

An Illustrated Guide for Forest Stewardship



MANAGING FORESTLANDS IN WASHINGTON

COOPERATIVE EXTENSION



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Managing Forestlands in Washington

We have prepared this guide for woodland owners and forest managers or consultants to use together. While some management aspects apply primarily to larger forest areas, we have included the principles for discussion purposes. Many illustrations of desirable forest practices are taken from larger forests.

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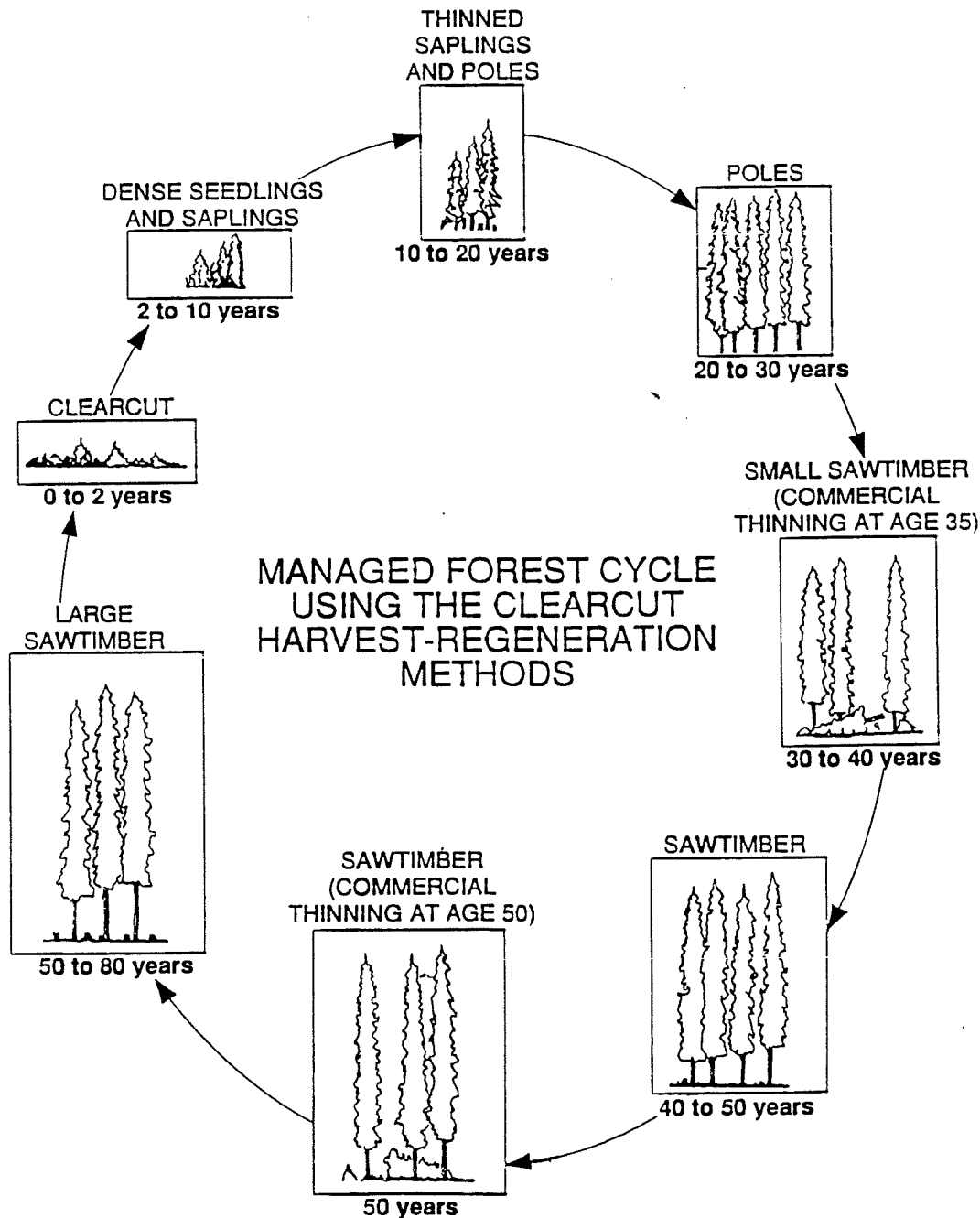
Table of Contents

	Page
Managed Forest Cycle	3
Management Plans	4
Practical Economics of Woodlot Management: A Dozen Hardnosded Rules	5
Site Preparation	9
Reforestation	12
Precommercial Management and Intermediate Harvests	17
Stand Management	18
Harvest/Regeneration Systems	27
Access Roads	31
Special Problems	34
Commercial Products from the Forest	43
Types of Timber Sales	46
Timber Sale Agreements	47
Marketing Woodland Products	51
Terminology for Forestland Owners	55

Managed Forest Cycle

Forest management is the application of scientific, economic, and social principles to a forested property to achieve stated goals. One such goal could be the production of wood or wood products.

- *Uneven-aged management* is achieved by periodically removing the oldest trees of a stand or management unit to maintain a specific age or size-class distribution on the property.
- *Even-aged management* is designed to remove all trees of a stand or management unit at once, or over a short period of time. It will produce trees that are relatively close in age.



Management Plans

You, as the owner, may choose to manage for timber, wildlife, watershed, recreation, or multiple use—a combination of these goals.

A woodland owner must first decide what to manage for, then how. A *forest management plan* is a long-term guide to outline what you have, and the steps to reach your goal.

A plan can vary from a brief statement to a highly detailed document, depending on your goals and the complexity of the management situation. Good plans are flexible in order to take advantage of changing owner objectives, conditions, and markets. Efficient planning saves time and money by helping you avoid costly mistakes.

Elements of a Management Plan

- **Ownership information.** Identify land location and landowner name, address and telephone number. State the location and acreage your management plan will cover. List the name, organization, address and telephone number of the forester preparing your forest management plan. Show date of plan preparation.

- **Existing conditions.**

Land description. Include slope, aspect, elevation, site productivity; indicate designated forest land, open space, or highest and best use. Include forest land tax rules, erodability of soil, climate, access, habitat type, property boundaries, soil description, and any other information pertinent to treatment decisions.

Forest resource description. Record stand age and size classes, cover type, species composition and distribution, trees per acre or basal area, animal damage history, disease history, regeneration species, growing stock volume per acre, condition of stand, growth information, seedling mortality, drainage, windthrow hazard, plant competition, and other pertinent information.

Local markets. List products desired, location, transportation routes, and equipment required.

Other forest resources. Describe existing wildlife, recreation, water, and grazing resources. List conservation alternatives.

Current management. Record current practices, if any.

Forest Management Act/Regulations. List any which apply.

Sources of assistance.

- **Management objectives.** Outline land management objectives. Incorporate landowner needs and interests within the land's productive capabilities.

- **Silvicultural planning.** Describe planned silvicultural treatment. Outline the treatment prescription, including con-straints such as streamside management. Explain how the prescription is applicable. Develop a timeline for planned treatments. Show reasons for prescriptions, and keep a record for future use.

- **Anticipated results.** List anticipated results. List the expected brush control and maintenance requirements of stands. What road or skid trail construction or erosion control needs will arise? How will the results fit in with landowner objectives? What will you need to do to protect the resource from fire, trespass, and erosion?

- **Recording map.** Develop a recording map. Show the location of major points in the management plan, including ownership boundaries, treated areas, future treatments, important physical and cultural features. Include a legend, showing map scale, relation to main roads, and to nearby towns and markets.

This list is a starting point for landowner and forester.

PRACTICAL ECONOMICS OF WOODLOT MANAGEMENT: A DOZEN HARDNOSED RULES

By Lloyd C. Irland

The financial practicalities of managing a woodlot are easily obscured in financial calculations and tax gobbledygook. Foresters have done little to help landowners understand the basics of making decisions about their woodlots. I cannot remedy that situation with just this article. But I will help you think about your woodlot as an asset in your personal portfolio and then provide a dozen "hardnosed rules" to guide you in handling that asset. The advice I offer applies to properties of all sizes.

I will assume that you have a clear view of your financial and other goals, and of the constraints within which your plan will be developed. I will omit tax considerations here, but you should deal with them in framing your overall strategy.

Few owners hold their land for timber growing alone. But regardless of your principal motive for ownership, it is reasonable for you to seek a financial return. And it is sensible to maintain the woodlot so that anytime you need to sell, it will bring the best price.

So use the dozen rules to the extent that financial considerations are important to you. They are not meant to suggest that purely financial considerations should dominate. That is up to you.

Foresters commonly tell us that the investment yields on forest landownership are low and the returns long deferred. But how low is low? What alternative investments provide a reasonable comparison? In occasional bull markets or periods of falling interest rates, conservative portfolios can appreciate 30 to 40 percent in a single year. But look at the long haul. Experts agree that few investors in securities can expect to reap, after taxes and inflation, more than three percent per year over any long period of time.

For example, an unpublished report by John Hancock Insurance Company showed the following annual real pretax returns from 1955 to 1983:

Common stocks	6.2%
Long-term corporate bonds	-0.3%
Index of timber prices	9.1%

Considering that timber can have modest tax advantages compared to the other investments, this is not bad at all. (*Caution: these figures may not hold true in your geographical area and may not recur.*)

Note that the 29-year period from 1955 to 1983 is not too long for people saving for college education, retirement, or estate building. Estate building? Yes. A recent survey showed that many southern timberland owners consider estate building to be a principal motive for owning and managing forest land. So much for the idea that forest owners won't take the long view.

We can put the doubt about long-term investments in perspective by noting that by the end of 1984, 39 million people had opened Individual Retirement Accounts (IRAs), which tie up money at least until age 59. Of course, IRAs offer a nice tax break for many taxpayers, but the point is that long-term thinking is in fact widespread in the U.S.

Lloyd Irland was State Economist with the Maine State Planning Office when the article was originally published in American Forests, January/February 1987. He wishes to thank Bud Blumenstock of Maine Cooperative Extension for his help. Currently, Dr. Irland now heads The Irland Group, Forestry Consultants, The Weston Building, 7 North Chestnut Street, Augusta, Maine 04330, (207) 622-4023. He has graciously allowed us to use this article.

1. Do Early Estate and Tax Planning

Most forest owners are over 40. For this reason, their forest management could also be considered estate planning. This does not mean that yields are not possible during your lifetime. But don't work hard to improve a woodlot that you care about and then blow it by lackadaisical estate planning. As my attorney says, "None of us is getting out of this alive." If your estate plans are not in good order and up to date, revise them now.

Likewise, obtain early tax advice on structuring your books and your timber sales so you'll benefit from tax provisions that may apply to you.

2. Hire the Best Forester You Can Find

You need a good relationship with a forester you trust. Perhaps your local state forester helps with advice, but typically, public foresters have limited time and only offer specific services. You'll probably want to work with a consultant at times—regularly if you have a large property.

Before hiring a forester, consider a few things. Previous customers of the forester should give strong recommendations. Get referrals. Check around a bit. Walk over some other woodlots the forester manages. Do you like what you see?

The forester should understand and believe in the investment potential of forestry. Foresters are taught in school about the workings of long-term investments.

He or she should work for your best interest. If the forester has interests or friends in wood-procurement functions, that may influence his/her advice to you. Be aware and make changes if unethical conduct seems likely to occur. Don't depend on forester

registration laws to protect you. Some states don't require foresters to register, and enforcement is awkward in those that do.

Explain your plans to your forester in clear terms. Merely saying you want to do "what's right" is not enough. If you want the place to look like a park and be a haven for birds, say so.

Some foresters may try to put words in your mouth. Resist this. It's your forest. Decide what you want, then direct your forester to do it.

Make sure the forester will provide a long-term management plan that is readable and understandable. Don't just buy a timber inventory (a calculation of timber volume, usually by species and diameter class) and call it a management plan.

You'd use great care in choosing or dismissing an attorney, accountant, or stockbroker. Doesn't your woodlot—a major portfolio asset—deserve similar care?

3. Ignore the Opportunity Cost of Land

Many calculations show investment returns of forestry practices and include land as a cost. If you plan to keep the land, its cost (and taxes) should not be charged against incremental investments in timber treatments.

If you do such calculations to aid in comparing possible investments in your lot, consider interest or debt service and real estate taxes as fixed costs and omit them.

Of course, you should keep an ongoing tally of how your costs and returns match up, which leads to the next rule.

4. Keep Separate Books on the Woodlot

Think of your woodlot as a business. Keep a separate set of books on it, even a separate checkbook. When timber-sale time comes, the IRS will look for records. Without solid documentation, you won't be able to support your returns.

5. Value Your Portfolio

With the aid of your forester, estimate the worth of your woodlot. If you don't have an inventory, use typical figures for your area. You may use typical forestland sale values, but you should realize that they may understate the value of the timber.

Make a portfolio summary showing your principal assets—home, securities, retirement funds, and the woodlot. What proportion of the total is the woodlot? Is the woodlot getting enough attention based on its position in the portfolio? For most woodlot owners, the answer is no. Otherwise, foresters would do a good deal less hand-wringing about the "small landowner problem."

6. Compete With Excellence

Since most woodlots have infrequent timber sales and minimal growth and inventory data, it may be hard to tell what your woodland asset is now earning. It's a lot easier for your stocks.

But don't be discouraged—look ahead. Identify a few well-managed properties, large and small, in your region. Ask your forester what they are worth in annual growth per acre and annual revenue, and learn what their costs are, in rough terms.

Pick well-managed properties, and set your own management goals to compete with such

excellence—whether you define it in terms of deer per square mile, aesthetic appearance, or net return per acre. Think of inventory buildup as part of the return, too.

7. Eliminate Some Growing Stock

Your woodlot may be overstocked in terms of volume per acre for its age, which means you're not getting the best possible growth rate on high-value trees. It may have too many cull trees or trees of low commercial or wildlife value. Many woodlots have too much mature and overmature timber and not enough young timber. The typical woodlot suffers from all three ailments. In addition, most lots have a dearth of quality sawtimber of desirable species.

