect for investing time and money on wildlife? The return for game and nongame animals is increased use by people.

Hunters want to harvest more and/or bigger (trophy) animals. In cases where acreage is sufficiently large (600+ acres or 1 square mile),

it may be profitable to lease the right to hunt on your land. Birdwatchers want to spot more birds and/or a larger number of different bird species.

This publication discusses management of game and nongame wildlife for the purpose of increasing their use by people. Pest wildlife is discussed only to the extent that land management for game and nongame species does not lead to increased damage by pests. Control of damages to conifers by pest animals is covered in EC 1201 and EC 1255.

Whether you manage land for game, nongame, or pest species, the objective is to increase, decrease, or maintain numbers of wildlife. Increased use of wildlife usually necessitates increasing numbers or quality of wildlife available for use, which is known as wildlife *enhancement*.

What is enhancement?

Enhancement of wildlife populations means to cause an increase in number and/or quality of animals within those populations. The objective may be to produce more deer or quail, to have more trophy-class animals, or, to increase diversity—the number of different species.

How do we get enhancement?

All wildlife species are products of their environment or habitat. Each species has specific, unique habitat requirements that are different from those of other species. The habitat provides basic life requirements including food, protection from enemies and weather, and a place to rear young.

As the *amount* of the specific habitat and the *diversity* of different kinds of habitats increase, diversity and numbers of wildlife species on a given piece of land will also increase. Much of the answer to the question, "How do you enhance wildlife species?" is met by the response, "How do you enhance habitat?"

Enhancement must provide for year-round wildlife needs. For some species, like deer and elk in eastern Oregon, the quality and quantity of some elements of the habitat vary seasonally. The quality and quantity of forage in summer and fall determine the amount of fat they store in preparation for the tough winter months.

If forage is not plentiful and of high quality on summer ranges, the

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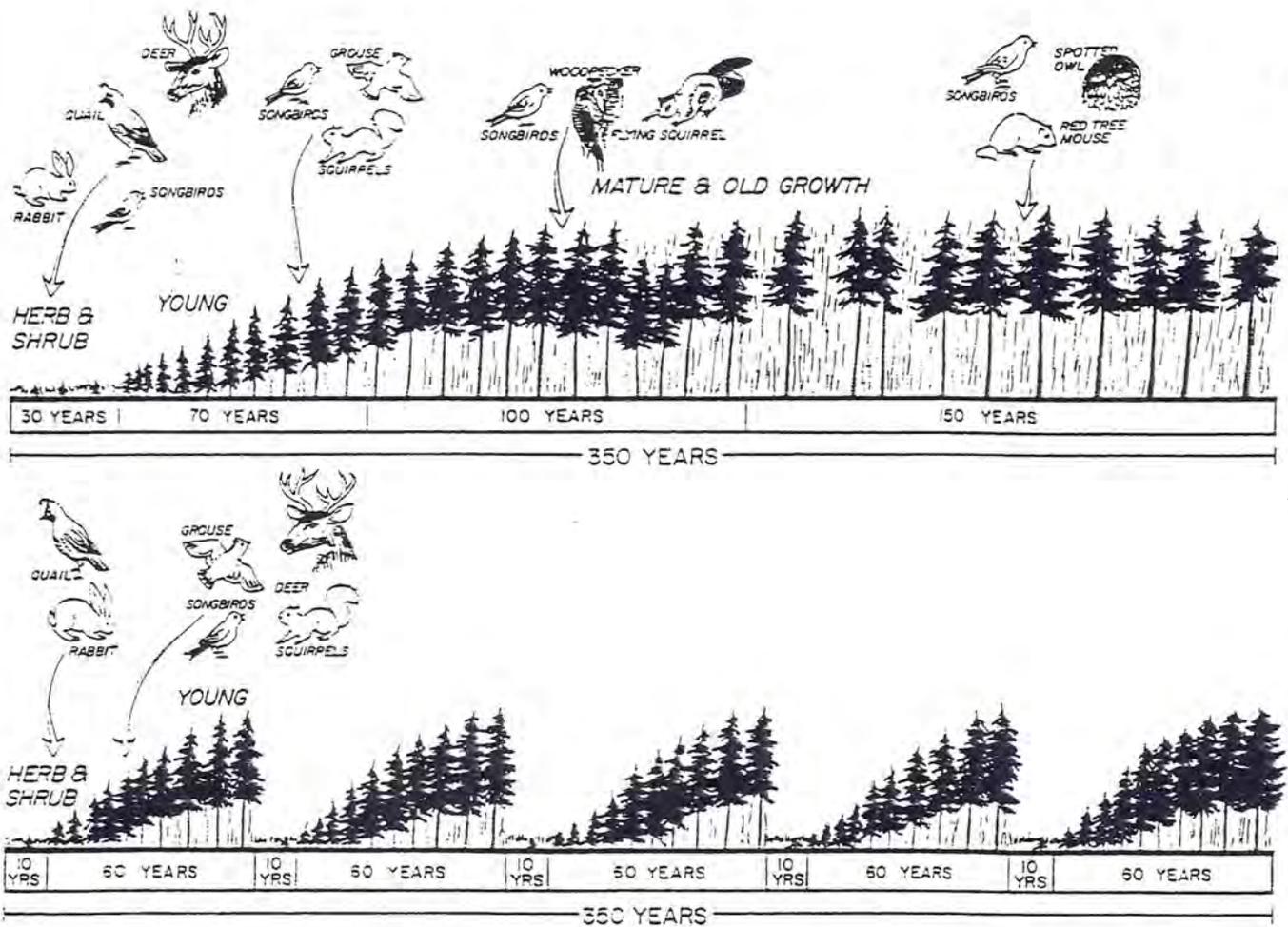


Figure 1.—(top) Combinations of wildlife species that occur on a natural, unmanaged forest, and (bottom) those that appear on a managed forest.

animals may starve on winter ranges where food typically is of low quality and quantity. Also, if deer and elk are not in prime condition in fall, they may not breed, and fawn and calf crops may fail in the spring.

Enhancing habitat

Habitat diversity. Vegetation (trees, shrubs, grasses) provides wildlife habitat. Different species live in different places within this structure. Various birds, like some warblers, live only in the tops of conifer trees. Here they find food (insects), build nests, and take shelter from weather and predators. Other species, like pocket gophers, live underground in grassy meadows.

Some species, like certain frogs and salamanders, have a special requirement for the riparian zone, the moist forested area along stream sides. Most species, however, like deer, quail, and chipping sparrows, require combinations of habitat—meadows and other forest openings to feed in, and timber for breeding sites and for protection from weather and predators.

Habitat variety occurs naturally when natural events like fire, windthrow, and insect and disease attacks open portions of forested areas. These areas usually are revegetated in stages, beginning with grasses, progressing to shrubs, then seedling trees, saplings and mature trees, and finally old-growth trees.

With each successive stage, different combinations of wildlife species likewise appear, persist awhile, and then decline (figure 1, top scale). The diversity of wildlife species present depends on habitat diversity associated with these stages. Providing a diversity of habitats (and thus a diversity of wildlife species) requires a diversity of areas in different stages of vegetative development.

Clear-cut logging works like nature in opening forest lands and beginning the progression of vegetative stages, starting with grassy meadows. The practices of reforestation (planting conifer seedlings) and brush control provide other vegetative stages, but the time sequence is shortened (figure 1, bottom scale). The last stage, old growth, usually is not attained.

Habitat quantity. Can I grow deer on a 10-acre plot? How many acres does a covey of quail require? What quantities of habitat support viable, reproducing populations of wildlife species? The diversity and abundance of wildlife populations that a given parcel of land supports are directly related to the amount and kinds of land available.

Table 1 notes the minimum space requirements of representative species. Deer require a minimum of 30 acres per animal of combined forest lands and openings.

Quail require a minimum of 5 to 10 acres per bird of open meadows, with brushy areas interspersed within the meadows and adjacent forest lands. Song birds, such as chipping sparrows, require about 5 acres per bird, again of open areas adjacent to forested acreages.

The size and timing of timber harvest can be a major tool in simultaneous management of timber

and wildlife. Instead of creating large (more than 100-acre) clearcuts in single cuttings, many smaller cuts can be spread over a number of years (40 to 60 acres could be cut every 5 to 7 years). This would even out the flow of dollar returns from timber and the supply of forage and habitat diversity for wildlife. Thinning timber also provides forage and habitat diversity.

Habitat placement. Wildlife species use different habitats to meet different needs (openings for food, forested areas for cover). These different habitats must be close enough so that wildlife can readily move from one to the other with minimal exposure to predation and weather.

For wildlife species with small home ranges (songbirds, quail, grouse, rabbits, and deer and elk in western Oregon), these different

habitats must be close together (mere hundreds of feet for quail and rabbits, usually less than ¼ mile for deer and elk).

Problems may occur in eastern Oregon with animals such as deer and elk. These have seasonal habitats that are miles apart—summer range at higher elevations in mountain meadows, winter range down on sagebrush flats. Preservation of migration corridors used for traveling to and from such seasonal ranges is another habitat requirement. If these migrating animals have to cross many logging roads, they are exposed to hunters and cars.

Hunting of deer and elk may occur when the animals are on summer range, on winter range, or traveling on migration corridors. If your property includes only one of these seasonally used habitats, your management of these animals may be influenced by management on land over which you have no control.

Table 1.—*Habitat requirements of representative wildlife species*

Wildlife group	Representative species	Required habitats and acreages	Special habitat requirements
Meadow wildlife	California quail, brush rabbit, meadowlark	Open areas with grasses and forbs; some shrubs (15 acres)	Brush piles essential (1 per 2 acres)
Meadow/forest wildlife	deer, elk	Openings (50 acres); closed canopy (15-year-old +); conifers (150 acres)	Migration corridors between seasonal ranges
	chipmunk	Opening (15 acres); second-growth timber (15 acres)	
	juncos, bluebird	Opening (5 acres); second growth (5 acres)	Snags with nest cavities
Young forest wildlife	red squirrel	Mixture of 15- to 75-year-old conifer trees; understory of grasses, forbs (100 acres)	Cone-bearing trees for food
	ruffed grouse	50-50 mixture of conifers and alder (15 acres)	Moist streamside
	MacGillivray's warbler	Mixture of 15- to 75-year-old conifers (15 acres)	
Mature forest wildlife	flying squirrel	75+ year-old conifers (100 acres); understory with forbs, small shrubs	Nest cavities in older (100+ year-old trees)
	spotted owl	100+ year-old conifers (400 acres)	
	pileated woodpecker	100+ year-old conifers (100 acres)	Conifer snags; minimum 20" d.b.h. for nest trees
Riparian wildlife	salamanders, frogs, snakes	Moist, streamside vegetation with closed canopy (¼ to 2 acres); flowing streams	
Large predators	bobcat, bear, coyote, goshawk	Mixtures of closed canopy with open ings (300 to 1,500 acres)	Large (> 15" d.b.h.) trees for nesting/denning

Enhancement doesn't stop at merely providing amounts, diversity, and habitat placement. There are additional habitat needs of wildlife, primarily food and breeding places, that you can manage and thus indirectly influence wildlife.

Special requirements. Managing forest lands for timber production generally provides a variety of habitats. However, practices like brush control and snag removal alter or remove special habitats of some wildlife species. In some cases, one management practice can provide multiple habitat requirements like food and cover for several species.

Leaving a few standing snags and allowing down logs to remain on the ground provides nesting sites (cavities in snags) and a food source (insects that burrow into decaying wood) for birds. Slash is often removed from clearcut sites, usually by burning. Small amounts of this slash may instead be piled to provide brush piles for quail and rabbits to use as protective cover, breeding sites, and food sources (berries and leaves).

In other cases, management practices may provide only for a single need of wildlife. The rapid establishment of conifer seedlings on forested openings (clearcuts, small meadows, etc.) within 3 to 10 years greatly shortens the length of time that these areas would otherwise provide forage for deer (7 to 25 years). One way to provide additional forage for deer in the shortened time span is to make forage plantings on parts of clearcuts. Deer especially like seedings of grasses and legumes. Quail, grouse, and rabbits will also take advantage of this additional food source.

One cannot always maintain snags and other dead standing trees as nesting sites for cavity-nesting birds and mammals such as flying squirrels. However, you can build nest boxes for bluebirds, other songbirds, squirrels, and wood ducks and place them in appropriate locations as an alternative to natural nest sites.

The key to providing special requirements is to identify those animals you wish to enhance, determine if there are special

requirements that current management does not provide, and implement those activities that will benefit the desired populations.

Constraints on enhancement

One manages forest lands for a variety of reasons—timber production and recreation, as well as wildlife. The manner of management on neighboring private or public lands may influence wildlife on *your* land. You must account for these factors in your management plan to avoid conflicts and to increase wildlife abundance.

Conifer damage. Game like deer and elk may damage conifer seedlings. Conducting habitat management to enhance populations of these animals should not result in increased amounts of damage. However, habitat enhancement may increase populations of some animals to a level where they deplete normal food sources and begin to damage conifers.

Planting forage crops for deer may increase populations of pest species like mice; they girdle conifer seedlings and can cause significant economic loss. Building brush piles will provide food and cover for quail and rabbits; however, if you have too many brush piles close to conifer seedlings and not much forage available in winter, you may find the rabbits causing significant damage to the seedlings.

