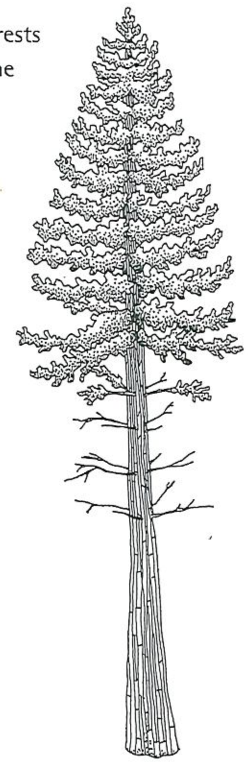
Logging Selectively

A practical field guide to partial timber harvesting in forests of the Inland Northwest and the northern Rocky Mountains



Chris Schnepf

PNW534
A Pacific Northwest Extension Publication
Idaho • Oregon • Washington

Pacific Northwest Extension publications are jointly produced by the three Pacific Northwest states—Oregon, Washington, and Idaho. Similar crops, climate, and topography create a natural geographic unit that crosses state lines. Since 1949 the PNW program has published more than 500 titles. Joint writing, editing, and production have prevented duplication of effort, broadened the availability of faculty specialists, and substantially reduced the costs for participating states.

Published and distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914, by the University of Idaho Cooperative Extension System, the Oregon State University Extension Service, Washington State University Cooperative Extension, and the U.S. Department of Agriculture cooperating.

Partial funding for this publication provided by the Idaho Department of Lands, the United States Department of Agriculture, and the Forest Service–Northern Region.

Copies of this publication can be obtained from:

• Agricultural Publications, University of Idaho, tel. 208-885-7982; e-mail: cking@uidaho.edu; web: http://info.ag.uidaho.edu;

• Publication Orders, Extension & Station Communications, Oregon State University, tel. 541-737-2513; e-mail: puborders@orst.edu; web: http://eesc.orst.edu; or

• Bulletin Office, Washington State University Cooperative Extension, tel. 1-800-723-1763; e-mail: bulletin@coopext.cahe.wsu.edu; web: http://pubs.wsu.edu.

Shipping and sales tax requirements vary by state.

Partial funding for this publication provided by the Idaho Department of Lands, the United States Department of Agriculture, and the Forest Service–Northern Region.

Copies of this publication can be obtained by sending $5.00 plus $1.00 postage and handling (and 5% Idaho sales tax if applicable) to Agricultural Publications, University of Idaho, Moscow, ID 83844-2240; tel 208 885-7982; fax 208 885-4648; email cking@uidaho.edu; website http://info.ag.uidaho.edu.

A copy of the *Resources of Idaho* catalog of publications and videos can be obtained free from the same office.

PNW 534

2000/20,000 Produced by Agricultural Communications $5.00

Acknowledgments

Thanks to the following people who reviewed this publication and provided many constructive comments:

Lauren Fins, Professor, Forest Resources, University of Idaho
Ron Mahoney, Extension Forestry Specialist, University of Idaho
G. Kirk David, Service Forestry Coordinator, Idaho Dept. of Lands
Doug Ferris, Area Forester, Boise Cascade Corporation
Bruce Reay, Chief Forester, Boise Cascade Corporation
John Schwandt, Forest Pathologist, U.S. Forest Service
Ladd Livingston, Forest Entomologist, Idaho Department of Lands
Bill Emmingham, Extension Silviculturist, Oregon State University

Thanks also to Jim Felix, Chad McMaster, Steve and Janet Funk, Greg Bassler, Bob Whitehead, Carol Randall, Sandy Kegley, Gail Worden, Bret Roper, Bill Love, Glenn Roloff, and Jenny Taylor.

Contents

INTRODUCTION

While many forest landowners are interested in cutting trees to improve forest health, generate income, or other reasons, they are often reluctant to alter the appearance of their forest too dramatically. Many say they want to log "selectively." Foresters often cringe at this expression, having seen too many well-intentioned but uninformed attempts to "log selectively."

Partial harvests made without a basic understanding of forest ecology, tree growth, and genetic principles may threaten forest health. Such partial harvests often tend to focus primarily on the value of the trees *removed*, taking the largest trees with the best form. While such immediate financial returns are often important, a healthy future forest depends on the quality of trees that remain.

Leaving the best trees at an adequate spacing usually reduces insect and disease problems (top). Leaving quality trees can improve the genetics of new seedlings (bottom).

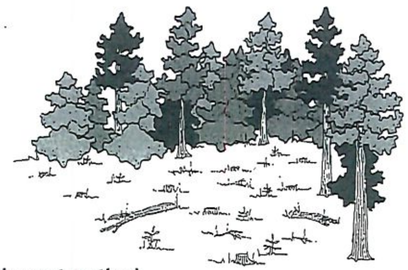
Leaving high quality trees can:

- Reduce insect and disease problems,
- Improve the genetic quality of new tree seedlings,
- Maintain stand growth and shorten the time until next harvest,
- Produce higher value trees in future harvests, and
- Improve wildlife habitat and other ecological values.