A woodlot with too many mature and overmature trees is poorly positioned for a steady sustained yield over time. Of course, your timing of harvest will depend on many considerations, including taxes. But your options are greatest if you maintain a smaller growing stock with a more or less balanced distribution of age classes.

A lower growing-stock level with more young trees, protects you against losses to disease, insects, or windthrow. Try to maintain a balance of species that are suited to the site. In most instances, you will not be able to achieve a mathematically perfect, uniform balance of age classes, even in a few decades. This is not important; the key is to use a right balance of age classes as one standard in evaluating how a given set of management practices will affect the future productivity of the lot.

If you are a typical owner of a small forest tract, analysis of your portfolio will tell you that much of your wealth is tied up in timber. So for balance, you may

wish to reduce inventory somewhat. In reducing inventory volume, work toward improving, not degrading, timber quality.

8. Manage for Quality

The owner of a small forest property may be better positioned to manage timber for quality than the owner of a large, sprawling, remote one. It will probably be closer to markets, and its small size will allow you to really know your trees and closely supervise their marketing and cutting.

Look at the price differences between fuel, pulp, sawlogs, and veneer in your area. This will convince you that adding quality can give you a powerful financial boost.

9. Self-Finance Improvements

The good news here is that many woodlot owners can self-finance improvements like roads, thinnings, and planting with revenue from the initial cuts. The boom in fuelwood markets has been a major help in this regard. Most woodlots have little timber left in the high-value sawtimber classes, and you may want to save yours for later. This can be done without degrading quality or future productivity.

The revenue to be generated from these early cuts should be determined by the overall long-term strategy, the balance sought between timber and other benefits, and a planned rate of progress toward a more balanced distribution of age classes.

10. Don't Overspend on Inventory

All too often, your forester will advise you to buy a complex timber inventory before undertaking active management. This has a ring of sense to it, but few foresters seem trained to balance inventory spending against the actual information needs of a given moment or the returns that inventory will bring.

For example, if one stand obviously needs thinning, and yet another is decaying because of overmaturity, treatment decisions will not depend on an inventory of overall volumes. They will depend on careful examination of the stands in developing prescriptions and on the use of sound guidelines in setting planned residual stocking for the post-cut condition.

As your program develops, you are likely to want an inventory. And for depletion accounting on tax returns, you may need one. But it's best to fund it out of woodlot revenues if you can, and to know exactly what you're buying and why. On a larger property, or if you can easily afford it at the outset, an initial inventory is of course useful and gives you a good baseline for documenting progress over time.

11. Identify and Rank Your Treatments

As you write up a schedule of things you want to accomplish in the next 10 years or so, scrutinize your stands for opportunities, and make a list of options. Group them into three categories: treatments yielding net cash, those that will break even, and treatments requiring a net investment. To the extent possible, try to fund the third group with returns from the first. Proceed in an orderly way to do all the things in the first two categories.

The result will be—at no net cost other than your own time—a much improved woodlot. Its volume and value growth will improve. Your net cash investment is zero, so who cares about rates of return or how long it takes? The typical woodlot of any size contains at least a few opportunities that will yield cash or break even. If more land-owners would study their treatment options, it would put our forests into far better condition for the future—and cost nothing. And each of the options would significantly increase the earning power of our woodlots.

It's the third category for which you'll need to sharpen your pencil. You may have cash limits or other factors that keep you from making net investments. So look at opportunities with different payback periods and rates of return, and invest in the best of them. Usually, some can wait. Or market trends or other considerations may suggest deferring them.

You can carry out elaborate calculations, accounting for your own tax circumstances, on these investments. Microcomputer programs are available to facilitate such operations. If you don't enjoy this, don't do it. Use your common sense, and get expert advice.

12. Sell Your Timber With Care

Most timber from small woodlots sells for far less than it should. People who exercise excruciating care in selling a used car, a house, or securities will dispose of standing timber in an incredibly casual manner. It always costs them.

A crop on which you've been paying taxes for decades deserves care, thoroughness, and ingenuity when market time comes. Some foresters are good at this. But don't be reluctant to do some checking on your own. Spadework can sometimes undercover profitable markets

for small volumes of particular woods—sometimes at a distance. Veneer logs regularly travel 150 miles or more in New England, and a lot of timber crosses international borders. Also for small volumes, a few neighbors might get together to bring an operator to their area to collect a few modest volumes from each.

Managing your wood lot can be as simple or as complex as you wish to make it. But it boils down to sound business management, and giving the woodlot the amount of time it deserves should be based on its importance among your personal assets. Better management will cost more in timber and in fees, but it will bring in more revenue over time. Even in years when you gain no financial reward from your woodlot, you'll have the satisfaction of seeing the results of a job well done.

Site Preparation

Site preparation is work done to prepare land for tree planting.

Use site preparation

- on existing forests following harvest to remove slash and reduce the danger of wildfire;
- where natural regeneration from existing trees is planned, but the seedbed is poor;
- where cleared sites are needed to plant seedlings;
- where browsing livestock or wildlife have damaged new seedlings; or
- an overgrown area of brush, with or without a tree overstory.

It can be accomplished in several ways. Tractors may be needed to clear away large areas of brush or slash, or to haul dead and down timber from the site.

Thick vegetation may compete with newly planted seedlings for nutrients, water and sunlight. It can be eliminated by spraying with herbicides, tractors, or burning. When planning to use fire for a prescribed burn, obtain proper permits from the Washington Department of Natural Resources. Have fire equipment and an adequate water supply on hand.

Clearing brush by hand can be used on small or steep areas. Turning or scraping vegetation to bare soil for planting is called *scarification*.

Important considerations

- Timing is critical. Herbicide or fire must be applied under proper weather and seasonal conditions. Heavy equipment used during the rainy season can permanently damage the land and watershed.
- Decide which tree species you want to manage for before preparing the site.
- Know soil and site capabilities to withstand different preparation methods. Heavy equipment may leave tracks that can cause erosion and degrade water quality. Try to follow the contours of the land. Use equipment carefully.
- Study the extent of slash and debris or competing vegetation. Remove slash promptly to prevent disease or insect spread.
- Check on equipment availability.
- Estimate the total cost. Treating a larger area could reduce per acre costs.
- Follow permit restrictions. If herbicide sprays or burning is done carelessly, you may be liable for environmental or property damage to streams, ponds, or nearby homes.
- Does your plan fit within the Forest Practices Act? You will need to notify the Department of Natural Resources.



Use herbicides, followed by a broadcast burn, to remove brush and hardwoods before planting conifers.



Mechanical scarification used here will prepare this site before planting.



Piling and burning logging slash reduces fire hazard and the potential for beetle infestation. Above, too much soil is being moved with the slash.



Piling and burning logging slash reduces fire hazard from fuel buildup, and the potential for spread of insects or disease. Avoid moving too much soil with the slash. Keep a slash pile fairly compact. Always have proper permits and fire equipment on hand before burning slash.



Applying herbicides by helicopter can be more economical on large woodland areas.



A backpack sprayer is efficient for smaller acreage. Follow all label requirements and wear protective clothing.



A forester may use a drip torch to burn slash on a calm day. A specialist can use carefully managed fires under certain weather conditions to remove understory vegetation and slash from a stand of trees. This method prevents fuel buildup.

Reforestation

Reforestation is renewing through planting, seeding, or natural regeneration. Planting tree seedlings improve a stand of trees, conserve soil and moisture, beautify an area, or protect a watershed.

Use reforestation

- To replant forest sites after harvesting;
- To establish a stand of trees on brushy areas, tilled fields, or idle land capable of supporting trees;
- To increase the number of trees per acre on underutilized forest land or on converted Christmas tree stands;
- To improve a young tree plantation where many seedlings from the original planting have died;
- To supplement natural regeneration or to change the next crop species beneath existing forest trees.

Decide how many seedlings to order for desired stocking. Trees planted for timber production are normally planted 9 to 12 feet apart (400 trees/acre).

Seedling nurseries supply planting stock as bare root plants, or as plugs, which come in plastic or styrofoam cylinders. Keep the seedlings cool before planting so they do not dry out. Properly packaged seedlings can be sorted for up to 1 week in a shady location, at 34 - 40°F. Prevent freezing and high temperatures. If you must delay planting longer than 1 week, refrigerate seedlings at 34 - 36°F. Plant dormant seedlings during periods of adequate soil moisture in cloudy weather, when the soil is free of snow and frost.

On rocky or steep slopes, seedlings are planted by hand. Use mechanical equipment on large areas of fairly flat or gently sloping land with good soil. Be sure that site preparation is adequate for the species you wish to plant. Grass or brush compete with seedlings for nutrients and water.

At the planting site, keep seedlings out of direct sunlight. Place a large styrofoam container, or cooler chest of seedlings in the shade until ready for use. Planting crew members can transfer seedlings to insulated pouches or backpacks as needed. Dip seedlings in water for 1 minute before placing in carrying bag. Cover seedling roots with wet peat moss or leaf compost.

Remove one seedling at a time from the carrying bag and plant immediately.

Try to place each seedling where it will receive natural afternoon shade from a rock or tree stump, especially in areas which become hot and dry in summer, such as a south-facing site. You may need to place shingles or small boards to shade seedlings.

Important considerations

- Select seedling stock that matches the tree seed zone and elevation for your site.
- Select a suitable tree species for the soil and site conditions.
- Select seedlings age and size with the best chance of survival on your site.
- Will the trees you are planting be marketable, or enhance the marketability of your site? Will they benefit wildlife?
- Make sure of the time of the year you expect to plant. Will planting stock, labor and equipment be available then?
- If you are reforesting a harvested area, try to replant shortly after timber or crop harvest, before weeds and competing tree species take hold.
- Try to plan around local weather conditions. Plant on a wet, rainy day!
- Plan for temporary cool or refrigerated storage before planting, where seedling stock will not dry out.
- Have you planned for plantations maintenance?
- If you plan to use mechanical equipment to cultivate or treat the stand later, allow for the width of equipment in your spacing.



Planting equipment includes hand tools for rugged areas, above, or machinery for flat areas, below.





This hot, dry clearcut site offers little protection for tree seedlings. Planting in the shade of existing stumps (microsite selection) can improve the chance of seedling survival.

Remember to figure total planting cost, cost sharing, and tax incentives.

Will you need to add rodent, grass or brush control to your management plan to protect the seedlings until they become established?

Does your plan fit within the Forest Practices Act?



Choosing a location that will provide afternoon shade for each seedling and maintain desired spacing involves microsite selection.

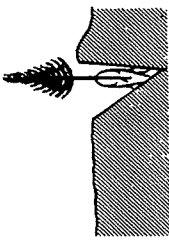
Bare root (left) or container grown seedlings (right) offer established root systems.

Plant Your Trees Right

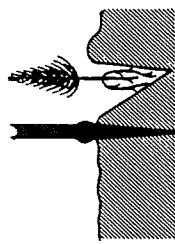
Planting with Bar (Usually a 2-person operation)



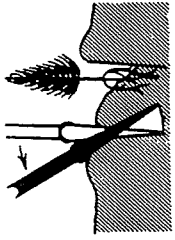
1. Insert bar at angle shown and push forward to upright position.



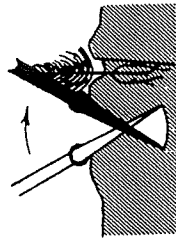
2. Remove bar and place seedling at correct depth.



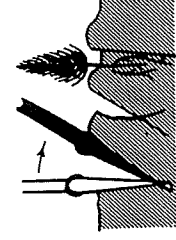
3. Insert bar 2 inches toward planter from seedling.



4. Pull handle of bar toward planter firming soil at bottom of roots.



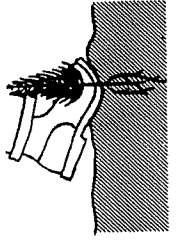
5. Push handle of bar forward from planter firming soil at top of roots.



6. Insert bar 2 inches from last hole. Push toward tree.

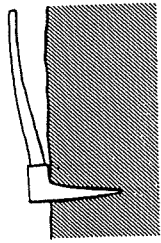


7. Fill last hole by pressing with heel.

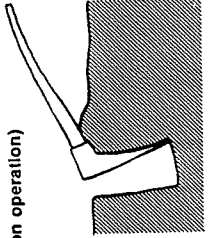


8. Firm soil around seedling with the feet. Use heel or ball of foot, depending on convenience.

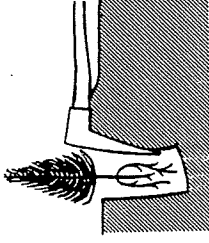
Hole Planting with Hoe or Mattock (Usually a 1-person operation)



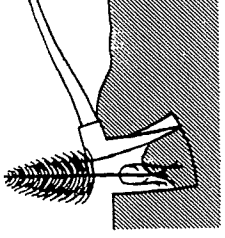
1. Swine hoe to get full vertical penetration.



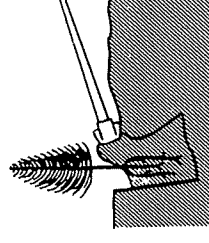
2. Lift handle and pull to widen hole.



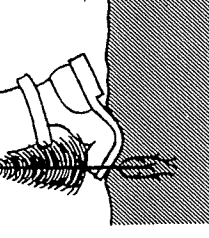
3. Place seedling while using hoe to hold back soil.