Conflicts with timber production. Often the primary product on forest lands is timber. In some cases, increasing habitat for wildlife will reduce the yield of timber products. Keeping meadows open for production of deer forage will preclude production of timber for market. Maintaining stands of old-growth forest for species such as spotted owls and pileated woodpeckers prevents the short term rotation (50 to 80 years) required to maximize timber production on forest lands.

Maximizing diversity of wildlife species requires maximizing diversity and location of habitat sites. Altering vegetation to maximize diversity will result in lowered

production of timber on forest lands.

Neighbors. Forest management on neighboring land (private and public) may influence the wildlife on your land. If your habitat represents an island of deer management surrounded by land with few deer—like a large clearcut—few deer and elk will move in, and the population will have to sustain itself.

On the other hand, if the neighboring land is managed for deer and elk as well as other forest resources, you may be providing an attractive area that will draw additional animals from neighboring lands. The influx of these animals may overwhelm your ability to keep the population low enough to prevent damage to your seedlings.

Matching what you want with what you've got

In any enhancement program, you must match the desired wildlife with the available habitat(s). The first step is to determine what sort of wildlife you desire.

What wildlife do you want?

Usually, if wildlife is to be managed, it will most likely be for you and your friends, with recreation and food as the chief values. Perhaps you wish to emphasize game. In most cases, leasing or selling hunting rights requires large acreages (600+ acres) to provide sufficient numbers of deer, rabbit, quail, and grouse. There is competition from Federal lands (U.S. Forest Service and Bureau of Land Management), where anyone can hunt without charge and probably can find more variety and larger numbers of game animals than on a small, private ownership.

The required habitats for game animals are meadows and young forests (table 1). This requires that you retain open grassy meadows with little emphasis on older and mature forests that do not provide for optimum numbers of the primary game species. Note also that you will need fairly large acreages, especially for deer—an expected annual harvest of 2 to 5 deer from your land will require at least 100 acres.

If you desire other uses of wildlife, such as birdwatching, you should increase habitat diversity. This means providing the full range of habitats, beginning with open meadows, progressing through regeneration, and ending with mature forests.

If a stream runs through your property, pay attention to riparian habitat. For some species, small areas of each habitat are needed. For others, like spotted owls, you must set aside hundreds of acres of primarily old-growth forest.

As for a private game reserve, selling the privilege to observe wildlife on your land will not bring in much money—public lands are available for this.

The best approach is to design habitat improvements around silvicultural practices. The variety of species and numbers of individual species may be less than ideal, but the use of small unused areas, riparian zones, steep slopes, and other areas where timber production cannot be maximized, will provide many of the requirements you need for a diversified habitat.

What habitat(s) have you got?

When you determine the desired kinds of wildlife, you may identify the required habitats and check them against what is available. You must assess the diversity of habitats and acreage of each, as well as the habitats of neighboring parcels of land. If the species you desire match the type and amount of habitat available, the situation is ideal. If the matchup is not good, you must decide whether to manipulate the habitat to increase species diversity, or to increase the total number of animals—or perhaps both.

To do this properly, an inventory of your property is essential. Make a sketch of your land with the various habitats roughed out, including acreages. Then list the wildlife species that this type of habitat will provide. Couple a drawing of habitats resulting from vegetation enhancement with a listing of the associated wildlife that these modified habitats would favor (figure 2).

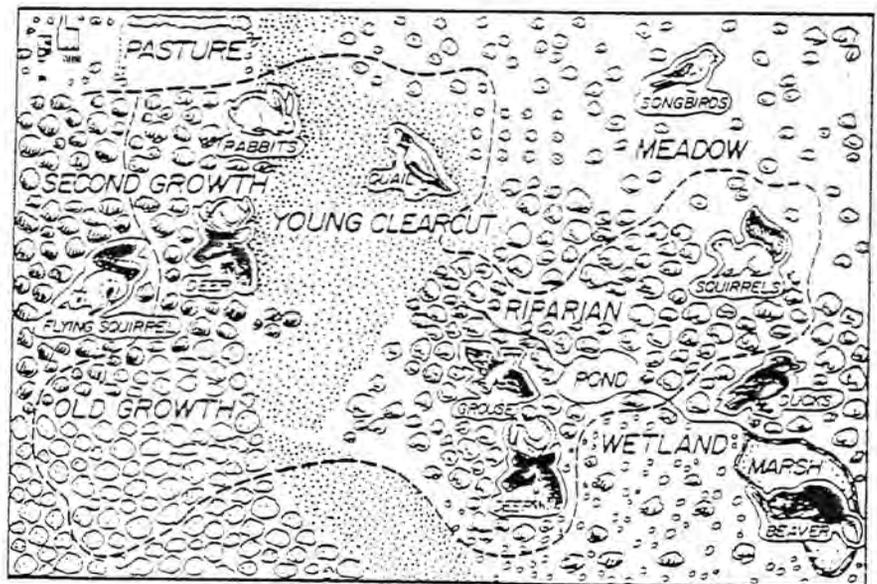
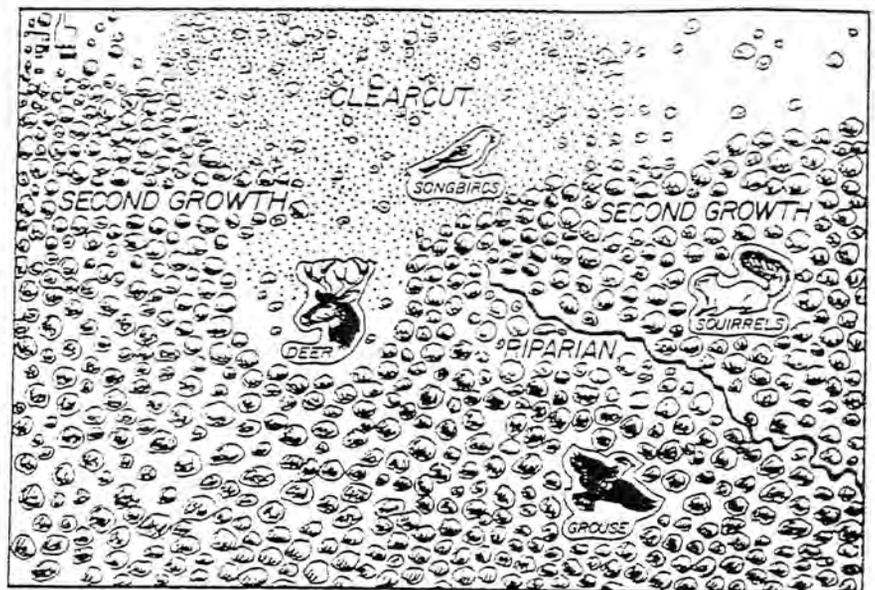


Figure 2.—(top) Wildlife/habitat associations on an undeveloped woodlot, and (bottom) on a developed woodlot.

Make a plan. If you intend to enhance vegetation to provide a greater variety of habitats for wildlife, you must make a plan for the desired changes. The plan should include the location and acreage of habitat you desire to manipulate, the expected cost of the enhancement, and provisions for special habitat requirements not provided by typical vegetation manipulation. An example of such a plan is presented in table 2.

Where to go for help. There is a number of public agencies and private groups in Oregon that provide assistance. The Oregon State University Extension Service has publications that describe how to provide special habitat needs like nest boxes. The Oregon Department of Fish and Wildlife has information on preferred habitats of wildlife, and the Soil Conservation Service provides help with habitat manipulation. The Audubon Society is an excellent source of information on providing for special needs of songbirds. Most large towns have a local Audubon chapter.

Table 2.—*Habitat enhancement plan*

Wildlife species	Habitat enhancement and acreages	Provision for special requirements
Deer, elk	Provide openings in forest (20- to 50-acres each); harvest standing timber; suppress tree and shrub regeneration.	Seed to grass-legume mix—5-to 10-acre patches in meadows.
Rabbits, quail	Provide permanent openings (15 acres) and brushpiles (1 to 2/acre).	
Songbirds	Maintain a good mixture of meadows, second growth, and old growth (5 to 10 acres for each habitat).	Establish nest boxes; establish system of trails through all habitats for bird watching.

Helpful references

OSU publications

These publications are available from Publications Orders, Agricultural Communications, Oregon State University, Administrative Services Bldg. 422, Corvallis, OR 97331-2119. Please add 25¢ shipping and handling to \$2.50. For orders between \$2.50 and \$100, add 15% shipping and handling. For orders of \$100 or more, please call (503) 737-2513 for a price quote.

DeYoe, David, David deCalesta, and Wieger Schaap, *Understanding and Controlling Deer Damage in Young Plantations*, Oregon State University Extension Circular 1201 (Corvallis, 1985). \$1.75

deCalesta, David, and K. Asman, *Controlling Pocket Gopher Damage to Conifer Seedlings*, Oregon State University Extension Circular 1255 (Corvallis, 1987). 50¢

Other publications

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Benson, D. E., *Helping Wildlife: Working with Nature* (Washington: Wildlife Management Institute, 1000 Vermont Ave., 1977).

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The Woodland Workbook is a collection of publications prepared by the Oregon State University Extension Service specifically for owners and managers of private, nonindustrial woodlands. It's organized into 11 sections, containing information of long-range and day-to-day value for anyone interested in wise management, conservation, and use of woodland properties.

The Workbook is available in a three-ring binder with tabbed dividers for each section. For information about how to order, and for a current list of titles and prices, write Publications Orders, Agricultural Communications, Oregon State University, Administrative Services Bldg. 422, Corvallis 97331-2119, or inquire at the office of the OSU Extension Service that serves your county.

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\$1.25

The Woodland Workbook

Kinds of Assistance



Glossary of Woodland Words

Foresters will readily admit that they have a language all their own. If you are to deal effectively with those who work in the forest, and with forestry information, you need to be able to speak and understand that language.

We collected this glossary from a number of different sources. We hope it will get you started learning this new language. As you read it, please feel free to contact either of us if you are aware of mistakes or words that should be added.

Maybe someday we will see you out on your woodland, looking at a nurse tree, part of a shelterwood system, in a riparian zone that has become a monoculture of hardwoods—because the site was overstocked with boomers.

Happy reading! —Rick Fletcher and Bert Udell

A

- abney level.** A hand surveying instrument designed to measure angles of elevation or depression, expressed in degrees or percent. Similar to clinometer.
- acre.** A unit of land measurement, 43,560 sq ft or 10 square chains, or a square 208.7 ft on each side.
- advance growth.** Young trees that have become established naturally in a forest before cutting or regeneration begin. *Syn.* advance reproduction.
- afforestation.** Establishment of a forest on an area not previously forested.
- age class.** One of the intervals into which the range of ages of trees in a stand are divided into for classification and use.
- agro-forestry.** The practice of raising trees, forage, and livestock on the same ground, at the same time. Common associations are cattle and trees or sheep and trees.
- all-aged.** Applies to a stand that contains trees of all ages. *See also* even-aged and uneven-aged.

all-aged management. A system of growing forest trees in groups where the individual trees are not the same age (theoretically, an all-aged forest has trees scattered throughout that range in age from 1 year to the oldest tree, whatever its age may be).

allowable cut. The amount of wood that can be removed from a landowner's property during a given period, without exceeding the net growth during that period on the property.

animal unit (AU). A measure of livestock numbers by which different kinds, classes, sizes, and ages of animals are converted to an equivalent common standard in relation to feed and forage needed by a mature cow (approximately 1,000 lb, live weight). In the western range territory, one animal unit is equal to one head of cattle, one horse, one mule, five sheep, five swine, or five goats.

annual ring. The growth layer of 1 year, as viewed on the cross section of a stem, branch, or root. One year's growth consists of a layer of lighter-colored wood (springwood) and a layer of darker-colored wood (summerwood).

arch. A trailer or structure in the shape of an inverted V or U, which is used in logging and is towed behind (or attached to the back of) the skidding machine, lifting one end of the logs off of the ground during the yarding operation.

aspect. The direction toward which a slope faces. *Syn.* exposure.

available water. The amount of moisture in the soil that plants can extract, usually not including water that drains readily and water beyond the "wilting point."

B

back cut. In the process of felling a tree, the final cut, made on the opposite side of the tree from the face cut (or undercut).

backfire. Controlled fire set ahead of a forest fire to create a firebreak by reducing fuel in the path of the main fire.

basal area.

1. The cross-sectional area of the bole of a tree, 4½ ft above the ground. Basal area = diameter of tree squared, times .005454.

2. The sum of all the individual tree basal areas for a given land area. Commonly expressed as sq ft of basal area (a well-stocked, 40-year-old Douglas-fir forest may have 200-250 sq ft of basal area).

BGR. Acronym for "Big Game Repellent," a putrified-egg product originally developed by Weyerhaeuser Company scientists; now sold under various trade names, as a repellent to animal browse.

Biltmore stick. A stick graduated in such a way that the diameter of a standing tree may be estimated when the stick is held out at right angles to the main axis of the tree, and at a distance from the eye for which the stick is graduated (usually 25 in).

biological control. Control of plants, diseases, and animal pests by the use of natural enemies.

biomass. The sum total of biological material that exists on a given land area. For trees and plants, this can include leaves, branches, stems, and roots.

blaze. A mark placed on a standing tree to call special attention to the tree.

blowdown. Trees that have been knocked over by wind.

blue stain. A fungus discoloration, predominantly bluish, but sometimes grayish, blackish, or brownish in appearance; confined almost exclusively to sapwood; common in pines.