4. Use hoe to pack soil at bottom of hole.

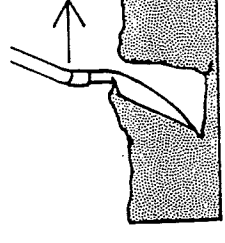


5. Use hoe to pack soil at top of hole.

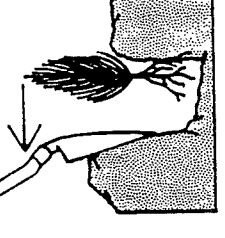


6. Firm soil around seedling with feet.

Planting with Spade or Shovel (Usually a 2-person operation)

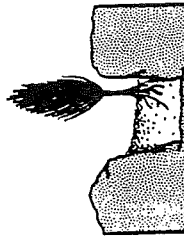


1. Insert shovel vertically with blade reversed, push handle forward, then pull soil back and out of hole.

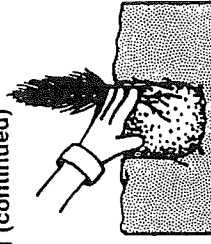


2. Straighten back of hole and insert tree at proper depth.

Shovel Planting (continued)

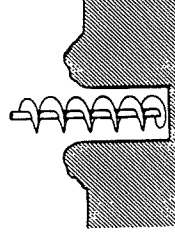


3. In first packing, fill hole half way with soil and place tree in proper position.

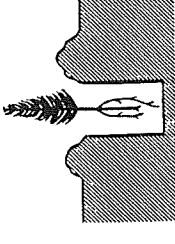


4. In second packing, fill the hole completely, pack with hand and cover surface with mulch of loose soil.

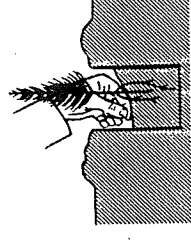
Hole Planting with Auger (2-person to 5-person operation)



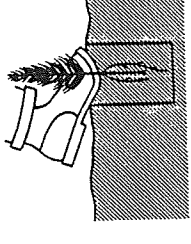
1. Auger hole to desired depth. Extract auger at slow speed to avoid scattering soil needed for backfill.



2. Hold tree at proper depth in hole.



3. Fill hole half full and firm soil with hand.



4. Finish filling hole and firm soil around seedling.*

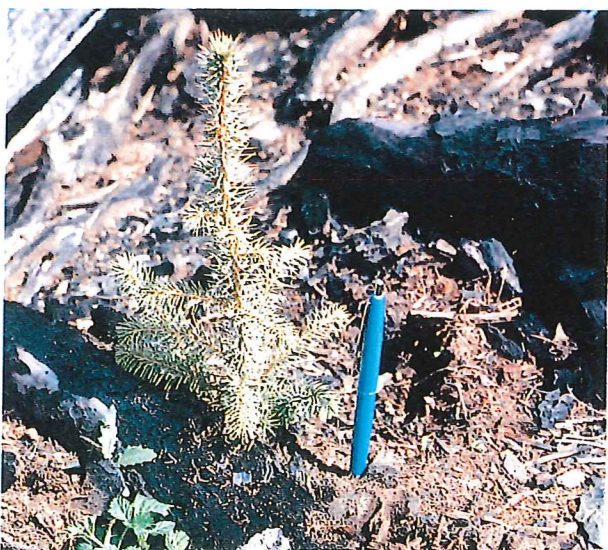
*Use foot or hand only to firm the soil (not to compress it) or you may damage the roots, particularly in a rocky soil.



Placing cardboard around the base of a seedling, left, or careful use of herbicides, center, are other methods of controlling competing species. Seedlings may be obtained from nurseries, right.



Cultivation can control competing vegetation.



A healthy, well planted Douglas-fir seedling.



A healthy, established Douglas-fir plantation.

Precommercial Management

Cutting or thinning a stand before any trees are large enough to sell is called *precommercial management*. Most commonly, this operation involves thinning and pruning an overcrowded stand where trees compete for light, moisture, or growing space. Schedule a precommercial thinning before crowding affects diameter growth of crop trees, or when tree crowns begin to overlap.

Pruning will improve the appearance of a stand, reduce the fire hazard, and may increase the value of the timber at harvest.

Precommercial thinning allows the landowner to select for individual trees or species, and increase diameter growth, remove competing vegetation, enhance the stand aesthetically, and improve the quality of remaining crop trees. As competing species are removed, conifers are "released" to take advantage of light, moisture and nutrients.

Use different colors of paint to mark trees to be cut, and those to be left. Stack cut trees in a deck near an access area for cutting into firewood or chips. Pile and burn unusable branches or slash away from the leave trees. Removing the slash during cleanup prevents fuel buildup that could feed a forest fire.

Intermediate Harvests

Cutting some commercially valuable trees to maintain or improve growth of the remaining trees is an *intermediate harvest*. Trees that have lost the battle for light and nutrients to neighboring trees will no longer grow vigorously. They may become targets for insects or disease. Use an intermediate harvest to remove these trees before they die or decay.

Healthy trees should have 40% of their height in live green crown. Overcrowding reduces both diameter and crown growth. Commercial thinning provides income and reduces crowding. Use the intermediate harvest to remove rough-limbed, poorly formed, damaged, diseased and insect-infested trees. Also remove those trees with poor vigor, which would probably die before the next harvest.

Mark trees clearly for "cut" or "leave." Don't remove the "best" trees in the stand, which still have good growth potential. Plan skid trails to avoid damage to main crop trees which are to be cut. Plan the harvest to take advantage of equipment and markets, road access and soil conditions. Check over Forest Practice Act rules and regulations and your property boundaries before harvesting. Plan your thinning operation with a consultant, and make sure the job is supervised. Don't forget to pile and dispose of slash as part of the operation, while equipment is still on hand.

Stand Management



Thinning: An Important Timber Management Tool

Thinning is the practice of removing some trees in an immature stand to increase growth of the remaining trees and the total yield or value of usable wood. You thin stands in which the trees are approximately the same age.

There are two methods of thinning—commercial and precommercial.

In commercial thinnings, the immediate value of the removed trees pays the thinning costs. If the value of the trees does not return enough to pay thinning costs, the practice is a precommercial thinning.

A good thinning program will meet one or more of six objectives:

1. To use or sell trees that would otherwise die and decay.
2. To redistribute the total fiber growth of the stand to fewer trees of higher quality, thereby increasing the value of *usable* fiber.
3. To increase the profitability of growing trees by reducing the investment in standing volume.
4. To provide money to pay off investments, such as reforestation, precommercial thinning, and other stand improvement activities.
5. To enhance nontimber use of the forest like grazing, wildlife, and recreation.

6. To provide more frequent *periodic* incomes.

In order to understand thinning, it is necessary to have some knowledge of how seedlings grow into mature trees and how groups or stands of trees develop.

Basic tree growth

Trees, as all living things, grow by forming cells. New cells form in the cambium (see figure 1), which is just inside the bark along the entire length and circumference of the tree stem, branches, and roots. Adjacent to this growth area is the transportation network for the tree.

Water and nutrients move upward in the xylem (sapwood), and food manufactured in the leaves moves downward in the phloem, a region between the cambium and the bark. If a tree is "girdled" (by cutting a notch all the way around the stem), the phloem is severed, and the tree will die unless the notch is bridged by new growth.

Except in the extreme tips of growing shoots, new cells formed in the cambium remain in place. The cambium layer moves outward as the tree grows in diameter, ever surrounding the tree, and forming new cells outside the old ones.

Thus, a nail driven in 5 feet above the ground in a tree with a 10-inch diameter will always remain 5 feet above the ground and will always be in the center 10 inches of the bole (trunk), no matter how large the tree grows. New wood will eventually bury the nail by growing around and over it.

Cells formed in the spring, when growth is rapid, have thin walls and produce wood that is light in appearance. Later in the summer when growth slows, cells have thicker walls, which appear to be darker. These alternate light and dark layers make up annual rings, which you see on a stump or log end.

A paired light and dark layer form an annual ring—the amount of wood a tree produces in one growing season. Annual rings enable you to trace the growth history of the tree.

Basic growth processes

Knowledge of three basic growth processes—photosynthesis, respiration, and translocation-assimilation—is important to understand thinning. You might also call these processes energy storage, energy release, and food transport-cell formation.

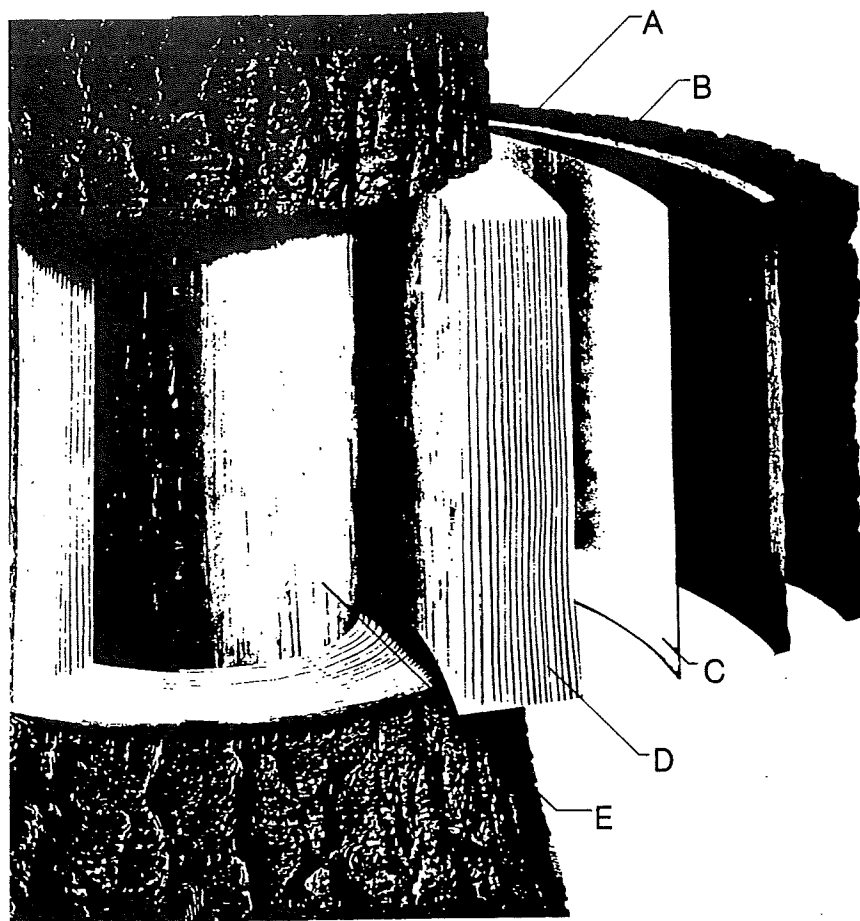


Figure 1.—Water and nutrients move in the sapwood. Immediately outside the cambium is the phloem, through which food is transported from the leaves to the rest of the tree. (A) The outer bark insulates the tree from extreme heat and cold, helps keep out rain, and protects the plant against insect enemies. (B) The phloem conducts food from leaves to the rest of the tree. Eventually, it becomes part of the tree's bark. (C) The cambium layer produces new bark and new wood annually in response to hormones, called auxins, that stimulate the growth of cells. (D) Sapwood is the pipeline for water moving from roots to the leaves. When its inner cells lose their vitality, they turn into heartwood. (E) Heartwood is the central, supporting column of the mature tree. Although it is dead, it will not decay or lose strength as long as a tree's outer layers remain intact. Illustration courtesy of The St. Regis Paper Company, New York, N. Y.

Energy storage (photosynthesis). This process converts carbon dioxide and water into carbohydrates—the basic food of the tree. Sunlight supplies the energy necessary for photosynthesis, which takes place in the leaves. The tree stores this energy in a form of reusable plant food. When water and nutrients are plentiful, light and temperature determine and limit the rate of photosynthesis.

Energy release (respiration). This process occurs in all living cells of the tree. It releases energy by breaking down the carbohydrate manufactured in photosynthesis. Although this breakdown and en-

ergy release is necessary, excess breakdown may occur and use more carbohydrate than necessary. Temperature is very important in regulating the rate of respiration.

Food transport-cell formulation (translocation-assimilation). Carbohydrates manufactured in the leaves must move out to all parts of the cambium so new cells can form and tree growth can occur. The carbohydrates must be assimilated into new cells. Transporting food and converting it to new cells requires energy. This energy is liberated from the food during respiration.

Summary. Photosynthesis, the energy storing process, is controlled by temperature and the amount of sunlight, water, and nutrients available to the tree. Temperature controls respiration which uses food to maintain the life processes of the tree and to release the energy necessary for growth. The amount of growth depends on how much energy or food is left over after the tree uses what it needs for respiration.

How thinning affects individual tree growth

Effects on the tree's environment. Removing some of the trees that compete for limited water and soil nutrients makes more water and nutrients available for the remaining trees. Thinning also opens the stand's crown canopy, making more light available for the remaining trees.

Effects on tree growth. The increased water, nutrients, and light that result from thinning increase photosynthesis in the remaining trees. More food is produced, making more carbohydrate available for new cell formation and growth.

The increased volume growth of individual trees normally occurs as diameter rather than height growth. With a wide range of tree density per acre, height growth is relatively constant for a given species and site.

The primary effect of thinning, therefore, is to increase diameter growth of the remaining trees. Effective thinnings will stimulate this growth within a few years.

Effect on species and age. The growth response to thinning varies with the age of the tree (more so for some species than others). Foresters have long observed that old and large trees do not respond to thinning as readily nor as dramatically as small, young trees. This is particularly true for species that are intolerant of shade.

Intolerant species require nearly full sunlight to thrive and grow. Tolerant tree species can survive and grow in low light levels, such as those that develop beneath a full canopy of intolerant species. Shade-tolerant species are more likely to respond to thinning at older ages.

The tolerance of common Pacific Northwest species varies:

<i>Tolerant</i>	<i>Intolerant</i>
Pacific silver fir	western larch
western hemlock	ponderosa pine
grand fir	lodgepole pine
western redcedar	noble fir
mountain hemlock	alder
spruce	cottonwood
<i>Intermediate</i>	
Douglas-fir	
sugar pine	
western white pine	

Thinning shock. There are exceptions to the generalization that thinning increases the growth rate of remaining trees. In dense stands of young trees, the trees may continue to grow at the same rate—or they might display up to 40 percent slower growth. This undesirable reaction to thinning is called *thinning shock*.