B.M. Bench mark, a point of known elevation usually referenced to sea level.

board foot. A volume measure of lumber, being 1 ft wide, 1 ft long, and 1 in thick (12 in × 12 in × 1 in = 144 cu in).

bole. The main trunk of a tree.

bolts (boltwood). Short material to go into turned wood products: furniture parts, shingles, shakes, arrows, etc.

boomer. Slang name for mountain beaver.

borrow pit. In roadbuilding, an area where fill material is "borrowed," and used in road sections where the normal excavation process does not generate adequate fill material.

breast height. 4½ ft above ground level. See d.b.h.

broadcast burn. A controlled burn, where the fire is allowed to proceed over an entire area. Sometimes called a slash burn.

broadleaf. See hardwood.

browse. Small bushes, sprouts, herbaceous plants, small trees, etc., that wildlife feed on.

brush. Commonly refers to undesirable shrubs and other low-lying vegetation.

bucking. Cutting a felled tree into specified log lengths.

budburst. In woody plants, the time in the spring when flower or leaf buds begin their annual growth. Syn. budbreak.

budcap. A piece of paper or other suitable material attached to a young seedling, covering the terminal bud, to prevent animal browse.

buffer. A zone or strip of land that shields one area from another. Commonly used along streams or as visual barriers.

bug kill. Tree or timber stands killed by insects.

bunk.

1. Supports on a railroad car or logging truck on which the logs rest.

2. A bed in a logging camp.

curl. An abnormal growth on a tree stem, with wood tissue growing in an irregular pattern. Usually circular in shape, these growths are widely sought for their interesting grain pattern.

burning, methods of.

1. **burn, controlled.** Any burning that a landowner starts intentionally to accomplish a particular purpose, and over which he or she exercises some surveillance or control.

2. **burn, prescribed.** The application of fire to land under conditions of weather, soil moisture, and time of day, that will accomplish specific silvicultural, wildlife, grazing, or fire-hazard-reduction purposes.

butt. The base of a tree or log.

butt cut. The first log above the stump. Syn. butt log.

C

caliper (or calipers). An instrument used to measure diameters of trees or logs. It consists of two parallel arms at right angles to a graduated rule, with one arm that slides along the rule.

cambium. A layer of cells between the woody part of the tree and the bark. Division of these cells results in diameter growth of the tree through formation of wood cells (xylem) and inner bark (phloem).

canopy. A collective term for the layer formed by the crowns of the taller trees in a forest.

- carriage.** In skyline logging, a load-carrying device from which logs are suspended and which rides up and down a stationary mainline for yarding or loading.
- Cat.** Tractor/bulldozer (trademark of the Caterpillar Tractor Company).
- catface.** A scar on the surface of a log, generally elliptical in shape, resulting from wounds that have not healed over; also a scar near the base of a tree.
- caulks** (also called "corks"). Steel pegs in soles of heavy boots to give loggers secure footing (often applied to the boots themselves).
- cellulose.** A complex carbohydrate occurring in the cell walls of woody plants and all other vegetable matter.
- chain.** A measurement of distance: one chain equals 66 ft, or 4 rods; 80 chains equal 1 mile; 10 sq chains equal 1 acre. Once used extensively in land surveys.
- charcoal.** One of the principal products of the destructive distillation of woods.
- check.** A lengthwise separation of the wood, which usually extends across the rings of annual growth, commonly resulting from stresses set up in wood during drying.
- chips.** Small pieces of wood used for pulp, fuel, or pressed board manufacture.
- chlorophyll.** The green material in plants necessary for photosynthesis.
- choker.** A noose of wire rope used for moving logs.
- clearcut.** An area on which the entire timber stand has been harvested. *See* reproduction methods.
- climax vegetation.** The final stage of natural plant succession, in which the plant composition remains relatively stable.
- clinometer.** Like an abney level, an instrument for measuring vertical angles or slopes.
- codominant trees.** Trees with crowns forming the general level of the crown cover and receiving full light from above, but comparatively little from the sides; usually with medium-sized crowns. *See* crown class.
- cold deck.** Pile of logs left for later transportation.
- compass.** An instrument used to measure direction. Called a "staff compass" if placed on a pointed pole, a "hand compass" if handheld.
- commercial thinning.** Removing trees from a developing young stand, so that remaining trees will have more growing space; dead and dying trees will be salvaged; and the operation will make a net profit.
- cone.** The female reproductive part of conifers. These structures have overlapping scales that cover several seeds.
- conifer.** A tree belonging to the order Coniferae, usually evergreen with cones, needle-shaped leaves, and producing wood known commercially as "softwood."
- conk.** A hard, spore-bearing structure of a wood-destroying fungus, which projects beyond the bark of a tree.
- conservation.** In forestry, the wise use of natural renewable resources. A key idea for understanding "conservation" is "use" by people.
- coppice forest.** A forest originating from sprouts or suckers. *Syn.* low forest.
- cord.** A volume measure of stacked wood. A standard cord is 4 x 4 x 8 ft or 128 cu ft of space. Since roundwood cannot be stacked to give solid volume, actual wood volume varies between 70 and 90 cu ft per cord.
- crook.** A defect in logs and poles or piling, consisting of an abrupt bend. Also refers to edgewise warp in a piece of lumber.
- crop tree.** A tree selected in a young stand, to be retained until final harvest.
- cross-drain.** A pipe placed under the road surface between major drainages, to collect water from the ditch line and deposit it on the lower side of the road.
- cross section.** A section of a stem or leaf taken at right angles to its longitudinal axis.
- cross tie.** A square timber used for supporting railroad rails.
- crotch.** The fork of a tree or branch.
- crown.** The branches and foliage of a tree.
- crown class.** A designation of trees in a forest with crowns of similar development and occupying similar positions in the crown cover. Differentiation into crown classes applies to even-aged stands and within small even-aged groups in which trees in an uneven-aged stand are often arranged. Five crown classes are commonly recognized: dominant, codominant, intermediate, overtopped (suppressed), and wolf trees.
- crown cover.** The canopy of green leaves and branches formed by the crowns of all trees in a forest. Generally expressed as a percent of total area.
- crown density.** The compactness of the crown cover of the forest; depends on the distance apart and the compactness of the individual crowns. A loose term combining the meanings of "crown closure" and "shade density."
- crown fire.** A fire that runs through the tops of living trees, brush, or chaparral.

E

- easement.** An interest or right to limited use of land, granted by the owner to another party. Commonly used for access.
- ecology.** The science that deals with the interaction of plants and animals with their environment.
- entomology, forest.** The science that deals with insects and their relation to forests and forest products.
- environment.** All elements, living and inanimate, that affect a living organism.
- epidemic.** Widespread insect or disease incidence beyond normal proportions; usually accompanied by excessive damage.
- even-aged.** Applied to a stand in which relatively small age differences exist between individual trees.
- exotic.** Not native; foreign.
- even-flow harvest.** A harvesting scheme designed to extract exactly the same volume of wood fiber each period.

F

- faller.** A logger who specializes in felling trees. Also called "cutters" or "sawyers" in some parts of the West, "choppers" in the redwoods.
- firebreak.** An existing barrier, or one constructed before a fire occurs, from which all or most of the inflammable materials have been removed.
- fire control.** All activities concerned with the suppression of a forest fire.
- fire danger.** The result of both constant and variable factors that determine whether fires will start, spread, and do damage, and the estimated difficulty of control.
- fire line.** A trail around a fire, dug down to mineral soil and clear of all debris. One type of firebreak.
- fire prevention.** Those fire-control activities concerned with the attempt to reduce the number of fires through education, hazard reduction, and law enforcement.
- fire scar.** An injury or wound in the bole of a tree caused or accentuated by fire.
- fire season.** The period or periods of the year during which fires are likely to occur, spread, do sufficient damage, and otherwise warrant organized fire control. In Oregon, this period is set by order of the state forester.
- fire suppression.** All the work of extinguishing a fire after its detection.
1. **direct.** A method where the edge of the fire is extinguished directly.
 2. **indirect.** A method where the control line is located along a favorable firebreak and the intervening strip between the fire and the firebreak is backfired.
 3. **one-lick.** A system of managing personnel on a fire, where the entire crew constructing the control line moves forward without changing relative positions in the line. As they move forward, they do "one lick of work," then advance one or more steps. The number of steps is controlled primarily by the number engaged and the consequent proper spacing of licks, in order that the control line may be completed and the fire extinguished when the last person has passed over the line.
- flash point.** The temperature at which a material will burst into flame.
- forage.** In range management, unharvested plant material of any kind available for animal consumption. When cut, it becomes feed.
- forage value.** The relative importance for grazing purposes of a range plant or plants as a whole on a range.
- forb.** A small herbaceous plant, unlike grass.
- forestation.** The establishment of forest naturally or artificially on areas where it has been absent or insufficient. *Syn.* afforestation.
- forester.** A person who has been professionally educated in forestry at a college or university.
- forest management.** The application of business methods and technical forest principles to the management of forest property.
- forest nursery.** An area in which young trees are grown for forest planting.
- Forest Practices Act.** Several states have legislation regulating private forest harvest to reasonably assure adequate regeneration and protection of soil and water values. Abbreviated in Oregon to OFPA (Oregon Forest Practices Act).
- forest protection.** The activities connected with the prevention and control of damage to forests from fire, insects, disease, and other injurious and destructive sources.
- forest site.** A land unit characterized by climatic, soil, and topographic features that control forest type and growth.

forest survey. An inventory of forest land to determine acreage, condition, timber volume, and species, for specific purposes (such as timber purchase and forest management) or as a basis for forest policies and programs. Also refers to carefully measuring and marking property boundaries.

forest type. A descriptive term used to group stands of similar character in composition and development, to differentiate them from other groups of stands. See stand, type of.

forest utilization. That branch of forestry concerned with the operation of harvesting, processing, and marketing the forest crop and other forest resources.

form. The shape of a log or tree.

form class. A measure of bole taper derived by dividing diameter inside bark at a given height (usually 16 or 32 ft) by d.b.h. These values are often required to use tree-volume tables.

forty. A land tract of 40 acres or a ¼-mile square.

frill. V-shaped cut in the cambial tissue of the tree made with a machete or other sharp tool, used as a place to apply herbicides.

frost crack. Longitudinal crack on the outside of a tree, caused by extreme cold. Especially common on thin-barked species, such as hemlock and true fir.

fungicides. Chemicals used to kill and/or prevent the growth of fungi.

fungus. A plant without chlorophyll that derives its nourishment from the organic matter of other plants.

G

gall. A pronounced localized swelling of greatly modified structure that occurs on plants from irritation by a disease or insect.

gallery. A passage or burrow, excavated by an insect under bark or in wood for feeding or egg-laying purposes.

genus. A botanical grouping of plants with similar characteristics. Species within a genus may be crossbred, but resulting offspring will usually be sterile. Genus *Pinus* contains ponderosa pine, lodgepole pine, and hundreds of other pines around the world. Each species within the genus is identified as *Pinus* + species name (in ponderosa's case, *Pinus ponderosa*). Hence, each tree has both a genus name and a species name.

germination. The initial growth of a seed or spore.

girdle. To encircle the stem of a living tree with cuts that completely sever bark and cambium and often are carried well into the outer sapwood, done to kill the tree by preventing the passage of carbohydrates to the roots. Also refers to same process caused by animals, such as mice or beaver.

grade.

1. A system of classifying lumber or logs according to quality.

2. The steepness of a forest road.

grain. The direction, size, arrangement, appearance, or quality of the fibers in wood.

grazing capacity. In range management, the ability of a range unit, in years of normal rainfall, to give adequate support to a constant number of livestock for a stated period each year without deteriorating. Expressed in number of livestock per acre of given kind or kinds, or in number of acres per specified animals.

green lumber.

1. Lumber with the moisture content greater than that of air-dried lumber.

2. Unseasoned lumber, boards from logs processed through mill before drying.

growth rate. With reference to wood, the rate at which wood has been added to the tree at any particular point, usually expressed in the number of annual rings per inch. May also be stated as "annual leader growth."

gyppo logger. A self-employed, independent timber harvesting contractor who is not an employee of the log purchaser. A more descriptive term is "contract logger."

H

habitat. The environment in which the plant or animal lives. Syn. site.

hand planting. A reforestation method of planting seedlings by hand, usually with spacing to minimize competition and maximize growth. Seedlings are often 2 years old, giving the new forest a head start over seeding methods.

hardwood.

1. Generally, one of the botanical group of trees that have broad leaves, in contrast to the needle-bearing conifers.

2. "Wood produced by broad-leaved trees, regardless of texture or density."

harvest. Extraction of some type of product from the forest. Generally associated with a cutting.

haulback line. In cable logging, the line used to pull chokers or the carriage from the landing out to the felling area.

heart rot. A decay characteristically confined to the heartwood. It usually originates in the living tree.

heartwood. The inner core of a woody stem, wholly composed of nonliving cells and usually differentiated from the outer enveloping layer (sapwood) by its darker color.

heel-in. To store young trees before planting by placing them in a trench and covering the roots with soil.

herbicides. A broad class of chemicals used to kill weeds, grass, brush, or competing trees.

high grading. The removal from the stand of only the best trees, often resulting in a poor-quality residual stand.

high-lead logging. Logging system that uses cables rigged to a spar high above the ground so that one end of the logs can be lifted during yarding.

hinge wood. In felling, the portion of the tree that remains uncut. The width and location of this wood helps determine which way the tree will fall.

hog. A machine used to reduce waste pieces of lumber and slabs, or small tree stems, to chip form.

hot deck. A log pile where both yarding and haul-truck loading take place in rapid succession.

humus. The plant and animal residues of the soil (litter excluded) that have decomposed to the point where their origin is no longer recognizable.

hybrid. A cross between two species that results in a sterile (but often more desirable) offspring.

hypometer. An instrument used to measure the heights of trees, employing geometric or trigonometric principles.