Shock occurs in trees with small crowns where the vertical crown length is less than one-third the total tree height (see figure 2 for an illustration of crown ratio).

Repeated thinning stimulates vigorous growth and produces crowns greater than 40 percent of the total tree height. Shock is unlikely in such stands.

What causes thinning shock?

There is no universally accepted reason. One explanation is that the limited crown size prevents an increase in photosynthesis large enough to offset the increased respiration that may result from direct sunlight on the stems of remaining trees.

Another explanation is sunscald—the death of the bark and cambium of young trees on the newly exposed south side of the tree. A possible reason for this type of shock is that trees in dense stands tend to have thinner bark, which may contribute to scald.

A third explanation is tree leaves that develop in shade cannot control water loss when they are exposed suddenly to full sun. They sometimes wilt and die and leave the tree with less leaf area, which reduces photosynthesis.

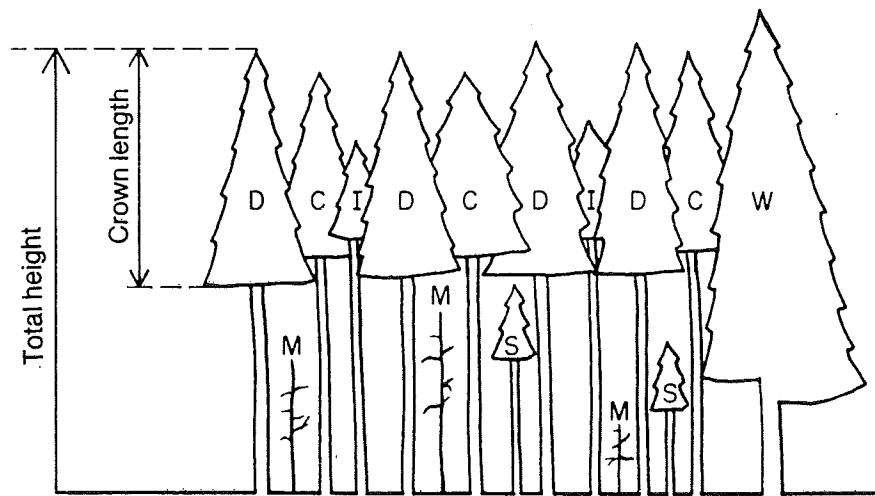


Figure 2.—Crowns of trees in even-aged stands are classified into crown types: D = Dominant, C = Codominant, I = Intermediate, W = Wolf, S = Suppressed, M = Mortality. The “crown ratio” is equal to the proportion of total tree height that is occupied by live crown. In this illustration, the dominants have a 50 percent crown ratio, while the wolf tree has an 80 percent crown ratio.

How thinning affects stand growth

Thinning applies to stands of trees rather than to individual trees. The fact that thinning ordinarily increases the growth of individual remaining trees does not mean total stand growth is increased—there are fewer trees in a thinned stand. The effects of thinning on stand growth are best understood after a discussion of stand development under natural, unthinned conditions.

Crown classification. A tree crown classification system is useful in discussing stand development. Figure 2 illustrates a commonly used system, which has the following six classes:

1. **Dominant.** Trees with the crown extending above the general level of the crown canopy receive full sunlight from above and some from the sides. The sides of the crowns are well developed but (possibly) somewhat crowded.
2. **Codominant.** Trees with crowns forming the general level of the crown cover receive full light from above, but little from the sides. The tree crowns are medium sized and are more crowded on the sides than are dominants.
3. **Intermediate.** These trees are usually shorter than those in the

two preceding classes, with small, crowded sides. The crowns extend into the canopy formed by dominant and codominant trees and receive a little direct light from above, but none from the sides.

4. **Suppressed (overtopped).** The crowns on these trees are below the level of the crown canopy. They receive no direct light from above or from the sides.
5. **Wolf.** These trees develop and grow in the open. They have full crowns on all sides, with branches well below the canopy level. The crowns are uncrowded on two or more sides and receive full light from above and well down on two or more sides.
6. **Mortality.** These are dead trees within the stand. Suppressed trees usually die, and trees of any crown class may die from disease or insect attack.

Stand development under natural conditions. As illustrated in figure 3, a very young, even-aged stand is composed entirely of dominant trees, since the seedlings do not shade each other. As the trees grow, height becomes critical to their survival. Tall trees shade short trees, and at some point, this increased shading reduces photosynthesis, which further reduces growth.

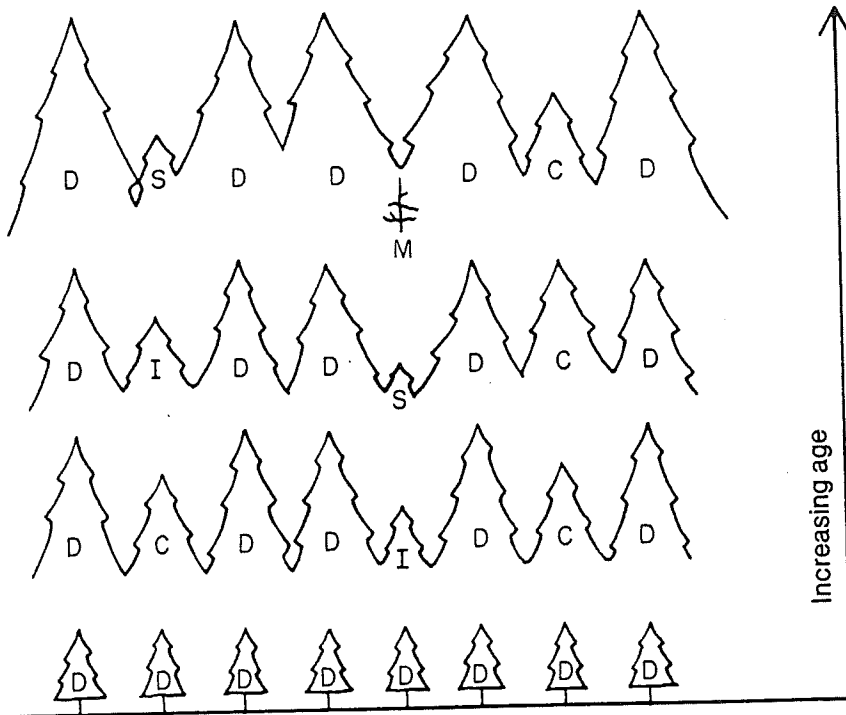


Figure 3.—Trees differentiate into crown classes as stands become older.

The tallest trees remain in the dominant crown class, while shorter ones drop down to the codominant, intermediate, and suppressed classes. Once lost, a height advantage normally is not regained. As this process continues year after year, the stand develops into one with varied crown classes. The process continues as long as the even-aged stand exists.

All trees compete for light, water, and nutrients. Some trees in the dominant class remain there; others are left behind gradually until they are in the codominant class. Some trees in the codominant class remain there, but others fall behind and become members of the intermediate class. Trees in the intermediate class frequently become overtopped and eventually die.

With increased stand age, crown class differentiation becomes more pronounced, and the number of trees in the stand is reduced constantly. In an unmanaged stand, the remains of dead trees rot in place.

Stagnation of tree stands occurs when normal stand development does not take place. It is usually found on poor sites and results in

very slow stand growth and many suppressed trees.

Trees which develop in the open often become undesirable wolf trees with large branches.

Effect of thinning on stand development. Thinning can alter the way a stand develops by influencing the proportion of trees that grow into each crown class. The magnitude of the alteration depends on the particular way you conduct thinning. If you remove trees early in a stand's development, you reduce the competition the remaining trees face.

With reduced competition, fewer remaining trees will develop into intermediate and suppressed trees. They will grow faster and will be larger than trees in an unthinned stand on a similar site.

After competition begins and the stand develops all crown classes, removal of intermediate and suppressed trees only may not significantly reduce the competition faced by the larger dominant and codominant trees. Suppressed trees, in particular, do not compete significantly with larger trees.

A successful *low* thinning removes all suppressed, most intermediates, many codominants, and

even some dominant trees. The remaining stand consists of uniformly spaced dominant and codominant trees.

In a *high* thinning, removal of relatively few dominant and codominant trees will release a large number of remaining trees. High thinning is not likely to stimulate a good release response if competition has produced a stand where few trees have crowns extending 30 to 40 percent of the tree's height.

Effects of thinning on total stand yield. On a forested site, the total amounts of water, nutrients, and light are fixed, which limits the total volume of wood fiber a stand will produce within a given period of time. This implies that total fiber growth is also fixed and you cannot increase it by thinning. However, thinning can increase the *usable* fiber a stand produces.

Thinning channels the limited light, water, and nutrients into fewer trees enabling each of them to grow faster. Unless thinning is so severe that too few trees are left to fully occupy the site, the total fiber growth that the site is capable of producing is concentrated on fewer stems. This results in a few large logs rather than many small logs.

Large logs usually have a higher value per unit of volume than small logs for two basic reasons: The logging cost is lower because a few big logs cost less to handle than many small logs; and the products that can be made from large logs (veneer, large timbers) are worth more than those made from small logs.

In a natural stand, part of the gross growth is lost on trees that die from competition or other factors, go unsalvaged, and eventually decay. Thinning "captures" this mortality—it increases the amount of usable (and salable) fiber a stand produces.

Thinning *does not* produce increased growth, but because thinning concentrates growth onto a few large stems, *individual tree and stand value increase.*

The way to increase stand production is to supplement elements that stimulate growth, such as increasing nitrogen by fertilizing or

water by irrigating. Genetic improvement programs that make all trees in the stand more efficient growers can also increase production. You obtain best results with fertilization, irrigation, and genetic improvement when you do them together with a careful thinning program.

How to thin

In deciding how to thin, you must answer several questions: When should I thin? How many trees should I remove? Which trees should I remove? What logging methods should I use?

When to thin. To achieve maximum increase in usable fiber, begin thinning early—when trees are between 10 and 20 years old. Actually, the density of the stand and size of trees rather than stand age dictate when thinning is effective. Thinning before competition begins accomplishes little, but thinning when the crowns of adjacent trees begin to touch will reduce competition.

In 4- to 12-inch diameter stands, thin before the vertical length of tree crowns drops below 40 percent of the total tree height. If crowns have receded beyond this point, thin lightly to prevent thinning shock. Use early thinnings, (which are likely to be precommercial thinnings) to shorten the time until you can

harvest merchantable logs and to keep stands vigorous and healthy.

Make subsequent thinnings as competition recurs, but before severe reductions in diameter growth occur. As competition increases in a stand, the annual rings of individual trees become thinner. Rapid increases in the width of the trees' growth rings following thinning often are used as dramatic examples of the benefits of thinning. Ideally, however, you should thin before severe dropoffs in diameter growth occur (see figure 4).

The interval between thinnings depends on the *intensity* of thinning and the productivity of the site. Intensity of thinning refers to the number of trees (and competition) you remove with respect to full, natural, or "normal" stocking. A *heavy* thinning removes many trees and reduces competition for a longer period than does a *light* thinning, which removes fewer trees.

When you do precommercial thinning (usually a heavy thinning), space the trees you leave so they will reach merchantable size before the stand closes and severe competition occurs. Crown closure and competition resume soon after light thinnings; therefore, conduct them more frequently than heavy thinnings. In the Northwest, intervals between thinnings commonly range from 5 to 15 years.

Time of year. Late summer and fall are the best times to carry out thinning operations. Trees grow in the spring and early summer, and it is easy to scrape the bark from residual trees during felling and yarding operations. Also, during this season, cut trees can attract insects that have the potential to kill the remaining trees.

For example, if you thin ponderosa pine or lodgepole pine in the spring, large numbers of *Ips* bark beetles may be attracted to the cut trees. *Thin pine stands after August 1 to minimize the danger associated with this bark beetle.*

Winter is also an acceptable time for thinning, with one note of caution. Soils are more prone to compaction and erosion during the wet season; regulate use of ground-based skidders carefully. In areas where snow accumulates or the ground freezes, winter thinning is perfectly acceptable.

Thinning intensity. If the intensity of thinning is too light, the growth is spread over too many trees to achieve maximum benefits. If the intensity is too heavy, considerable amounts of nutrients, water, and light are outside the reach of the remaining trees, and the total productive capacity of the site is underused. Also, windthrow following thinning may be a problem for some species or on highly

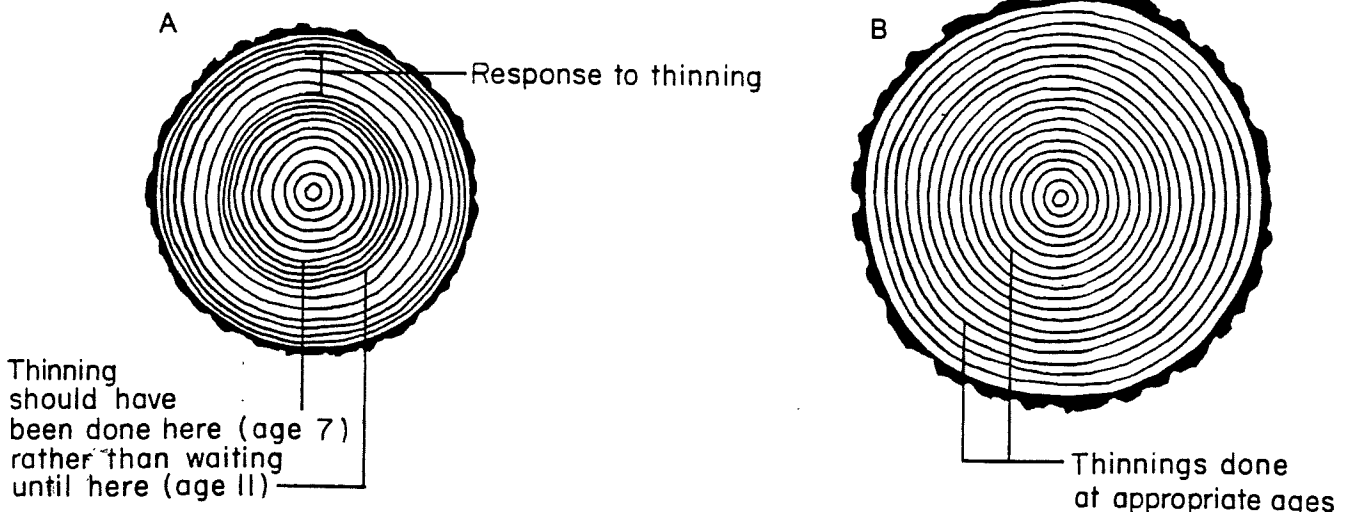


Figure 4.—Thinnings should occur frequently so that the width of growth rings remains relatively constant. Drawings A and B show cross sections of 21-year-old trees. Thinning for tree A was postponed too long causing the diameter growth restriction shown. Upon thinning, diameter growth increased, only to slow again as the tree crowns closed. Tree B was properly thinned, allowing its diameter growth to remain fairly uniform.

exposed sites. For these reasons, the intensity of thinning is an important management choice.

In Douglas-fir stands, a common guide for spacing trees to be left is the *D-plus* ($D +$) rule. It specifies that the average spacing (in feet) of remaining trees should be equal to the average stand diameter (in inches), plus some constant.

For example, if the average diameter of trees remaining in the stand will be 12 inches and you follow a $D + 5$ rule, the *average* spacing of the remaining trees will be 17 feet, leaving 150 trees per acre.

Use of the $D + 5$ spacing guide does not indicate an arbitrary 17-foot by 17-foot spacing between all trees. Some variation, both greater and less than 17×17 , is necessary to accommodate differences in tree vigor, tree quality, and other considerations.

It is commonly advocated that you make $D + 4$ or $D + 5$ thinnings in early years (until trees are about 8 inches d.b.h.), and follow with somewhat heavier thinnings (perhaps $D + 6$) in later years. Consider this a rough guide only.

Experience in thinning over the years in the Northwest has resulted in a gradual increase in the intensity of thinning. Other techniques for determining the spacing of trees to leave, such as density management diagrams, are now available and can produce equally satisfactory results.

The important objective is to use *some* thinning guide so you can determine the spacing of residual trees. Consult with a professional forester about the guides used in your area.

Tree selection. The type of thinning you select depends on your objectives: the age, size, condition, and species composition of the stand; and past management history. A cardinal rule when thinning is to improve the stand's condition for future growth.

A low thinning is the most common approach if the residual trees are in the dominant and codominant crown classes. Residual trees should be straight and vigorous, have relatively small limbs and considerable clear bole, and be as uniformly spaced as possible.

A young Douglas-fir stand that has been precommercially thinned presents an entirely different set of selection problems than does a middle-aged Douglas-fir stand that has never been thinned. In the middle-aged, unmanaged stand, concentrate your initial thinning on diseased trees or rough, limby trees in the dominant and codominant crown classes, and on poor quality trees in the lower crown classes. Pay less attention to the spacing of the remaining trees than you would a thinned stand. The thinning primarily upgrades stand quality.

In a younger, previously thinned stand, focus on crown classification, spacing, and competition, and aim for maximum fiber production from the site on good quality trees.

If you are a novice at thinning, visit stands that have been thinned in different ways to gain a better feel for tree-selection criteria.

Species selection. Thinning offers a means of controlling the species composition of a stand by leaving the more valuable or better growing species to mature. This is often done during precommercial thinning when you remove large shrubs along with undesirable hardwood or conifer species.

Logging methods. Selection of logging methods and equipment is important. Logging systems differ in their capacity of handling logs of different sizes, adaptability to steep slopes, road access requirements, site disturbance, soil compaction potential, potential damage to remaining trees, and cost.

You can reduce damage to residual trees by not logging during spring and early summer when the bark is easily broken loose from the trunk. Planning and marking skidtrails can reduce the amount of soil compaction.

Some final notes

Thinning is an important stand management tool available to woodland owners. State service foresters, industrial and consulting foresters can provide you with valuable assistance in planning and conducting thinning operations. Educational programs and other literature on thinning are available from most county Extension offices. It is important that you understand thinning and define management goals before contacting professional help.

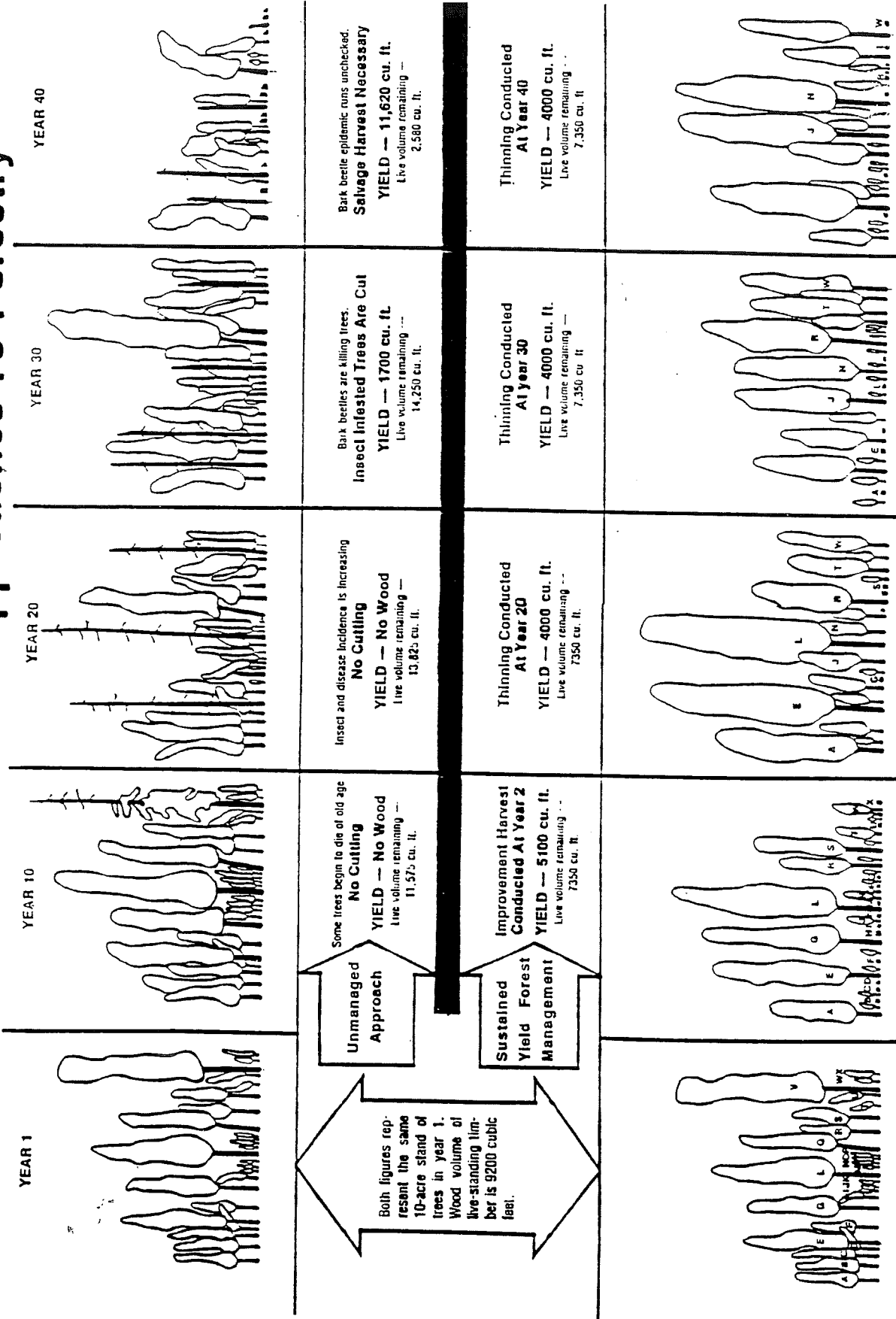
Pacific Northwest cooperative Extension bulletins are joint publications of the three Pacific Northwest states—Washington, Oregon, and Idaho. Similar crops, climate, and topography create a natural geographic unit that crosses state lines. Since 1949, the PNW program has published over 200 titles. Joint writing, editing, and production has prevented duplication and conflicting recommendations, broadened the availability of faculty specialists, and substantially reduced costs for the participating states.

This publication was prepared by William H. Emmingham, Extension silviculture specialist, and Norman E. Elwood, Extension forest management specialist, Oregon State University. It is a revision of an earlier work by Larry Streeby, former Extension forestry management specialist, Oregon State University. The authors acknowledge the assistance of Extension foresters at Washington State University and the University of Idaho.

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Results of Two Approaches to Forestry



Unmanaged Results

The timber stand is depleted. Only the poorest quality trees remain. Natural regeneration will occur with seed from inferior trees. Stand recovery will take 30 years.

Products gained over 40 years

- 94 cords firewood plus
- 10,200 board feet of sawtimber.
- Total Yield 13,320 cu. ft.
- Yield & live volume 15,900 cu. ft.

Management Results

The timber stand is well stocked with healthy trees, some young trees from year one remain as large trees. Natural regeneration is occurring with seed from high quality trees. Another thinning will be conducted in ten years to yield an additional 4000 cubic feet of wood.

Products gained over 40 years

- 60 cords firewood plus
- 40 cords fence poles plus
- 17,000 board feet of sawtimber
- Total yield 17,100 cu. ft.
- Yield & live volume 24,450 cu.ft.



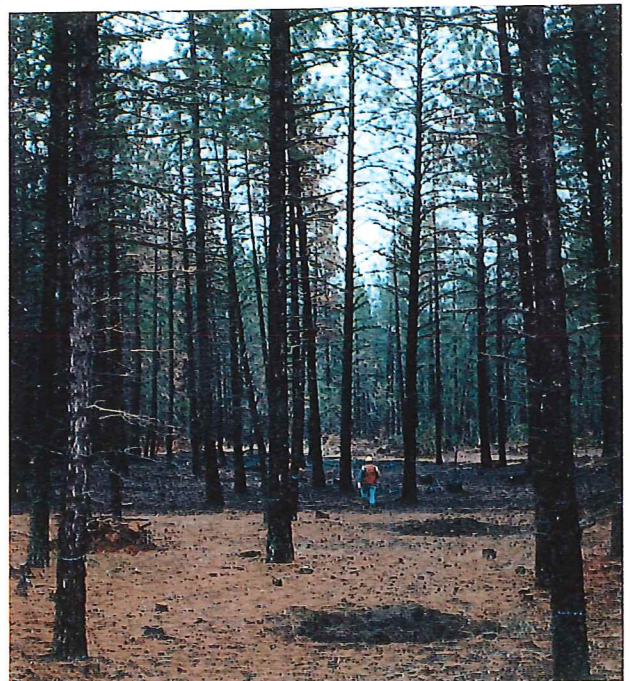
"Cambium application", tree species which resprout when cut may be thinned by applying a herbicide in a circle around the stump, on the cambium layer.



"Hack-n-squirt", score the tree deep enough to inject herbicide into the cambium layer. Also kills tree species which resprout when cut. (Wear protective clothing.)



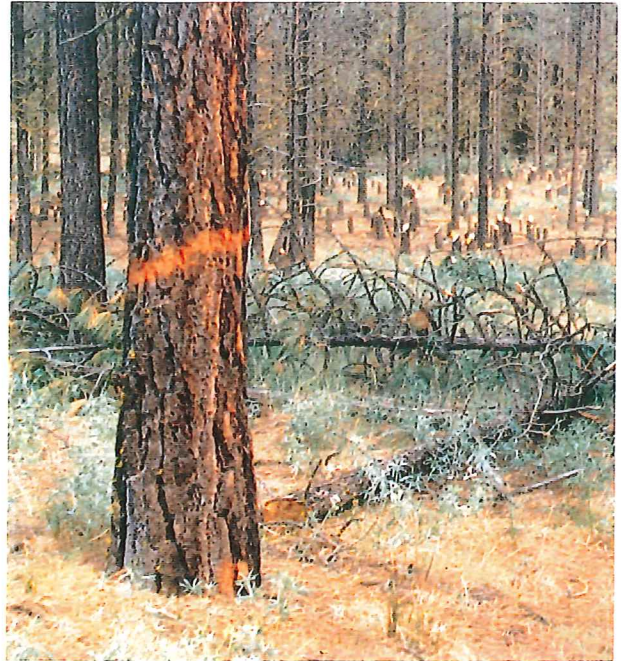
Firewood is cut and loaded for transport.



Cleanup is the final step. Any wood which is not utilized should be piled and burned.



Pruning will improve the appearance of a stand, reduce the fire hazard, and may increase its value at harvest time.



Mark a "cut" or "leave" tree by painting a spot at the base of the tree and a circle around the trunk about five feet above ground level.



Conifer release - the competing species are manually removed allowing the conifers access to light, moisture, and nutrients.



This unthinned Douglas-fir stand is too old to respond fully to a precommercial thin. The small alder along the road should be controlled.

Harvest/Regeneration Systems

The final harvest should be planned with the objective of establishing a new forest on the site.

Harvest trees when they reach or exceed their economic maturity. Other reasons for harvest include disease or insect infestation, stand growth stagnation, or replacing low value tree species.

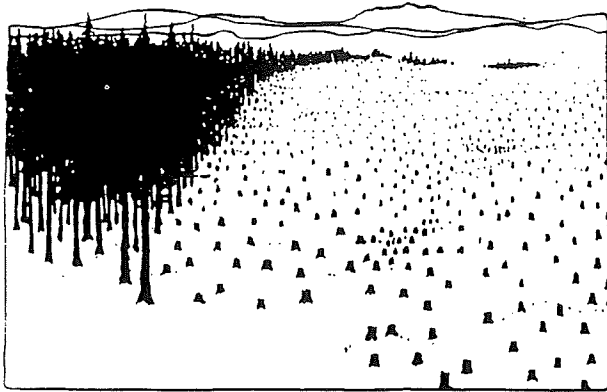
Work with a consultant to plan the harvest and to prepare a contract—which should include harvest specifications, bucking, height of cut stumps, slash disposal, and site preparation. Keep in mind your equipment needs, road access, terrain and weather conditions, soil type and market availability. Harvest only when soil is dry or

frozen. Plan road landing and skid trail layout to minimize forest soil disturbance and stream pollution.