I

ice damage. Breakage of tops and branches and stripping of branches and needles by an ice storm.

ignite. To set fire to, cause to burn.

increment. An increase in the diameter, basal area, height, volume, quality, or value of individual trees or stands over time.

increment borer. A tool used to extract a core of wood from a tree, allowing study of the radial growth of a tree without felling it.

increment core. That part of the cross section of a tree extracted by an increment borer. Used to determine tree age and growth.

insecticides. Chemicals used to kill insects.

intermediate trees. Trees shorter than those in the dominant or codominant classes, but with crowns either below or extending into the crown cover formed by codominant and dominant trees; receiving a little direct light from above, but none from the sides; usually with small crowns, considerably crowded on the sides. *See* crown class.

interplant. To plant seedlings among existing trees, planted or natural.

K

kerf, saw. Width of a cut made by a saw.

kiln, dry. A structure heated by gas, steam, or electricity, in which lumber is dried under controlled conditions to a desired moisture content.

knot. That part of a branch that has been incorporated into the main stem.

L

landing. The area where logs are collected for loading.

leader. The growing top (terminal shoot) of a tree. The distance up the main stem of the tree between each whorl of branches generally represents 1 year of height growth.

leave trees. Trees left in or just outside a harvest zone (often otherwise a clearcut) to reseed the area. This is nature's method of reforestation; but it is often slower, and it does not have the more assured results of direct seeding or planting. May also refer to trees left after a thinning.

litter. The uppermost layer of the soil, made up of freshly fallen or slightly decomposed organic materials. *See* duff.

log.

1. To cut and deliver logs.

2. A tree segment suitable for lumber and other products, typically 8 or more ft long.

logger. A person who is engaged in a logging operation; locally, one who moves logs to landings or skidways.

log rule. A table showing the estimated or calculated amount of lumber (in board feet) that can be sawn from logs of given length and diameter.

1. **Doyle rule.** A simple formula used in the eastern and southern U.S. It underestimates the yield from small logs and overestimates with logs over 28 inches in diameter.

2. **Doyle-Scribner rule.** A combination rule, derived by using Doyle rule values for logs up to 28 inches in diameter and Scribner rule for logs larger than 28 inches.

3. **International rule.** A formula allowing $\frac{1}{2}$ -inch taper for each 4 feet of length and $\frac{1}{4}$ -inch shrinkage for 1-inch board. In one form, it assumes a $\frac{1}{4}$ -inch kerf; in modified form, it assumes a $\frac{1}{2}$ -inch kerf.

4. **Scribner rule.** A diagram rule, one of the oldest in existence. It assumes 1-inch boards and $\frac{1}{4}$ -inch kerf, makes a liberal allowance for slabs, and disregards taper. Official rule in many parts of the U.S., including the Pacific Northwest.

5. **Scribner decimal C rule.** The Scribner rule modified by rounding off the last digit to the nearest 10 and dropping the zero. Zeroes are added to total of volumes. Used in Oregon and Washington.

log scale. The lumber content of a log as determined by a log rule.

lookout.

1. Fire spotter.
2. A station or post used primarily in the detection of fires, often an observation tower located on a high point of ground.

lop.

1. To chop branches, tops, or small trees after felling, so that the slash lies close to the ground.
2. To cut the limbs from a felled tree.

M

mainline.

1. In cable logging, the line used to retrieve turns of logs.
2. The main access road to a forest tract.

management plan. A written plan for the organized handling and operation of a forest property. It usually includes data and prescribes measures designed to provide optimum use of forest resources according to the landowner's objectives.

marking timber. Selecting and indicating, usually by an axe mark (blaze) or paint mark, trees to be cut or retained in a harvesting operation.

maturity. For a given species or stand, the approximate age or condition beyond which the growth rate declines or decay begins to assume economic importance.

MBF. Abbreviation for "1000 board ft."

mensuration, forest. The science dealing with the measurement of the volume, growth, and develop-

ment of individual trees and stands, and the determination of the various products obtainable from them.

merchantable. That part of a tree that can be manufactured into a salable product.

merchantable height. The length of the tree stem from the top of the stump to the top of the last merchantable section. Usually expressed in ft or number of logs.

merchantable timber. A tree or stand of trees that may be converted into salable products.

merchantable volume. The amount of wood in a single tree or forest stand that is considered salable.

monoculture. The practice of growing a single species of tree or plant on a given land area.

mountain beaver. A small nocturnal rodent, found throughout the Coast Range in Oregon and Washington. This burrowing animal has a voracious appetite for Douglas-fir seedlings. *Syn.* boomer.

mortality. Death of forest trees as a result of competition, disease, insect damage, drought, wind, fire, and other factors.

multiple-use management. Management and use of forest land for more than one purpose (timber, wildlife, watershed, etc.). Uses may be shared on the same acreage or allocated to different portions of a forest tract.

N

national forest. Federally owned land managed to provide wood, water, and other uses for the benefit of the people of the United States. National forests are under the administration of the Forest Service of the U.S. Department of Agriculture.

national park. Federally owned land managed to maintain areas of outstanding and unique scenery and geographic features for public enjoyment. National parks are under the administration of the National Park Service of the U.S. Department of the Interior.

natural thinning. Death of trees in a stand as a result of competition.

needle cast. Premature browning and dropping of needles caused by a fungus. (Douglas-fir Christmas trees are particularly susceptible to Swiss needle cast.)

nurse tree or crop. A tree or crop of trees, shrubs, or other plants that foster another, generally more important, tree or crop. *Syn.* trainer.

nutritive value. A term usually prefixed by "high," "low," etc., to indicate relative quality of a given forage or feed to furnish elements valuable for animal nutrition.



old growth. A forest that has never been changed by management or harvesting. This term is misapplied by many to describe any forest that appears to be old. Individual trees in this type of forest are usually over 200 years old, and there are large standing and fallen dead trees throughout the stand.

operation. Used interchangeably for logging jobs, harvesting, cutting, milling, etc. An all-inclusive term for harvesting and hauling out the forest products.

outplant. Planting nursery-grown tree seedlings on a freshly prepared area. See *transplant*.

overgrazing. Grazing so heavy that it impairs future forage production and causes range deterioration through damage to plants, soil, or both.

overmaturity. That period in the life cycle of trees and stands when growth or value is declining. See *maturity*.

overrun. The excess lumber sawn from logs over the estimated volume or log scale, usually expressed in percent of log scale.

overstocked. A condition of the stand or forest, indicating more trees than desired, normal, or full stocking would require.

overstory. That portion of the trees in a stand forming the upper crown cover.

overtopped tree. Trees with crowns entirely below the general level of the overstory cover, receiving no direct light either from above or from the sides. *Syn.* suppressed. See *crown class*.

P

palatability. The relative desirability of certain plants as forage for domestic and wild animals. Varies with composition of the plant cover or the season of grazing.

partial cut. A silvicultural cutting scheme that removes at any one time less than the total tree stand (selective cut, seed tree cut, shelterwood cut).

particle-board. A type of board made by compressing chips or particles of wood under heat and pressure,

in the presence of glue or resin. Flakeboard is a new product made by a similar process.

pathology, forest. The science that pertains to diseases of forest trees or stands, and to the deterioration of forest products by organisms.

peavey. A long-handled tool with a spike point and hinged arm; used to roll logs.

peeler core. A piece of roundwood that is a byproduct of the veneer-peeling process; usually 8 feet long and about 4 inches in diameter.

percent grade.

1. The vertical rise of land in 100 horizontal ft. A 16% grade means that in 100 ft horizontal, the elevation has changed 16 ft. Measured with an abney level or clinometer.

2. Amount of forest volume found to be in a given log grade.

percolation. The downward movement of water through the soil, primarily because of gravity.

pesticides. A general term for chemicals used to kill any of the pests of a desired crop.

phloem. An outer layer of tree tissue that conducts food from the leaves to the stem and roots.

photosynthesis. The conversion by green plants of light, water, and air into food energy.

pile and burn. A controlled burn where the material to be disposed of is concentrated, usually with machinery, before burning.

piling. Round timbers driven into the ground to support other structures.

pistol butt. Applied to trees with bases curving away from the slope and then upwards. This may indicate unstable or moving soil.

pitch. A term applied to the resin occurring in the wood of certain conifers.

pitch pocket. A well defined, lens-shaped opening between or within annual growth rings of coniferous wood, containing pitch and possibly bark.

planer. A machine used to put a smooth surface or shape on lumber.

plant.

1. To place young trees or cuttings in the soil on forest land; to establish a forest crop. Sometimes used loosely to include direct seeding. Trees may be placed as bare-root stock, or with roots within a ball of earth, or in earth within a container.

2. A processing facility for wood products.

plantation. An artificially reforested area established by planting or by direct seeding.

planting bar. A hand tool used in making a slit-hole in the soil in which trees are planted.

plot. A carefully measured area laid out for experimentation or of mensuration; may be permanent or temporary. *Syn.* study plot.

plug seedling. A seedling grown in a small container, under carefully controlled environmental conditions.

Seedlings are removed from containers for planting.

plywood. A wood product constructed of three or more layers of veneer joined with glue and (usually) laid with the grain of adjoining plies at right angles to one another.

pole.

1. A young tree between 5 and 12 in d.b.h. *See* sapling.

2. A log cut for the manufacture of power or telephone poles (involves trees larger than 12 in d.b.h.).

portable mill. A small sawmill that can be readily moved from one place to another. The usual daily capacity ranges from 3,000 to 10,000 board ft.

prebunch. In logging, to collect logs or other material at intermediate staging areas, in preparation for the main yarding operation.

precipitation. Deposits of atmospheric moisture in liquid or solid form, including rain, sleet, snow, hail, dew, or mist (also refers to quantity of water deposited).

precommercial thinning. Removal of some of the trees in a young stand to reduce competition for water and nutrients, and to accelerate commercial growth on remaining trees. Trees thinned from these stands have no commercial value.

preservation.

1. To maintain in a natural state; human impact on the biological system is minimized. Commonly refers to wilderness area management.

2. Wood preservation involves the protection of timber and wood products against the action of destructive living organisms, especially fungi, insects, and marine borers.

preservative. A substance that, when properly applied to wood, makes it resistant to attack by fungi, insects, or marine borers.

primitive area. An area of forest land that is left unaffected by human activities. These areas are in essence wilderness, but they are created by administrative regulation rather than by act of Congress.

prism. A wedge-shaped piece of clear or amber-colored glass that is used to select trees for timber sampling.

pruning. The removal of live or dead branches from standing trees, whether done artificially or naturally. Natural pruning results from such causes as deficiency of light, decay, snow, ice, etc. *Syn.* self-pruning.

pulp, wood. Mechanically ground or chemically digested wood fibers used in the manufacture of paper and allied products. Bleached and purified wood pulp is also widely used in the manufacture of rayon and other chemicals.

pulpwood. Wood cut or prepared primarily for manufacture into wood pulp, for later manufacture into paper, fiberboard, or other products (the products depend largely on the species and the pulping process).

PUM yarding. Acronym for "pile unmerchantable material," referring to a U.S. Forest Service contract regulation that requires loggers to concentrate all tops, chunks, and other unmerchantable material generated by harvesting. *See* YUM.

punky. A soft, weak, often spongy condition in wood; caused by decay.

R

radial (surface). A horizontal surface or plane extending wholly or in part from the pith to the bark of a tree bole.

range. Land not under cultivation, that produces forage suitable for grazing by domestic animals and wildlife. Includes forest that produces forage.

"Open range" is an extensive grazing area on which the movement of livestock is permitted. In Oregon, these areas are established by law.

ranger. An administrative officer in charge of a unit of forest or other land, usually a subdivision of a public forest or park. Various classifications are recognized: forest ranger, district ranger, park ranger, county ranger.

ray. In wood anatomy, a ribbon-shaped strand of tissue formed by the cambium and extending in a radial direction across the grain in hardwoods.

reforestation. The natural or artificial restocking of an area with forest trees.

relative humidity. The amount of water vapor present in the air, compared to the amount in fully saturated air of that temperature and pressure.