Review Forest Practices Act regulations, check your forest land boundaries, and obtain required Environmental Protection Agency (EPA) permits before beginning the harvest (for example, permits for use of hydraulic equipment, broadcast or slash burning, and temporary access over neighboring land).

Timing of the final harvest is important for financial reasons as well. Study stumpage or delivered log prices. Determine the time of year that prices are high. Capture the highest price by being a wise merchandiser of your logs. Use the services of a Consultant Forester!

In clearcutting, all trees are removed and immediate steps are taken to promote the establishment of a new crop. Under some circumstances, nearby natural seed trees restock the area. More usually, however, restocking is obtained by planting nursery-grown seedlings or sowing seed by helicopter.



Clearcutting

The seed tree method is closely related to clearcutting, except that a few widely scattered trees are left to provide a seed source for the new forest crop.



Seed Tree Method

THE FOUR PRINCIPAL HARVEST/REGENERATION METHODS

Shelterwood Method



With the shelterwood method, timber is removed in two separate harvest operations. In the first cutting, overstory trees are left in a pattern that provides growing space and seed sources for the new crop. The overstory shades and protects the young seedlings during their critical establishment period. There are two major variations: STRIP SHELTERWOOD, in which all the timber is removed in very narrow strips, one to two tree lengths wide, and UNIFORM SHELTERWOOD, in which enough uniformly spaced overstory trees are left to provide some degree of shade. The overstory may be removed once a new crop is established, usually within 10 years.

Selection Method



Selection involves cutting a relatively small portion of the trees, individually or in small patches. Trees are removed on the basis of their age, size, species, quality, and distance to other trees. A succession of age groups is present in the stand, and harvesting can be repeated indefinitely if the species present are adapted to this method. The remaining overstory seeds the new crop, which must be able to establish itself and thrive in the heavy shade and root competition of the older trees. (NOTE: Thinning is a different practice. It removes immature trees. Its principal objective is to concentrate growth potential on remaining trees, not to provide space for a new crop of trees.)



Horse logging.



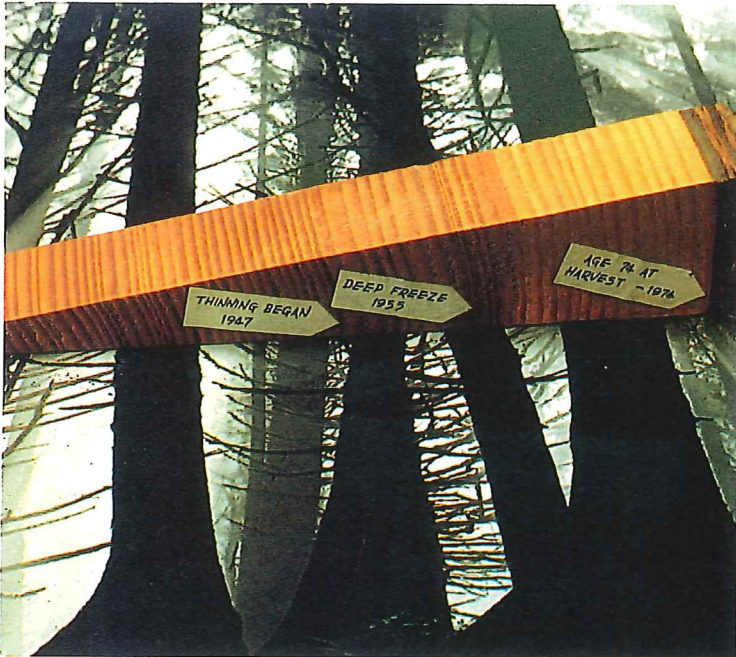
A log truck being loaded.



Skid trail with a Skyline system.



A skyline cable with logs. Commonly used on steep ground with heavy timber.



This cross-section of a Douglas-fir tree shows: (1) when thinning began in 1947, (2) the deep freeze of 1955, and (3) the tree at harvest age in 1974. Note: response to thinning.



A loader.



Logs being skidded.



Moist conditions in the winter and spring require special care so that soil and water resources are protected.

Access Roads

A system of forest roads and skid trails provides access for heavy equipment needed for site preparation, maintenance, thinning, skidding, piling slash, intermediate and final harvest, and for hauling trees, firewood and timber. A well designed road system provides access to all areas of the forest or tree farm while taking a minimum of space out of production.

Construct adequate culverts, bridges and water bars during road building. Roads may be built for harvest, but many are later used by recreational vehicles. Keep existing roads and access to public roads in mind when planning the forest road system. Skid trails are usually only suitable for tractors or off-road equipment.

Because skid trails and roads are the primary cause of soil erosion on forest land, plan to control erosion through water bars, grass seeding, or other measures. Take care not to plan roads for steep or unstable slopes, or through streams and wetlands. Be sure that roads are carefully designed, supervised during construction, and maintained during and after use. Roads which will no longer be used should have proper ditching and be put to bed.

Again, remember to check Forest Practices Act regulations on road-building, and obtain hydraulics permits, necessary easements, and the promise of necessary equipment before beginning the project. Do not overbuild a road for the value of the resource and the logging method.



Temporary skid trail.



Surveying is an integral part of road design and layout.



A culvert must be properly laid in the stream bed. Obtain all permits before beginning.



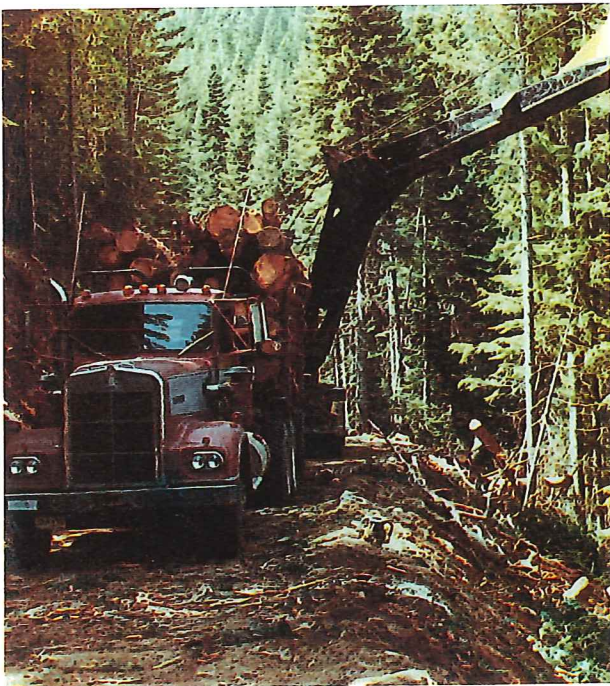
A graveled logging road.



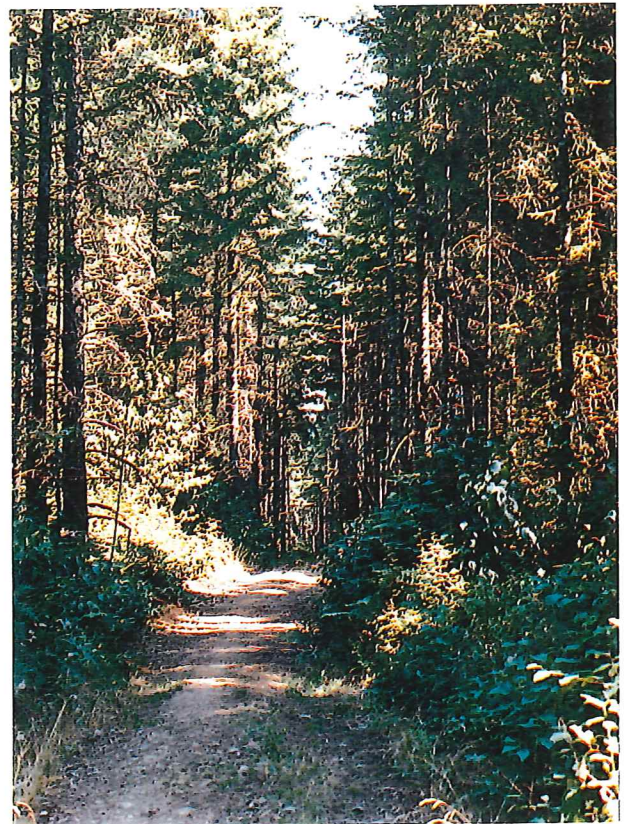
Seeding grass will help prevent erosion.



In unstable soils, direct outflow from a culvert away from potential damage.



Side casting is not permitted on slopes greater than 60 percent.



Low impact logging road.

Special Problems

Disease

Dwarf mistletoe on ponderosa pine or Douglas-fir may cause a thick, clustered appearance, or "brooming". A precommercial or sanitation thinning should remove trees infected with dwarf mistletoe.

Root rots and insect invasions often appear together in a stand. Trees stressed by root rot have less resistance to insect attack. Armillaria root rot, also called shoestring root rot or honey fungus, spreads to other trees in a stand through underground root contact. Decaying tree stumps supply food to the diseased roots. Pushing stumps from the ground and destroying them is an effective treatment east of the Cascades. On the west side of the mountains, careful planting of new seedlings will help avoid the disease.

Laminated root rot spreads from tree to tree by root grafts, producing seedlings with distinctive fungal growths. Stump pushing in infected areas will control the infection. Root rot residue lingers in the soil for about 10 years.

Animal Damage

Meadow voles, pocket gophers, deer, elk, bear, porcupines and mountain beaver can damage forest trees. Underground, pocket gophers chew tree roots, or pull small seedlings down into their runs. Above ground, meadow voles and pocket gophers can eat all the bark around the base of a small tree or seedling. By girdling the tree in this way, they completely cut off the tree's source of water and nutrients from the roots. Elk and porcupines strip off bark higher up on the tree. Mountain beaver clip off the top of a seedling while deer browse on new shoots. Long gashes and shredding indicate bear damage.

Insect Damage

Spruce budworm, Douglas-fir Tussock moths, Ips pini, Woolly adelgid, Spruce Cooley aphid, and the Mountain pine beetle attack large areas at a time, and will not be confined to your wood lot. Ask for help from local agencies or individuals. You may be able to take part in a cooperative project that covers a large area. Stands stressed by drought or disease are most often affected.

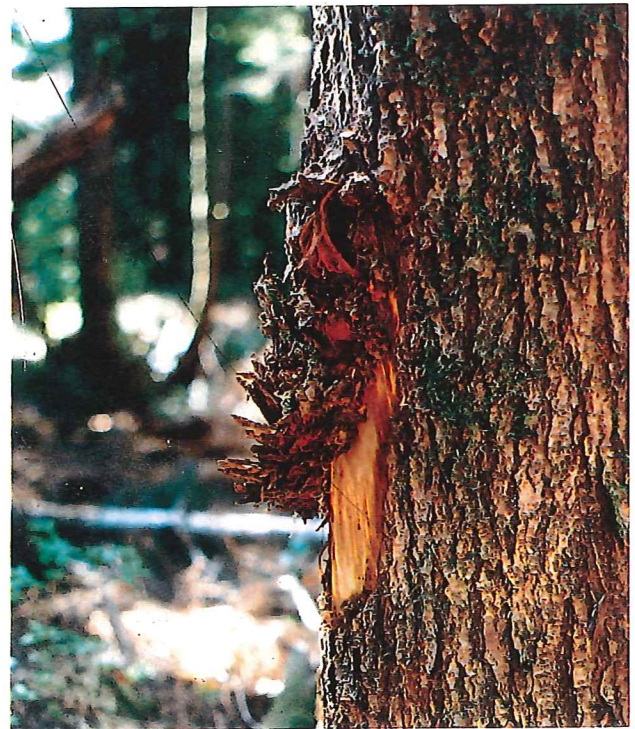
Wounding

Wounding and the compartmentalization of decay in trees. When a tree is wounded, by animal or machine, the cambium layer produces a barrier zone around the wound. Any decay organism or disease which enters the wound will be prevented from attacking the new wood which forms by this barrier zone. Consequently, the decay is forced up and down the tree inside the barrier zone. ➡

When thinning, it is extremely important that the "leave" trees are not damaged. Damage will at the least, reduce value and at the most, destroy their value at harvest.



Severe machine damage to the trunk and roots.



Cable damage to the trunk. In the spring when sap is flowing, the bark is more susceptible to wounding.



Armillaria Root Rot

Armillaria root rot has nearly destroyed this ponderosa pine stand.



West of the Cascades, Armillaria may cause sporadic mortality where the soil is rocky and planting is difficult or poorly done.



Laminated Root Rot

Laminated root rot travels from tree by root grafts. The fungus grows over the surface of the roots.

Laminated root rot infected seedling with the distinctive surface fungus mycelia.

Armillaria Root Rot

Removing stumps and large roots may reduce disease spread.

Selection of alternate species less susceptible to the strain of *Armillaria* which is present.

Armillaria has been recently identified as having strains, of which each strain has particular species of trees that show different levels of being susceptible.

Armillaria is also called the shoestring fungus, and the honey fungus.

Armillaria "pipe" root carries the infection to crossing seedling roots (stakes) from the stump "food reservoir"). ➡



The root network from this stump occupied about one-sixth of an acre and killed 32 seedlings. The longest root was traced 52 feet from the stump where it was still over one inch in diameter.



A meadow vole runway.



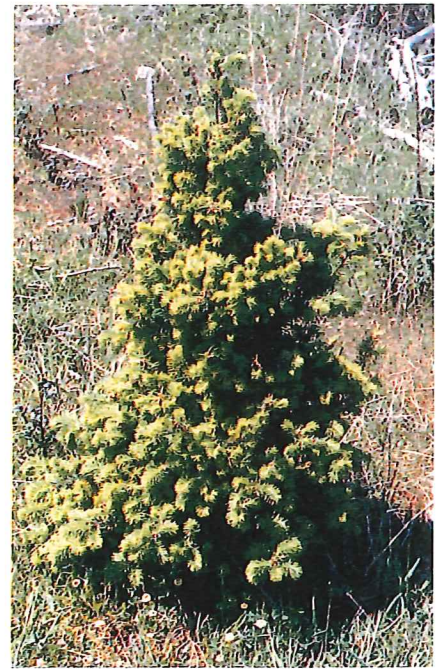
Girdling of young trees by various rodents.



Root pruning by a pocket gopher.



Elk bark feeding on willow.



Deer browse.

← Porcupine up in a seedling eating.



Clipped Douglas-fir seedling by a mountain beaver.



Bear damage, grand fir grooves.

Insect Damage

Insects tend to be a large area problem and not confined to a small woodlot. Thus, it is best to seek help from local individuals or agencies knowledgeable about insects and your specific situation. (A large scale cooperative project may result.)

Insects will usually begin attacking a tree which is under stress. So, management should focus on alleviating tree stress.



Spruce budworm is a defoliating insect. It tends to confine itself to new needles and is not known to cause heavy tree mortality.



Douglas-fir Tussock moth damage begins in the top of the crown in new needles, spreads to older needles and will kill the tree in 2 - 3 years.



Douglas-fir Tussock moth larvae cannot fly. They are spread by wind.



Mountain pine beetles east of the Cascades and Douglas-fir beetles west, usually attack young pole sized stands.



Mountain pine beetle galleries are vertical tunnels with eggs laid to one side of the tunnel, alternating from tunnel to tunnel.



Mountain pine beetles create pitch tubes when the larvae, feeding in the tunnels, girdle the tree. A stain fungus then invades and plugs the cambium.



Spruce Cooley aphid is most damaging to Christmas trees. It discolors and may twist the needles.



Dwarf Mistletoe

Ponderosa pine infected with dwarf mistletoe.



Dwarf mistletoe seeds are ejected into other trees.

Dwarf mistletoe seeds in Douglas-fir trees are smaller than mistletoe seeds in other species.



Commercial Products from the Forest

Saw-timber is not the only product which can be harvested from the forest. Tall, straight trees can be sold as utility poles. Shorter trees can be used in hop yards and grape vineyards to stake up plants, or for fence posts, railing and log houses.

Chips, the primary ingredient in paper manufacture, now fire furnaces built in a variety of buildings. Also, industry forms chips into

pressboard, a product which rivals plywood for shelving and housing construction. Many people choose cedar for shakes, shingles, fences and outdoor furniture, because of its fine weathering properties.

Small trees can be cut for firewood. Other speciality forest products include huckleberries, cedar boughs, ferns and salal for floral decorations, and Christmas trees.



Floral greenery - salal (above), cedar boughs, and ferns.



Log homes.



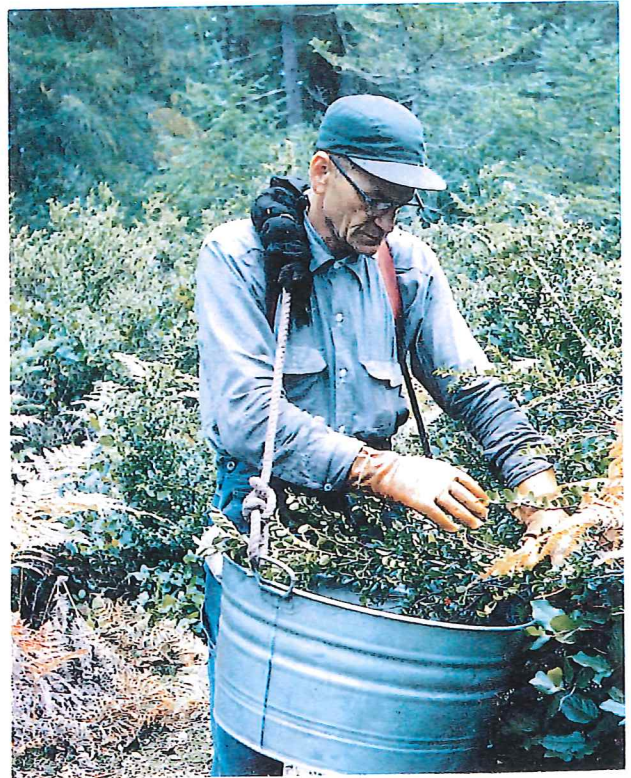
Chips.



Shelterwood Christmas tree farm.



Portable alder chipper.



Huckleberry harvester.



Cedar mill.



Firewood.

Types of Timber Sales

Three traditional methods comprise timber sales.

Lump Sum Sale

Using this method, the timber owner receives a total amount of money, "a lump sum," for a harvested area of forest land. For example, a sawmill may offer the owner \$80,000 for all of the timber on 40 acres of land.

This approach is simple and takes little effort to provide money for the landowner. The major pitfall of this approach is that landowners must know how much timber is actually being harvested to determine whether the lump sum is fair. The logger incurs all logging costs with this method.

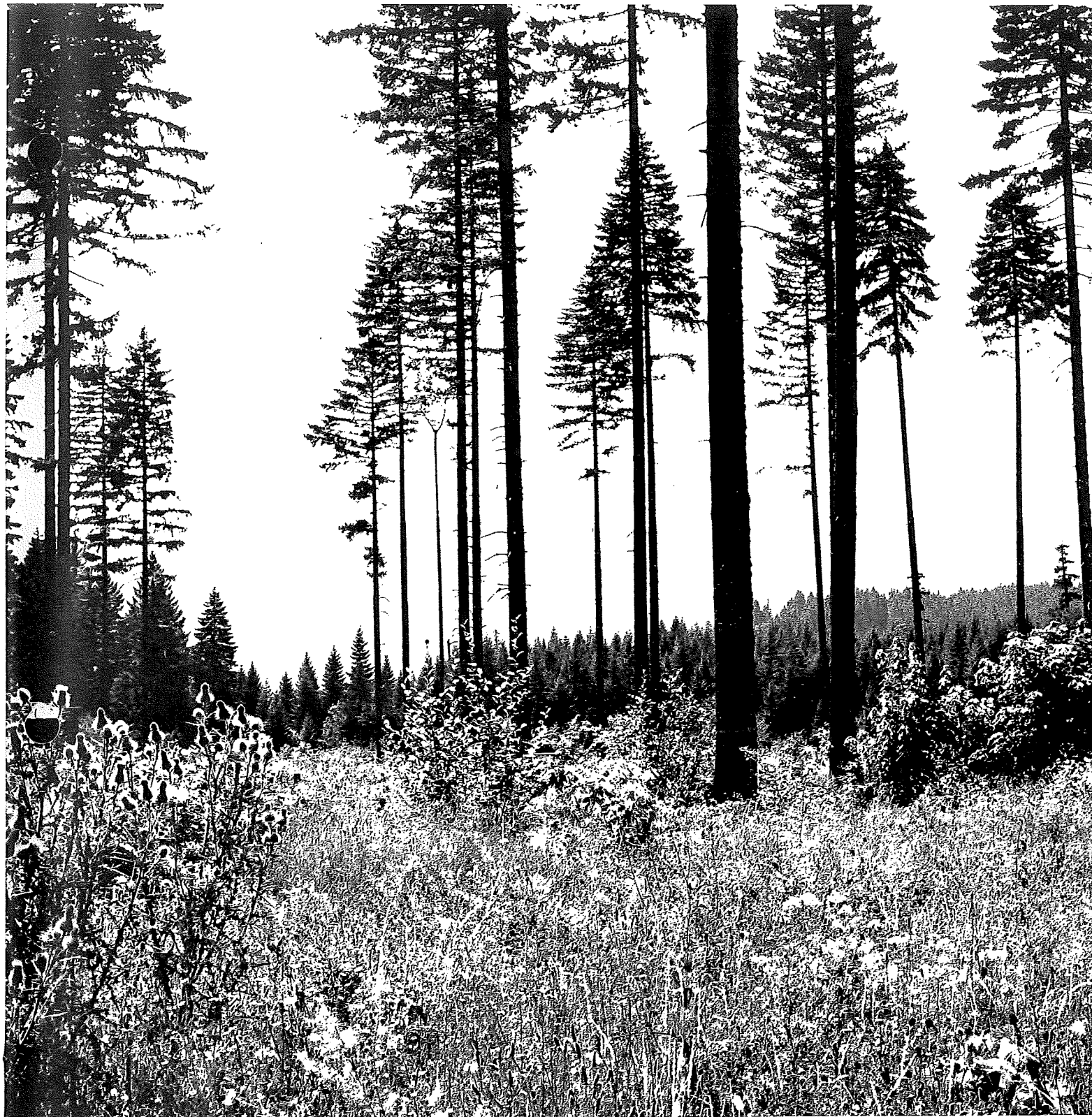
Stumpage Sale

When conducting a stumpage sale, the landowner is compensated for the actual amount of timber harvested on a board foot (or other unit) basis. Only those trees so specified are harvested and sold. The price paid to the landowner is "on the stump." The buyer incurs all logging costs. This

approach is also simple and straightforward. A major problem with this approach is that the landowner only receives compensation for sound wood. Scaling of felled trees is determined by the purchasing mill. A neutral third party, such as a scaling bureau, needs to check scale regularly.

Delivered Log Sale

When making a delivered log sale, landowner retains title to the logs until they reach the mill, and is responsible for all logging and hauling. Delivered log prices, which reflect these added costs of production, are always higher than stumpage prices. An advantage to this process is the option to sort and deliver logs by species and grade to those mills willing to pay premium prices. Common sorts are export and domestic by species. This merchandizing advantage comes with added responsibilities, however. The landowner usually handles the logging and hauling through a personal services contract. This sale method has the potential to make the landowner the most net profit, provided there is price competition and price differential by log grade and species.



Timber Sale Agreements

Extension Bulletin 0961

Many woodland owners still make verbal sales, agreeing to sell the timber on a piece of land for so much money. Such sales are usually unsatisfactory to both parties. Important promises or conditions may be forgotten. A written agreement can benefit both buyer and seller. It can clarify responsibilities, prevent misunderstandings, and provide for sale practices that improve woodland values.

TIMBER SALE AGREEMENTS

A timber sale agreement should fit the type of sale. This is particularly true in stumpage sales.

A trained forester can help you set up a plan of controlled cutting and intelligent marketing. A forester is in the best position to outline the key items to include in an agreement and may also be able to propose a draft contract. An attorney should review it to make sure it is in proper form.

Because there are many ways to sell timber effectively, it is impossible to have a simple, all-purpose sale agreement form. But every agreement should protect the rights of both buyer and seller and also provide for marketing and logging practices that will aid future timber growth. The following items should be included in most timber sale agreements.

CONTRACTING PARTIES

Your name, legal address, and signature and the buyer's should be shown in the agreement. Each party should sign in the other's presence and the signing should be witnessed. Sometimes, the names and signatures of spouses or other interested parties may also be required. Be sure to include the date and place where the agreement is executed.

LAND DESCRIPTION

A complete legal description of the cutting area should be given. Additional local descriptions should also be given if the cutting area includes only a portion of legal subdivision. It is a good idea for a sketch map to accompany the agree-

ment. If property lines have not been defined on the ground by a certified surveyor, be sure to name the party responsible for hiring this work. You may also need a clause designating where logging is to begin and how the buyer is to proceed in covering the sale area.

PRODUCT BEING SOLD

You need to clearly define the kind and amount of forest product being sold. State species and logging practices, such as:

- Maximum stump height.
- Minimum length above which logs are not to be left in the woods after felling if sound.
- Minimum top diameter above which logs are not to be left in the woods after felling if sound.
- Percent cull a tree or log may have and be merchantable.

When only certain trees are to be taken, mark or designate them as live timber, dead timber, or salvage. Be sure to explain the marking system used.

You need to indicate the unit of measure and the price per unit. When sales are based on log scale, you should specify:

- The scale to be used, such as Scribner or International.
- When the scaling is to be done.
- Where it is to be done.
- Who is to do it.

In the scaling requirements, you may want to give a maximum trimming allowance and require that logs be measured to the nearest even foot. You

need to decide on a maximum length for logs to be scaled as one log. Scale any logs exceeding this length as two or more logs. Deduct any visible defects from the gross scale.

If the log scale includes the grade, indicate the price per grade, such as No. 2 saw log or No. 3 peeler log. For products sold by standards other than log scale, indicate the price by the piece, lineal foot, standard cord, lumber tally, or whatever the unit of measure may be. It is a good idea to require duplicate copies of scale sheets or a summary of logs sold.

LAND PROTECTION

Be certain that the importance of soil and water protection is understood. A guarantee that streams and waterways will be kept open should be included. Suitable protection should also be provided for springs and domestic water supply. Proper logging layout, landings, skid trails, and roads should be required to minimize soil and water disturbance. It is a good idea to specify the size and types of logging equipment that can be used to minimize the damage to trees that are left. If you plan to allow equipment or activities in addition to logging — such as a sawmill — this should be indicated in the agreement.

The specifications you include concerning location, construction standards, and maintenance of logging roads will depend on future transportation needs. Well-constructed roads can be a permanent asset to a woodland. You may want to consider the construction of bridges, culverts, ditches, cattle-guards, fences, or gates. If existing fences, bridges, roads, or other improvements are damaged, the buyer should be required to repair them to their original condition or pay for the damage.

If right-of-way is required across land outside the sale area, you should specify who is responsible for obtaining, paying for, and maintaining it. You should indicate who can use the right-of-way other than you and the buyer. There may be need for a performance bond covering the right-of-way in addition to the timber sale agreement.