- schoolmarm.** Logger's slang for a tree with one or more trunks.
- season.** To dry lumber, either in the open or in a dry kiln.
- seasoning.** The process of drying (curing) lumber or other forms of wood to improve its properties: natural (air or underground drying) or artificial (kiln drying, electrical drying, oil drying, etc.).
- second growth.** A second forest that develops after harvest of the original, natural forest. In the Pacific Northwest, these forests also are often called young-growth stands.
- section.** A unit of land area equal to 640 acres, 6,400 sq chains, 1 sq mile, or 80 chains on each side.
- seedbed.** In natural plant reproduction, the soil or forest floor on which seed falls; in nursery practice, a prepared area in which seed is sown.
- seeding.** A reforestation method by sowing seeds, aerially or by hand. Often done immediately after harvest so that a new forest is started the next growing season.
- seedling.** A small tree grown from seed. Usually the term is restricted to trees less than 2 in d.b.h.
- seed year.** A year in which a given species produces (over a considerable area) a seed crop greatly in excess of the normal. Applied usually to trees of irregular or infrequent seed production.
- seed tree.**
1. A tree that produces seed.
 2. Trees reserved in a harvest operation to supply seed. *See* reproduction methods.
- seed-zone.** Areas of similar climatic and elevational conditions, used to specify where tree seed was collected and where trees from such seed are most likely to be successfully grown.
- selection cut.** *See* reproduction methods.
- severance tax.** A tax paid on forest products after they are cut.
- shade tolerance.** The capacity of a tree or plant species to develop and grow in the shade of and in competition with other trees or plants. *See* tolerance.
- shake.**
1. A lengthwise separation of wood (usually caused by wind) that usually occurs between and parallel to the growth layers.
 2. A thin section split from a bolt of wood and used for roofing or siding.
- shear.**
1. In Christmas tree culture, to shape and trim back the branches to make dense foliage and give tree a conical shape.
 2. In felling, a mechanical device that pinches trees off at the stump.
- shelterbelt.** A wind barrier of living trees and/or shrubs, maintained to protect farm fields or homesteads. *Syn.* belt, windbreak.
- shelterwood.** *See* reproduction methods.
- shrinkage.** The contraction of wood caused by drying the material below the point at which the wood fibers are saturated. Shrinkage values are usually expressed as a percentage of specific dimensions (or the volume) of the wood when green.
- shrub.** A woody perennial plant (lives more than 1 year) that differs from a perennial herb by its woody, persistent stems, and from a tree by its low stature and branches that start from the base.
- sidecast.** Earth and other material generated by roadbuilding and deposited on the downhill side of the road.
- silver thaw.** A weather phenomenon in which great quantities of ice collect on trees and other vegetation, often causing much breakage.
- silviculture.** The art and science of producing and tending a forest; the theory and practice of controlling forest establishment, composition, growth, and quality of forests to achieve the objectives of management.
- site.** An area of land, especially with reference to its capacity to produce vegetation as a function of environmental factors (climate, soil, biology, etc.).
- site class.** A grouping of similar site indexes that indicates relative productivity. The common system for the Douglas-fir region includes five site classes, with 1 (I) the most productive and 5 (V) the least.
- site index.** A measure of forest site quality, based on the height (in ft) that dominant trees will reach at a given age. For Douglas-fir, this is commonly expressed as either a 50- or 100-year site index.
- site preparation.** Any treatment of a forest site to prepare it for establishment of a plantation or for natural regeneration.
- skidding.** The process of dragging logs from the woods to a landing, usually applied to ground-based operations. A similar term, used especially with cable or aerial logging systems, is "yarding."
- skid road, skid trail.** A pathway over which logs are skidded.

- skyline logging.** A type of cable logging in which the mainline is stationary and a carriage moves up and down it, collecting turns of logs.
- slab.** The exterior portion of a log removed in sawing timber.
- slash.**
1. Tree tops, branches, bark, and other debris, left after a forest operation.
 2. The process of cutting down undesirable vegetation.
- snag.** A standing, dead tree or a standing section of the stem of a tree broken off at the height of 20 ft or more. If less than 20 ft, it is properly termed a "stub."
- softwood.** One of the botanical group of trees that generally have needle or scalelike leaves—the conifers. Also the wood produced by such trees, regardless of texture or density.
- soil horizon.** A layer of soil with distinct characteristics that separate it from other soil layers. Commonly, a forest soil will have O, A, B, and C horizons.
- soil moisture.** The relative amount of water in the soil; usually applied to upper levels of soil, occasionally to humus layer.
- soil profile.** A vertical section of soil showing the nature and thickness of the various horizons, often used in soil classification.
- soil series.** Groupings of soils with similar profile characteristics.
- spar.** A pole, tower, or tree used in cable logging to raise the mainline off the ground.
- sprout.** A young tree developed directly from the base, stump, or root of another tree. Relatively common among hardwoods; with conifers, typical only of redwoods. *Syn.* sucker.
- species (of trees).** Trees having very similar genetic makeup, so that they freely interbreed and have common characteristics. In common language, a "kind" or "variety." Each species is identified by a scientific name that consists of a genus portion and then a species portion (*Tsuga heterophylla*, western hemlock).
- spike top.** A tree with a dead top, usually a mark of declining vigor.
- springwood.** The less dense, larger-celled, first-formed wood of an annual growth ring.
- spud.** A hand tool used in stripping bark from felled trees.
- staff compass.** *See* compass.
- stand.** An aggregation of trees occupying a specific area and uniform enough in composition (species), age, and arrangement to be distinguishable from the forest on adjoining areas.
- stand density.** A relative measure of amount of stocking on a forest area, compared with other areas.
- stand table.** A summary table showing the number of trees by species and diameter class of any given area.
- stand, type of.**
1. **mixed.** A stand in which more than 25% of the trees in the main crown canopy are of a species other than the major species.
 2. **pure.** A stand in which at least 80-90% of the trees in the dominant and codominant crown classes are of a single species.
- stem.** The trunk of a tree.
- stocking.** The number of trees in a forest. Usually expressed as trees per acre or some relative measure (well stocked/fully stocked, overstocked, understocked).
- stratification.** The technique of placing seeds in a cool, moist medium (such as sand or peat) to imitate winter conditions and aid germination when planted.
- stumpage.** The value of timber as it stands uncut in the woods; in a general sense, the standing timber itself. Can also denote price paid for this timber.
- stump sprout.** *See* sprout.
- succession.** The replacement of one plant community by another in progressive development toward climax vegetation.
- succession, types of.**
1. **primary.** Plant succession on newly formed soils or surfaces, exposed for the first time, that have never borne vegetation.
 2. **secondary.** Plant succession following the destruction of a part or all of the original vegetation.
- sucker.** A sprout from the lower portion of a stem, especially from the root.
- sucker knot.** A knot associated with a limb growing nearly parallel to the main stem. Sucker knots are not permitted on poles because they funnel water into the pole, promoting decay even if treated.
- summerwood.** The denser, later-formed wood of an annual growth ring. The cells are smaller, with thick cell walls, so they usually give the layer a darker color than that of the springwood.
- sunsald.** Death of cambial tissue on one side of a tree, caused by exposure to direct sunlight.
- suppressed tree.** *See* overtopped.
- surface runoff.** Water that moves over the ground surface. With the exception of established drainage channels, uncommon on undisturbed forest land.

sustained yield. A policy, method, or plan of forest management that calls for continuous production, to achieve, at the earliest practicable time, an approximate balance between net growth and amount harvested.

swamp. To clear the ground of underbrush, fallen trees, and other obstructions, to facilitate such later operations as logging or surveying.

sweep. A gradual (but pronounced) bend in a log, pole, or piling; considered a defect.

swell-butted. Describes a tree greatly enlarged at the base. *Syn.* bottle-butted, churn-butted.

T

tail tree. In skyline logging, a tree used to anchor the mainline away from the landing.

tally. The count of trees, logs, or other products; to count trees, logs, or other products; to record products, distances, etc., as measured.

taper. The gradual reduction of diameter in a stem of a tree or a log from the base to the top.

taproot. The major tree root with the greatest tendency to grow downward. Depending on the species and soil conditions, the taproot may or may not be pronounced or show heavy branching.

tarif table. A tree-volume table based on d.b.h. and total height.

terminal bud. The uppermost bud on the main stem of a tree. *See* leader.

thinning. Cutting in an immature stand to increase the growth rate of the leave trees. The goal is to foster quality growth, improve composition, promote sanitation, and recover and use material that would otherwise be lost to mortality. Thinning does not generally increase per-acre cubic-volume growth, but it can increase board-foot yield.

thinning shock. A condition of very slow growth in a thinned stand, usually from a heavy thinning that exposes residual trees to conditions much different from those present before thinning.

thinning, types of. *See also* commercial thinning, precommercial thinning.

1. **low thinning.** The removal of trees from the lower crown classes in a stand. *Syn.* thinning from below.

2. **crown thinning.** The removal of trees from the middle and upper crown classes in a stand, to favor the most promising trees of these classes. *Syn.* thinning from above.

3. **selection thinning.** Removal of dominant trees to benefit trees in lower crown classes.

4. **free thinning.** Removal of trees to benefit best trees, regardless of crown class.

5. **mechanical thinning.** Removal of trees based totally on their spacing or arrangement.

timber. A term loosely applied to forest stands or their products; often applied to wood in forms suitable for heavy construction (houses, ships, bridges).

timber stand improvement (T.S.I.). Any treatment intended to improve the quality of a forest stand, including pruning, thinning, salvaging, and fertilization.

timber type. *See* forest type.

tolerance. The capacity of a tree or plant to develop and grow in the shade of (and in competition with) other trees or plants; a general term for the relative ability of a species to survive a deficiency of an essential growth requirement (light, moisture, nutrient supply).

transpiration. The process by which water vapor leaves a living plant and enters the atmosphere.

transplant.

1. To replant a nursery seedling in another part of the nursery for further development. A "2-1" tree seedling is one that was grown from seed for 2 years in the nursery, then replanted and left for a year in another nursery bed.

2. To move a wild seedling to another location for regenerating a forest.

3. Any seedling that is removed from one location and planted elsewhere.

tree. A woody plant having one well-defined stem and a more or less definitely formed crown, usually attaining a height of at least 8 ft.

tree age. The number of years since the germination of the seed, or the budding of the sprout or root sucker.

tree farm. An area of privately owned forest land dedicated by its owner to the growing and harvesting of repeated forest crops. The name has been copyrighted by the American Forest Institute for its exclusive use.

tree length. Entire length of tree, or with the top lopped off at small diameter, as in skidding tree length to a landing for bucking into logs.

turn. The logs brought to the landing during a single yarding or skidding cycle.

turnup. In Christmas tree culture, the practice of leaving a green branch when harvesting a Christmas tree; this branch, turned upwards, becomes the next tree. *Syn.* stump culture.

U

underbrush. The brush growing in a forest.

undercut. In felling a tree, the initial cut that removes a wedge-shaped piece of wood and determines the direction of fall. *Syn.* face cut.

undergrowth. Small trees and shrubs and other plants growing under a forest canopy.

understory. That portion of the trees or other vegetation in a forest stand below the canopy.

uneven-aged. Applied to a stand in which there are considerable differences in the age of the trees and in which three or more age classes are represented. *See also* all-aged.

V

vener. A thin sheet of wood cut on a lathe or slicing machine. There are three kinds: sawed, sliced, and rotary cut.

Vexar tube. A rigid, plastic-net tube made from Vexar (a trademark of the DuPont Corporation). Used to protect tree seedlings from animal damage.

virgin forest. A mature or overmature forest essentially uninfluenced by human activity.

volume table. A table showing gross volume of trees, based on given tree measurements (usually d.b.h. and height).

W

water bar. V-shaped trench cut into the surface of a road, which collects water and channels it off the road surface, to avoid erosion.

watershed. Any sloping area that sheds water; an area of land that collects and discharges water into a single stream or other outlet.

wedge.

1. In logging, to drive a solid V-shaped object (the wedge) into the saw cut to prevent the saw from binding and to direct the fall of the tree.

2. Slang for a prism used in cruising timber.

weed tree. A tree of a species with relatively little or no value.

whorl. A group of branches originating at or near the base of the terminal bud. Generally, one whorl is produced each growing season.

widowmaker. Any limb, top, leaning tree, or other material in the forest that is in danger of falling to the ground without warning, creating a safety hazard. Often applied to limbs that get lodged in the crowns of other trees during a logging operation.

wilderness area. An area of public land (usually over 5,000 acres) designated by Congress as wilderness according to the definition in the Wilderness Act. Ecosystems present are preserved in their natural states, with minimum human influence (no timber harvesting, roads, or developed areas are allowed).

wildfire. A fire burning out of control, regardless of how or why it started.

wildling. A seedling naturally reproduced outside of a nursery, used in forest planting.

windbreak. A wind barrier of living trees and shrubs maintained to protect the farm home, other buildings, garden, orchard, or feedlots. *Syn.* shelterbelt.

windfall. A tree uprooted or broken off by wind; an area on which the trees have been thrown by wind. *Syn.* blowdown, wind-thrown.

windfirm. Describes trees capable of withstanding heavy wind.

wolf tree. A vigorous tree that has merchantable value but occupies more space than its value warrants. Usually very limby.

wood. The lignified water-conducting, supporting, and storage tissue of branches, stems, and roots. *Syn.* xylem.

woodland. The wooded portion of a farm or ranch, or the wooded land operated in connection with a farm or ranch.

wood-processing industry. That segment of the forest industry that manufactures lumber, paper, plywood, and other primary forest products.

wood technology. The study of wood and all its aspects, including anatomy, chemistry, properties, and treatment.

X

xylem. *See* sapwood.

Y

yard. A place where logs, pulpwood, or other timber is collected; to collect logs in a yard, landing, or skidway.

yield table. A table that projects the wood yield of a forest stand, given certain stocking, age, and site-productivity conditions.

young growth. Any forest of relatively young age and condition.