Minimum Requirements of a Sale Agreement

- Names and addresses of contracting parties.
- Date and place agreement is signed.
- Guarantee of ownership of timber.
- Guarantee of right-of-way and freedom of entry.
- Location and description of property.
- Description of timber to be sold, species, method of cutting, how marked.
- Selling price and conditions of payment.
- How, when, and where the timber is to be measured.
- Cutting rules and regulations:
 - Beginning and expiration date for cutting.
 - Penalty clause for cutting of or damage to unmarked timber.
 - Liability for fire or property damage.
 - Utilization requirements, stump height, top diameter, defect.
- Road construction requirements.
- Erosion control measures.
- Ownership of improvements and reimbursement.
- Fireline and slash disposal requirements.
- Bond for faithful performance of agreement.
- Termination of agreement and reversionary rights.
- Protection of property from legal claims and labor liens.
- Liability protection from bodily injury and other damage.
- Responsibility for payment of excise tax and compliance with other state laws, such as fire laws, Forest Practices, State Environmental Protection Act.

PERMITS AND SLASH DISPOSAL

Buyer and seller should agree on their individual responsibilities concerning state, federal, and local requirements. For example, you will need to name who is responsible for obtaining, and complying with, cutting permits and local fire protection requirements. You should name what fire tools the buyer must keep on hand and where these tools are to be located. There should also be some statement concerning the buyer's liability for damages from fires caused by logging.

The seller is responsible for paying fire protection tax or fire assessments to the state. On lands which have been classified for reforestation under the 1932 Reforestation Act, the landowner is responsible for obtaining the special permits required and for paying the yield tax. On all land except that classified as reforestation lands, there is a forest excise tax which must be paid. The party responsible for paying the tax must be specified on the Washington State Forest Practices Application form and should be included in the contract.

Be sure to name who is responsible for disposing of slash and what constitutes satisfactory disposal. Slash disposal should be part of the logging program, but too often is not considered until after the logger has moved his equipment from the area.

SALE PERFORMANCE

Both buyer and seller need to have adequate liability insurance for such things as bodily injury or property damage. You may also wish to have a guarantee that the buyer will fulfill all obligations he has assumed in the agreement. Good methods include surety bonds, cash deposits prior to cutting, or deposits made currently as timber is cut.

You may want to make provision for a board of three arbitrators in case of disagreement. If so, you will usually select one arbitrator and the buyer a second. These two arbitrators will then select a third person. You will need to state how the arbitrators will be compensated if their services are used. It is a good idea to set a time limit in case they cannot reach an agreement.

PAYMENT

You need to clearly state how, when, and to whom payments are to be made. In case of loss, it is important to know when title to timber passes from seller to buyer.

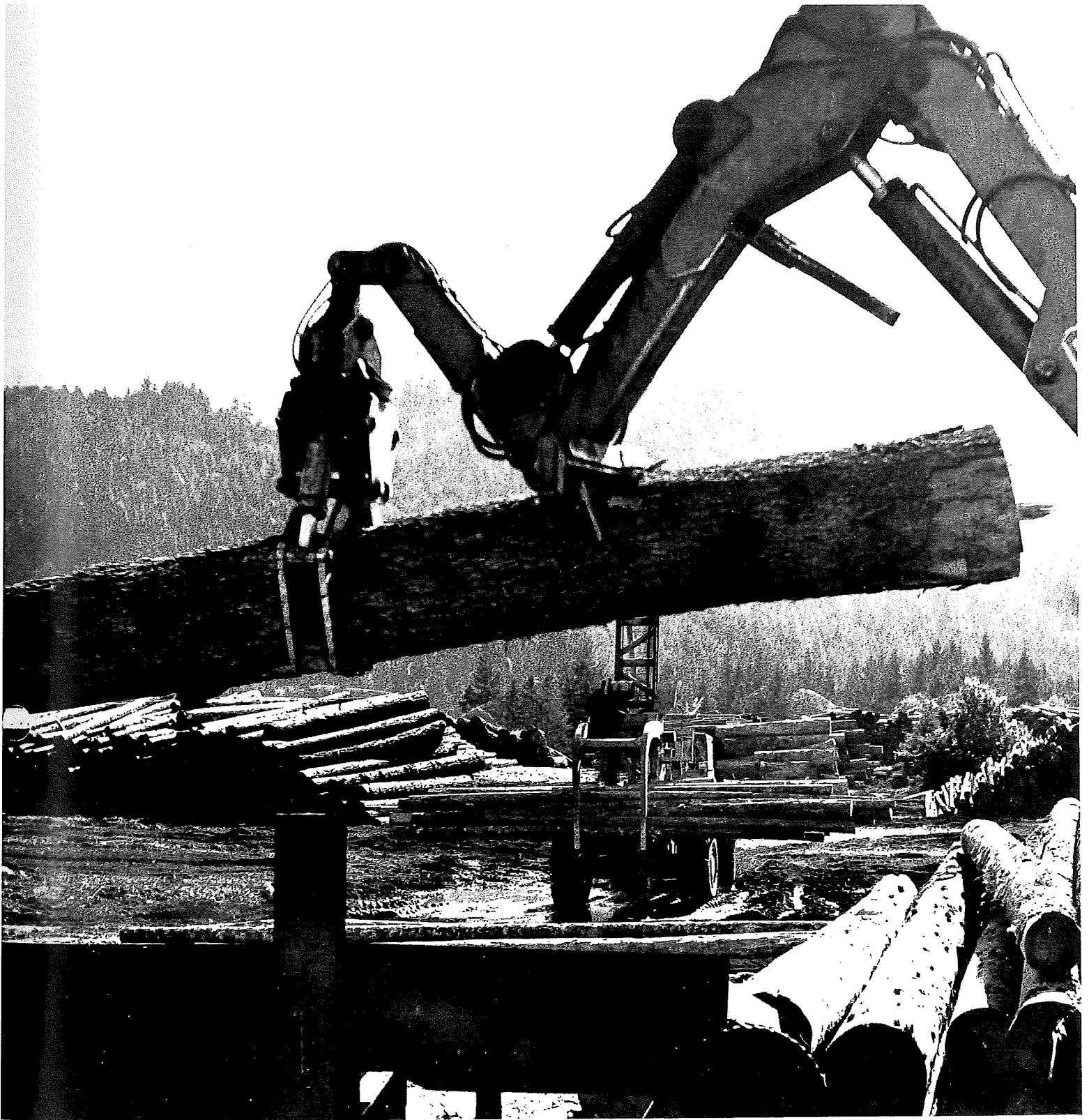
Provision should be made for additional or penalty payments. The buyer should be required to pay a certain rate for merchantable material left in the woods, except in lump sum sales. In this case, the buyer has already paid for all timber on the land and any merchantable material left is generally to the landowner's advantage. Set a rate for occasional damaged or broken-topped trees and for timber which is affected by rights-of-way outside the sale area. There should also be a penalty rate for cutting or removing unauthorized timber or products.

TIME LIMIT

You need to set a definite starting date and termination date for the sale. You may also wish to have an accomplishment date saying that a certain amount of timber must be cut or removed by a certain date. There should be provisions that will allow you to extend the time limit or alter terms which seem unreasonable. Also include a termination clause for failure to comply with the agreement. Agreements should state that timber remaining on the land after the agreement ends or is terminated belongs to the seller.

By David M. Baumgartner, Extension Forest Resources Specialist, and Helen M. Jones, Extension Project Associate, Washington State University. Guy Lusignan, private consultant, Bruce Cluff, Washington Department of Natural Resources, and Lloyd Soule, U.S. Forest Service, reviewed the manuscript and offered suggestions.

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Marketing Woodland Products

Extension Bulletin 0964



Cooperative Extension · College of Agriculture · Washington State University · Pullman, Washington

MARKETING WOODLAND PRODUCTS

Profits in selling timber depend on:

Knowing what you have to sell

Knowing the best market outlets

Knowing product specifications and prices

Knowing how to fit sales into your management plan

Using a written sales agreement

Using locally available technical assistance

As a woodland owner, you should cut trees under a management plan that is designed to retain or improve the productivity of your woodland. The plan should be based on your financial needs and the condition of your woodland.

PICK THE BEST SALES METHOD

Cut products. Prices for delivered products are from two to seven times those for stumpage. This is the best way to sell if you have the time, skill, and equipment to do your own logging.

Cut products are delivered to the mill, log dump, railroad siding, or concentration yard at previously agreed prices and specifications. They are subject to the buyer's scale and quality classification at time of delivery.

Deciding whether or not to do your own woods work may depend largely on how much time you have in the fall and winter.

If you own a tractor and truck, they can be used in the woodland. Farm equipment may not be as efficient as units designed for logging, but it will be less expensive to use since you already have money invested in it.

One definite advantage of doing your own woods work is that you have complete control of the land and all the forestry practices. Also, you can get full value from your trees by cutting them into the products with the highest value.

When you do your own logging, it is desirable to have a firm contract with your buyer that covers a specified period of time or a fixed amount of product. This protects you from a sudden loss of market or decline in price.

Stumpage. In all stumpage sales the buyer is responsible for the logging. You must be sure he will leave the logged area in good condition and follow slash disposal regulations. If you sell stumpage you will be paid either a lump sum or an amount based on log scale or on a piece count.

The lump sum may be for individual marked trees or for all merchantable trees on an area. In either case, this is a good method only when you have an accurate estimate of the volume of the trees.

Piece count payments are based on the number of pieces or units—cords, board feet, linear feet, etc.—taken from the woodland. This provides a fair basis for both the buyer and the seller and may be used either for specified trees or for all the merchantable trees on the land.

If you use this method, be sure the buyer takes out all the marketable timber he cuts. Also make arrangements for scaling, counting, or measuring the products the logger removes. One of the best ways is to obtain duplicate scale slips from the mill or dump where the logs are delivered.

Sometimes prices are adjusted to market fluctuations by allowing a given percentage of the delivered price for stumpage. If harvesting will take more than one year this arrangement may be desirable.

KNOW YOUR WOODLAND

If you don't know exactly what you have for sale, find out. Otherwise you may make a deal that lets high value products go at low prices.

You should know the board foot volume of trees that are ready for market. You should also know the quality and value of trees in terms of the products they will make.

Take a good inventory of what you have to sell. See if the trees could be sold as veneer logs or poles. Veneer logs usually bring from two to three times as much as sawlogs. Poles may be worth more than sawlogs, too. Check the market in your area for current prices.

A single tree may contain several products—a veneer log, several sawlogs, and many pulp sticks. For greatest returns, make the highest value products from each tree.

When your harvests are based on a good

management plan there is less chance that such additional values will be overlooked. A long range plan to harvest all these values is essential in sound marketing.

FIND MARKET OUTLETS

Never cut products before you are sure a market outlet is available. Local markets are usually the best bet, but take a look at distant ones, too. There are usually several nearby markets for sawlogs, pulpwood, poles, piling, shakes, fence posts, and greens. Get prices and specifications from several buyers.

Prices and outlets change, so it is important to keep up to date on market information. A Forest Products Price Report is published for the major forest areas of Washington. To receive copies write to Washington Crop Reporting Service, 909 First Avenue, Room 3039, Seattle, WA 98174.

After you have determined what you have to sell and have checked on markets and prices, you are in a good position to decide whether to sell now or hold your timber for better market conditions.

KNOW PRODUCT SPECIFICATIONS

Forest products must meet certain size and quality specifications. For example, a 16-foot sawlog is always cut 4 to 6 inches over 16 feet to allow for trimming. Logs without a trim allowance will be scaled down to the next size, in this case 14 feet. Some products may become unsalable culls if not cut to specifications.

If your market will accept logs of various lengths, it may be possible to cut to lengths that will eliminate defects such as crooks, knots, or scars. This will increase the quality of the logs and perhaps the total scale.

LET MANAGEMENT GUIDE CUTTING

All cutting should be based on your management plan. As with other enterprises, the objective is to make the greatest net income from the

resources involved and still maintain or improve the productive capacity. To maintain the highest level of productivity, cut only those trees that because of age, defect, or competition are not able to maintain good growth rates for the site.

It's seldom good management to remove all the trees from an area. This should be done only if the stand has reached maturity, is of very poor composition and quality, if you want to use the land for other purposes, or if you want a complete change of tree species. In any event, have a definite plan for reforestation or other land use before you sell all the trees on an area.

USE A WRITTEN SALES AGREEMENT

After you have selected the best market, make firm arrangements with the buyer on such things as price, product specifications, grade standards, and protection measures. A contract protects both the buyer and the seller.

You should definitely require a written contract on any standing timber you sell as stumpage. A contract is very desirable for all forest product sales because it clarifies the responsibilities of the contracting parties and prevents misunderstandings. Responsible operators should be willing to sign a reasonable contract.

A contract should always be drawn up with the advice of legal counsel and a local forester. The forester will know the situations the contract should cover and may be able to propose a contract. An attorney will be able to review the contract to assure proper legal form.

GET ASSISTANCE FROM A FORESTER

Getting the advice of a professional forester will pay. Controlled cutting and intelligent marketing under a good management plan will improve your woodland, step up its productivity, and increase your income. Professional assistance is available from a variety of sources:

The Washington Department of Natural Resources, through its Farm Forestry Program, provides, at no charge, technical assistance in a number of areas: identification of forest types, reforestation, timber stand improvement, harvesting assistance, and general explanations of management practices. Contact the Department at this toll-free number: 1-800-562-6010.

The Soil Conservation Service, through its Conservation Districts, provides technical assistance on erosion control planning, water management, use of plant materials for environmental protection and enhancement, soil maps and interpretations, and environmental education assistance.

Washington State University Cooperative Extension provides informative publications and workshops, shortcourses, and seminars. County agents also have information about other organizations which can provide assistance to landowners.

Private consulting foresters are available in most areas. Names of those in your area can be obtained from the farm forester, county agent, and most public or private foresters.

By David M. Baumgartner, Extension Forest Resources Specialist, and Helen M. Jones, Extension Project Associate, Washington State University. Guy Lusignan, private consultant, and Bruce Cluff, Washington Department of Natural Resources, reviewed the manuscript and made suggestions.

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