YUM. Acronym for "yard unmerchantable material," referring to a U.S. Forest Service contract regulation that requires loggers to move to landings any tops, chunks, or other unmerchantable material generated by harvesting. See PUM.

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Extension's forestry program improves Oregonians' knowledge of forest resources and their options for expanding benefits from these resources. This educational program assists forest owners, managers, processors, and users in understanding small woodland production and management and use of all forest lands. Priority subjects are reforestation, growth, management, harvesting, processing and use of wood, protection of soil and water, and other multiple uses and values.

This publication was prepared by Richard Fletcher, Extension agent (forestry), Linn and Benton counties; and Bert Udell, Lebanon. The American Forest Institute named Bert and Betty Udell "Tree Farmers of the Year" for 1982. This publication is one of a series being developed as an Extension *Woodland Workbook*. Trade-name products are used as examples only; this use does not constitute endorsement by the Oregon State University Extension Service.

The *Woodland Workbook* is made up of more than 50 publications prepared by the Oregon State University Extension Service specifically for owners and managers of private, nonindustrial woodlands. For information about how to order and for a current list of titles and prices, write Bulletin Mailing Office, Oregon State University, Corvallis, Oregon 97331—or inquire at the office of the Oregon State University Extension Service that serves your county.

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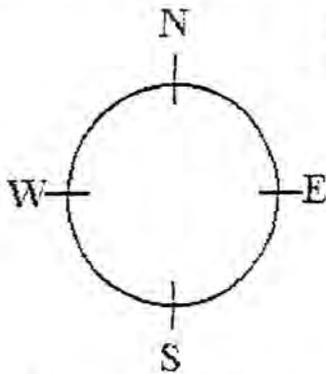
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Kjetil Kjernsmo's illustrated guide on

How to use a compass

Using the compass alone

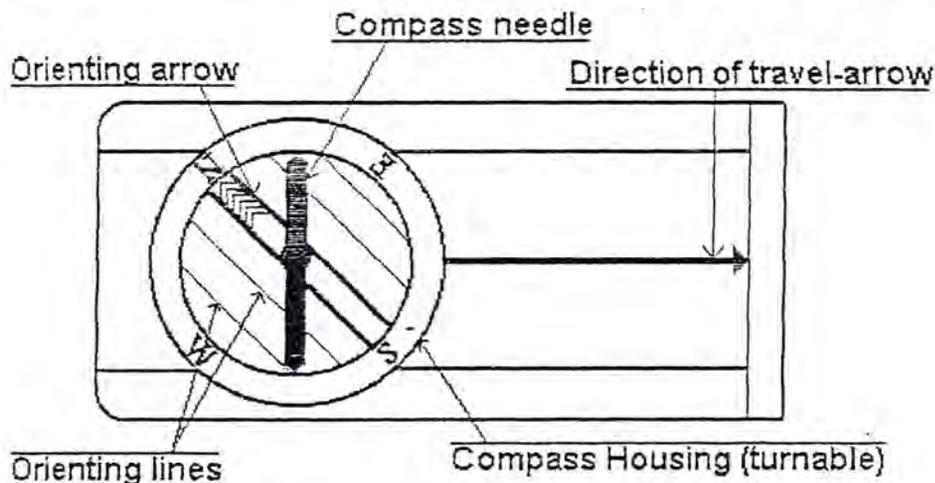
This is a very easy lesson, and I would say, not sufficient for those who would like to travel safely in unfamiliar terrain.



The first thing you need to learn, are the directions. North, South, East and West. Look at the figure and learn how they are. North is the most important.

There are several kinds of compasses, one kind to attach to the map, one kind to attach to your thumb. The thumb-compass is used mostly by orienteers who just want to run fast, and this is the kind of compass I normally use.

But not in this tutorial. I would recommend the third kind of compass. Let's take a look at it:

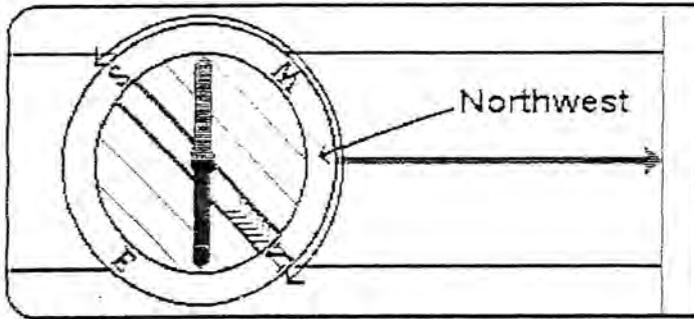


You see this red and black arrow? We call it the *compass needle*. Well, on some compasses it might be red and white for instance, but the point is, the **red part of it is always pointing towards the earth's magnetic north pole**. Got that? That's basically what you need to know. It's as simple as that.

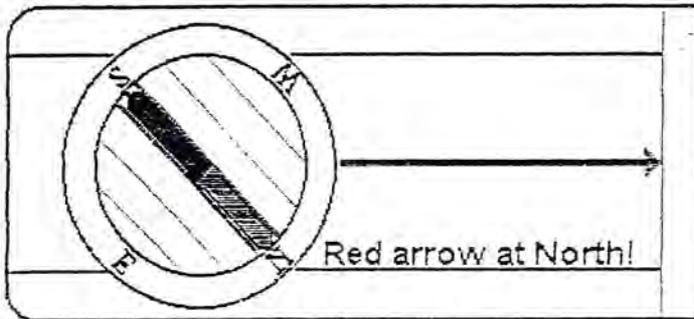
But if you don't want to go north, but a different direction? Hang on and I'll tell you.

You've got this turnable thing on your compass. We call it the *Compass housing*. On the edge of the compass housing, you will probably have a scale. From 0 to 360 or from 0 to 400. Those are the degrees or the *azimuth* (or you may also call it the bearing in some contexts). And you should have the

letters N, S, W and E for North, South, West and East. If you want to go in a direction between two of these, you would combine them. If you would like to go in a direction just between North and West, you simply say: "I would like to go Northwest".



Let's use that as an example: You want to go northwest. What you do, is that you find out where on the compass housing northwest is. Then you turn the compass housing so that northwest on the housing comes exactly there where the large direction of travel-arrow meets the housing.



Hold the compass in your hand. And you'll have to hold it quite flat, so that the compass needle can turn. Then turn yourself, your hand, the entire compass, just make sure the compass housing doesn't turn, and turn it until the compass needle is aligned with the lines inside the compass housing.



Now, time to be careful! It is *extremely* important that the red, north part of the compass needle points at north in the compass housing. If south points at north, you would walk off in the exact opposite direction of what you want! And it's a very common mistake among beginners. So always take a second look to make sure you did it right!



A second problem might be local magnetic attractions. If you are carrying something of iron or something like that, it might disturb the arrow. Even a staple in your map might be a problem. Make sure there is nothing of the sort around. There is a possibility for magnetic attractions in the soil as well, "magnetic deviation", but they are rarely seen. Might occur if you're in a mining district.

When you are sure you've got it right, walk off in the direction the direction of travel-arrow is pointing. To avoid getting off the course, make sure to look at the compass quite frequently, say every hundred meters at least.

But you shouldn't stare down on the compass. Once you have the direction, aim on some point in the distance, and go there. But this gets more important when you use a map.

There is something you should look for to avoid going in the opposite direction: The Sun. At noon, the sun is roughly in South (or in the north on the southern hemisphere), so if you are heading north and have the sun in your face, it should ring a bell.

When do you need this technique?

If you are out there without a map, and you don't know where you are, but you know that there is a road, trail, stream, river or something long and big you can't miss if you go in the right direction. And you know in what direction you must go to get there, at least approximately what direction.

Then all you need to do, is to turn the compass housing, so that the direction you want to go in, is where the direction of travel-arrow meets the housing. And follow the above steps.

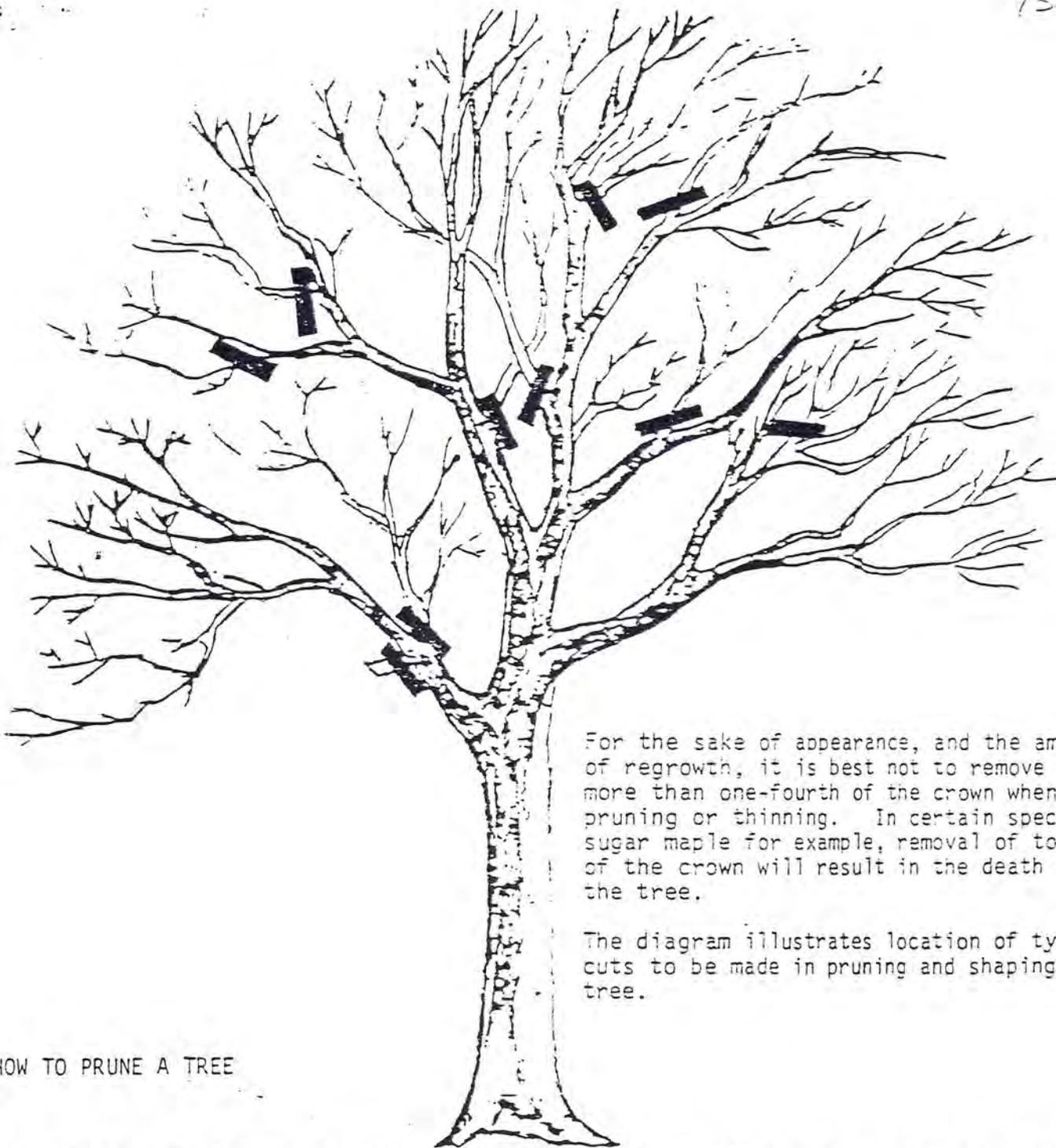
But why isn't this sufficient? It is not very accurate. You are going in the right direction, and you

won't go around in circles, but you're very lucky if you hit a small spot this way. And that's why I'm not talking about *declination* here. And because that is something connected with the use of maps. But if you have a mental image of the map and know what it is, do think about it. But I think you won't be able to be so accurate so the declination won't make a difference.

If you are taking a long hike in unfamiliar terrain, you should always carry a good map that covers the terrain. Especially if you are leaving the trail. It is in this interaction between the map and a compass, that the compass becomes really valuable. And that is dealt with in lesson 2.



Kjetil Kjernsmo © 1997
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For the sake of appearance, and the amount of regrowth, it is best not to remove more than one-fourth of the crown when pruning or thinning. In certain species, sugar maple for example, removal of too much of the crown will result in the death of the tree.

The diagram illustrates location of typical cuts to be made in pruning and shaping a tree.

HOW TO PRUNE A TREE

The question is often asked, "When should I prune my trees?" Probably the best answer is, "When the saw is sharp."

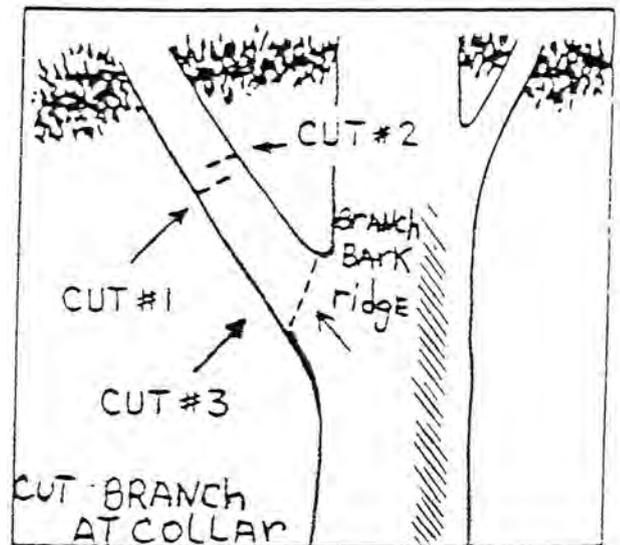
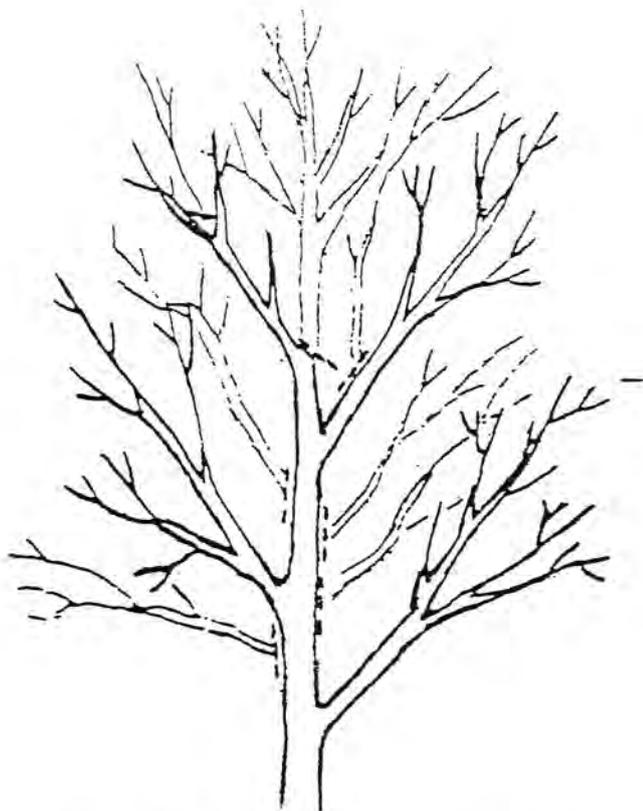
Most people worry about spring pruning, due to "bleeding" of certain species of trees--maples, elms, walnuts. However, the drying of the surface cells of a wound is fairly rapid, and when you consider that the "sap" lost through such a wound is only that which would have gone to the severed limb, physiological damage to the tree is negligible. Recent research has shown that spring leaf out and fall leaf drop are times when pruning should not be done.

Pruning is necessary for many reasons. Growth is controlled and dead wood is removed as a sanitary measure to eliminate diseased limbs and to remove hiding places for insects and decay. Weak crotches and other malformations must be removed. Limbs should be thinned out to eliminate dense shade and reduce wind resistance. A competent arborist can lower the crown or height of large trees, taking care to preserve the natural shape.

Pruning can be used to reduce the height and spread of a tree, as seen in figure below (left) by cutting branches to lower laterals (Drop crotching). Some limbs may be removed completely. A thinned tree retains its natural shape and is less subject to vigorous watersprouts than a headed or topped tree.

Bleeding of pruning wounds can be heavy on certain trees such as Sugar Maples and Elms. Bleeding of susceptible trees can be minimized if the cuts are small (less than 3 inches in diameter) and are made in the fall and early winter. Bleeding is much more likely if severe pruning is done just before growth begins in the spring. No harm occurs to the tree if bleeding takes place, however, if heavy and persistent, it may cause bark injury below the pruning cut.

If large limbs need to be removed or if pruning is required beyond reach, secure the professional services of an arborist. Arborists are trained in the art of pruning to retain the natural beauty of trees. To be sure you are hiring a qualified professional make certain that they are members and their work complies with standards set forth by the National Arborists Association and International Society of Arboriculture.

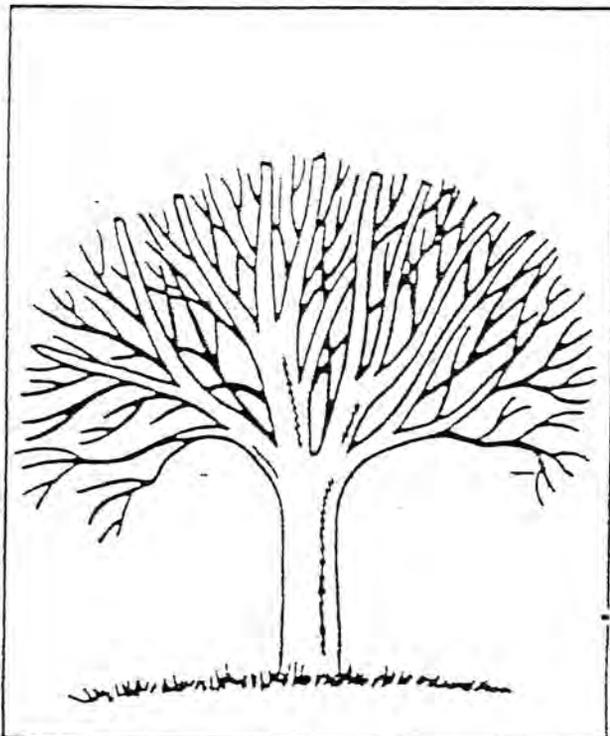
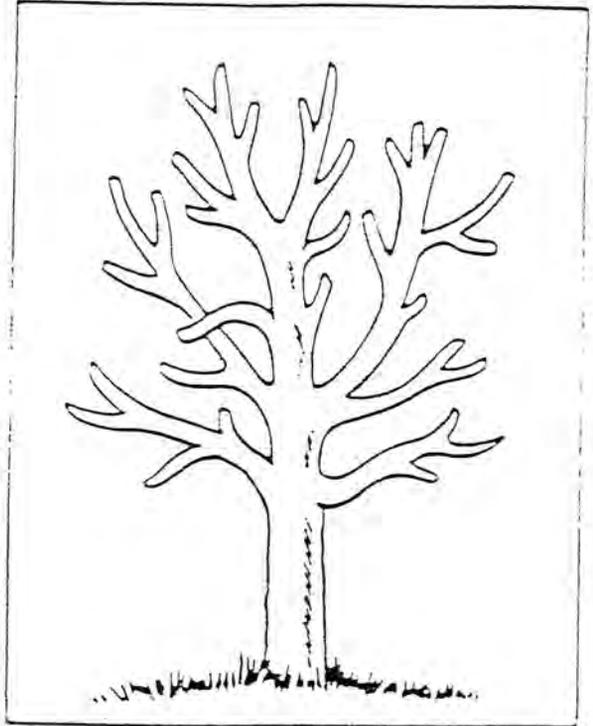


MAKE CUTS IN ORDER SHOWN

FINAL CUTS - All final saw cuts should be made to the collar with the parent limb. Stubs are not only unsightly but they are subject to decay which will work back into the tree. Stubs also promote sucker growth.

Thinning-out can be used to control height and it helps retain natural shape.

POLLARDING - This is done by stubbing off major limbs until the tree assumes the desired shape. The result is not only unsightly, but a multitude of fast-growing suckers will sprout from the stubs and this will soon result in a line clearance problem more acute than before. The stubs are quite likely to fall victim to decay or disease. In addition, this method of pruning attracts much unfavorable public attention and is to be used only for exceptional conditions.



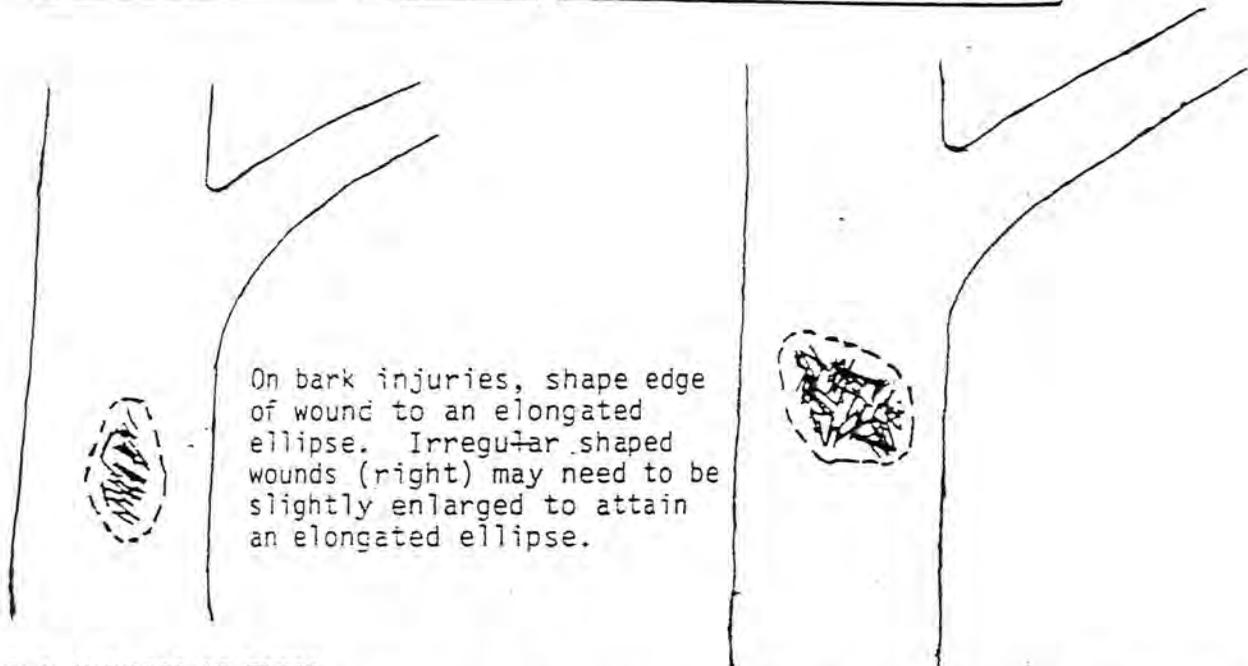
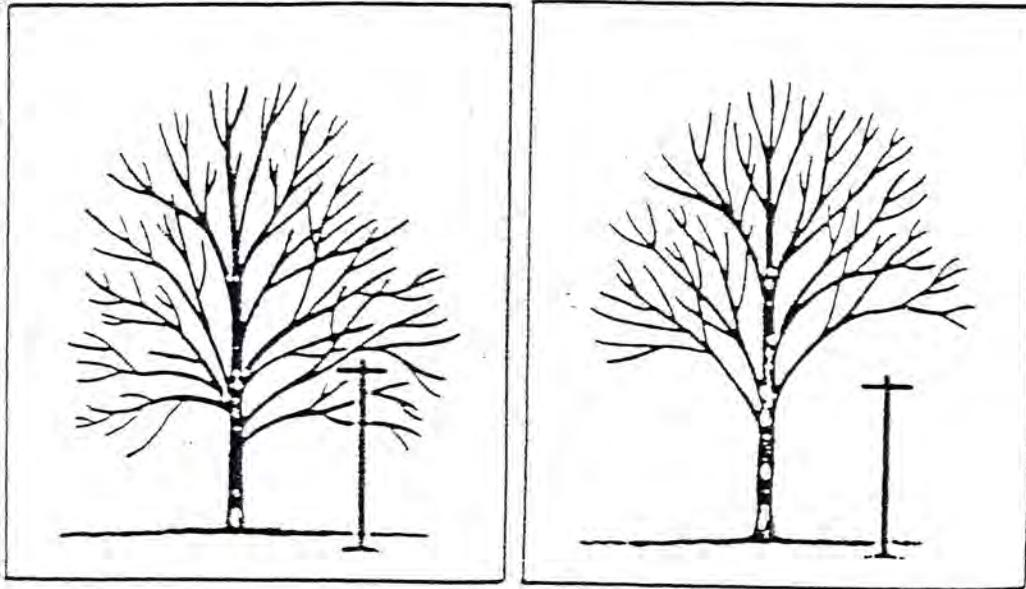
SHEARING OR ROUNDING OVER - Rounding over is done by making many small cuts so that the tree top is sheared in a uniform line. This creates an unhealthy tree condition and results in a rapid regrowth directly back toward the electrical conductors.



Topped trees produce vigorous water sprouts

Topping (heading) is, unfortunately, the most common method of reducing tree size. While more rapid than pruning the results are, in most cases, much less desirable. Regrowth is vigorous and upright from the stubs. The new branches form a compact head, broom-like terminals, and may be weakly attached to the older branches.

UNDER PRUNING - Under pruning involves removing limbs beneath the tree crown to allow wires to pass below the tree. To preserve the symmetry of the tree, lower limbs on the opposite side of the tree should be removed also. All cuts should be to the branch collar to avoid leaving unsightly stubs. The natural shape of the tree is retained in this type of pruning and the tree can continue its normal growth.



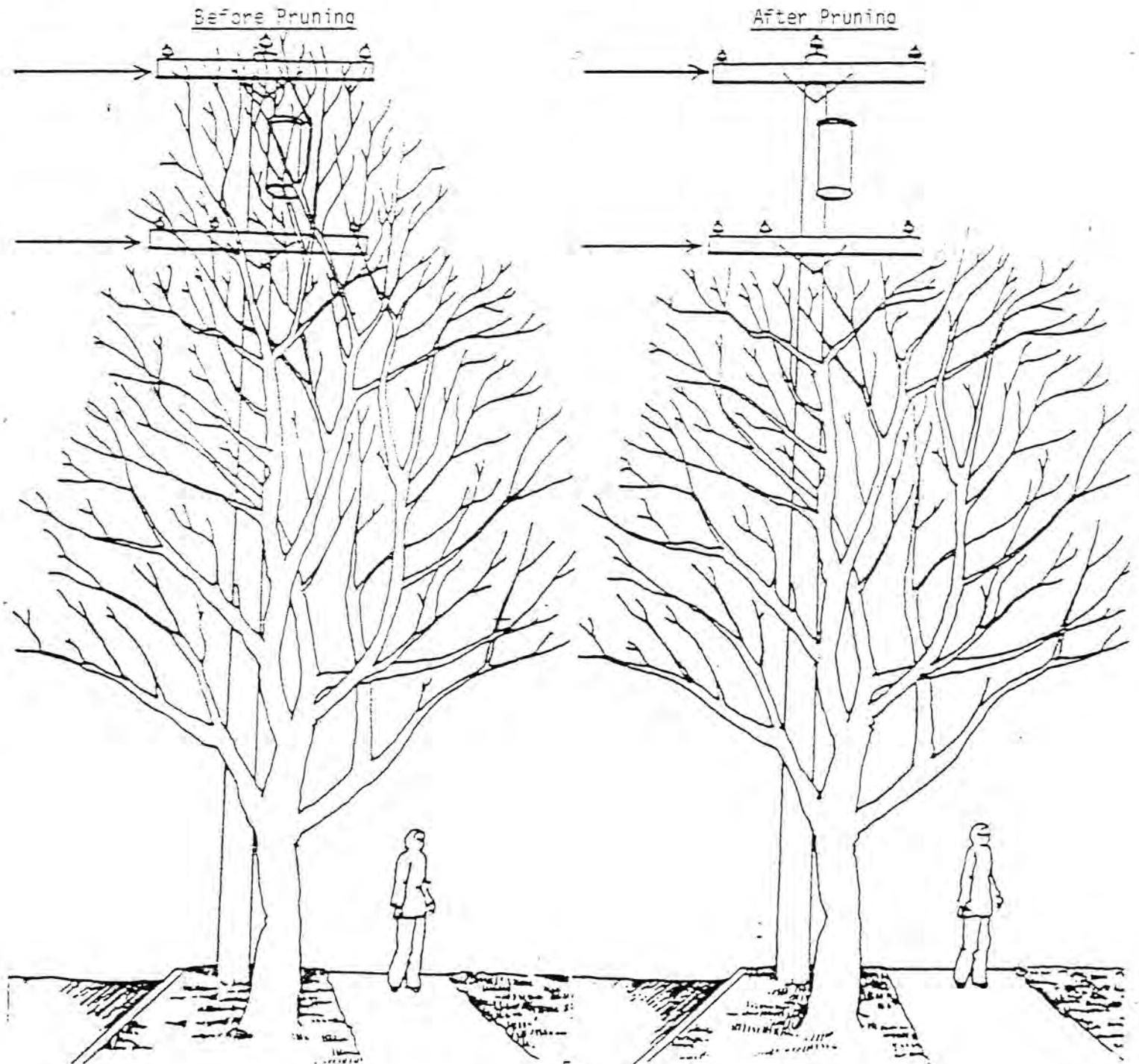
REPAIRING INJURIES OF TREES

Injuries to trees, which expose wood or kill bark, allow insects or disease organisms to enter the tree. Proper treatment protects the tree and promotes faster callus closure.

BARK INJURIES

If bark has been crushed or knocked from the trunk, remove injured bark and shape the wound. Tree wound paints have been shown to be ineffective in protecting tree wounds. (Tree paint may be used for cosmetic purposes.) Cut away damaged bark and remove isolated scraps of bark from the wound area. For fastest healing, shape the edge of the wound as nearly as possible to an elongated ellipse. (illustrated above)

NATURAL PRUNING - Natural pruning is a method by which branches are cut to collar at a suitable parent limb back toward the center of the tree. This method of pruning is sometimes called "drop crotching" or lateral pruning. Large branches should be removed to laterals at least one-third the diameter of the branch being removed. Natural pruning is especially adapted to the topping of large trees where a great deal of wood must be removed. In natural pruning, almost all cuts are made with a saw and very little pole pruner work is required. This results in a natural looking tree when finished, even if a large amount of wood has been removed. Natural pruning is also directional pruning since it tends to guide the growth of the tree away from the wires. Stopping or pole-clip clearance, on the other hand, tends to promote rapid sucker growth right back into the conductors. The big factor to remember is that natural clearance does work and that two or three pruning cycles done in this manner will bring about a solution for both the utility and the tree owner. Most shade trees lend themselves easily to this type of pruning. Elm, Norway Maple, Red Oak, Red Maple, Sugar Maple, Silver and European Linden are our most common street trees and these species react especially well to natural clearance methods.

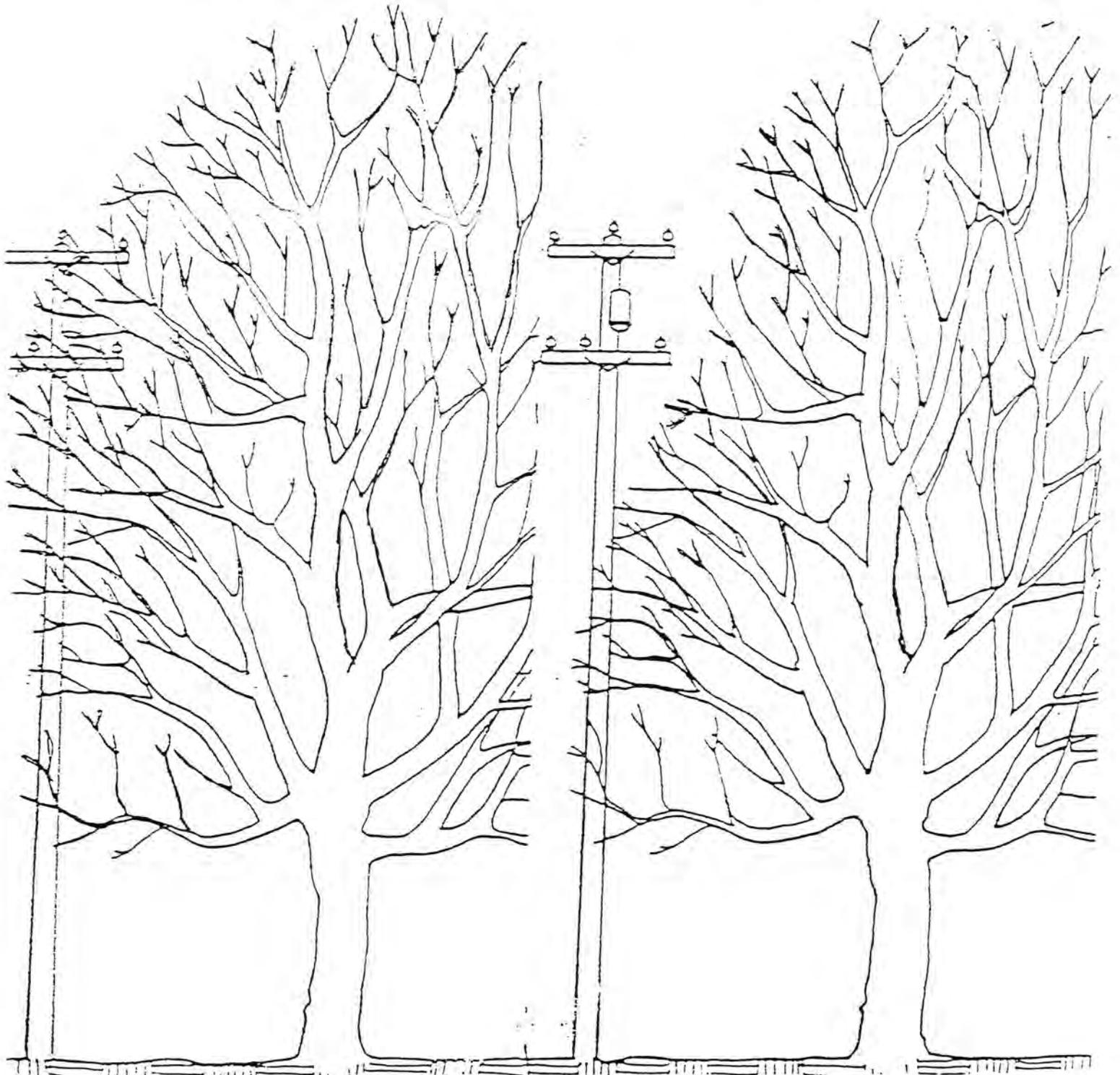


Side-Pruning -

Side-pruning is shortening back or completely removing side limbs that project toward conductors located to one side of the tree alignment. Avoid cutting so deeply that an unsightly notch is left. Limbs above and below a side notch may be partly shortened back to a side branch to reduce the notched effect and improve conductor clearance.

Before Pruning

After Pruning

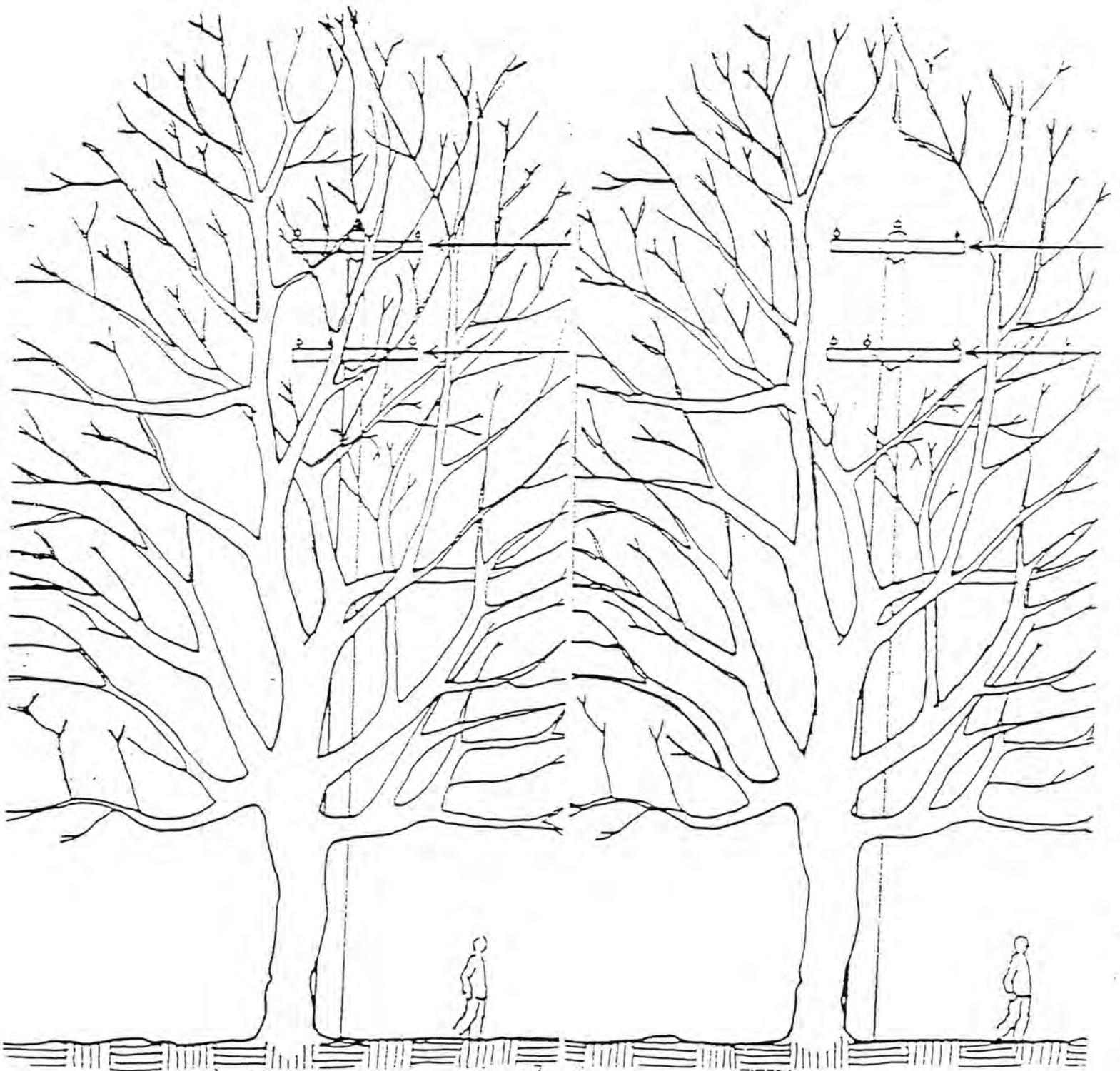


Through-Pruning-

Through pruning is the removal of limbs and branches from inner tree crowns to make room for the passage of conductors. This type of pruning is best suited to service drops and secondary. It may be used for primary conductor clearances where conditions do not permit top-, side-, or under-pruning.

Before Pruning

After Pruning



TEXT BOOKS

TREE MAINTENANCE
Fifth Edition
P.P. Pirone

ARBORICULTURE - Care of Trees, Shrubs, and Vines in the Landscape.
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