This publication outlines concepts to help forest landowners, logging operators, and thinning contractors understand and appreciate basic tree characteristics to favor or cut when harvesting timber.

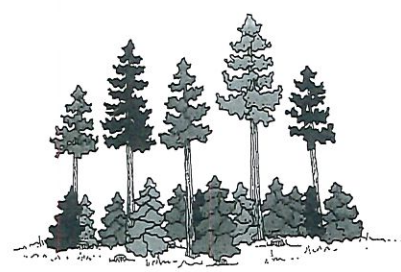
TIMBER HARVESTS

The term "selective logging" is often loosely applied to any timber harvest that leaves some trees. A timber harvest can improve or degrade a forest. Therefore you should study the forest conditions carefully, consider management goals, then harvest timber in a way that reflects those goals and site conditions. Timber harvests can be divided into two categories: (1) a stand regeneration harvest or (2) a thinning.



clearcut method

seed tree method



shelterwood method

selection method

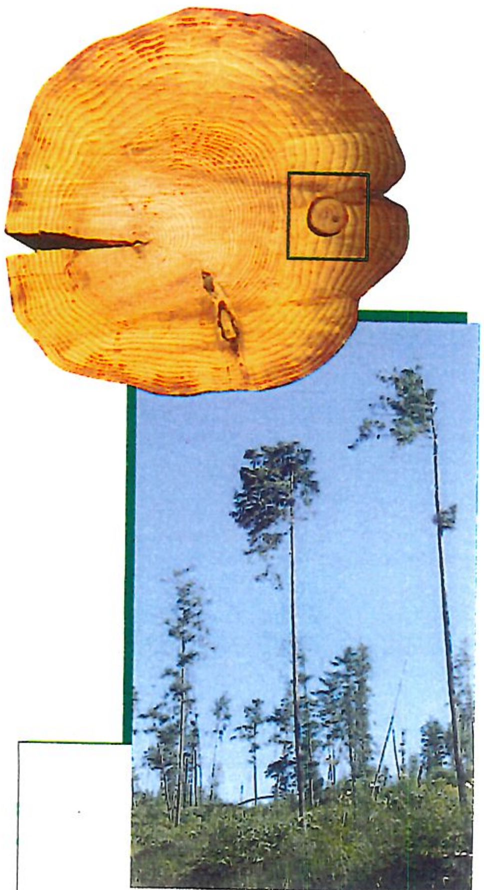
stand regeneration

A *silvicultural system* is a series of practices designed to manage a forest over a long period of time. Silvicultural systems are often named for the type of *regeneration method* they use to create favorable growing conditions for desired tree species. The four basic regeneration methods are: clearcut, seed tree, shelterwood, and selection.

With the *clearcut method*, all the trees in a unit are harvested in one operation, and the area is reforested by planting trees or natural seeding.

The *seed tree method* is like a clearcut, except that 5 to 10 trees per acre are left evenly distributed across the site to produce tree seed. The seed trees are usually removed after new seedlings are established.

The *shelterwood method* is similar to the seed tree method, except that more trees are left to shelter the site. This method is commonly used on hot or frosty sites. Shelterwood harvests may be made in two or three cuts, where small trees are removed in one harvest, more trees are removed in a second seed cut, and finally the seed trees are removed in a third harvest after the new seedlings have become well established.



Small trees are not always younger, as shown in these cross-sections (top) of two grand firs of the same age which were growing next to each other. Diameter limit cuts (bottom) are usually a harmful form of "selective" logging.

The *selection method* maintains a range of desired tree sizes, species, and ages by harvesting individual trees or small groups of trees. Groups are usually 1/4 to 1/2 acre, or 10 to 50 trees, depending on tree size. Each harvest thins the stand somewhat. Because individual tree selection maintains a fairly shady environment, it is often best suited to sites that can sustain shade tolerant trees over the long term.

The first three methods produce an even-aged stand—one in which all the trees in the forest canopy are nearly the same age. Historically, many Inland Northwest forests were even-aged because new trees seeded in after major fires. The selection method regenerates and maintains a multi-aged stand.

Simply taking the largest trees or all the trees over a minimum diameter (a "diameter limit" cut) is *not* employing the selection regeneration method. Many forests have been degraded by often well-intentioned but harmful "selective" logging of this kind. The small trees left are not necessarily younger; they are commonly the same age as the trees removed. They may be incapable of taking advantage of the new space, and often have undesirable characteristics, not the least of which is shorter height and slower growth.

Timber harvests should be tailored to forest conditions [eg: a dry site (top) vs. a moist site (middle)] and landowner goals. Shade-intolerant species such as larch (bottom) need more sunlight to grow and reproduce.

The choice of regeneration method depends on site characteristics, current stand conditions, management goals, wildlife needs, logging conditions, and desired species, among other factors.

The growing conditions needed by specific trees and other plants and animals you want to have on the property are of primary importance. A professional forester can help you assess those conditions and choose a method that reflects your site conditions and goals.

Pre-commercial thinning (top); Commercial thinning (bottom).

thinning

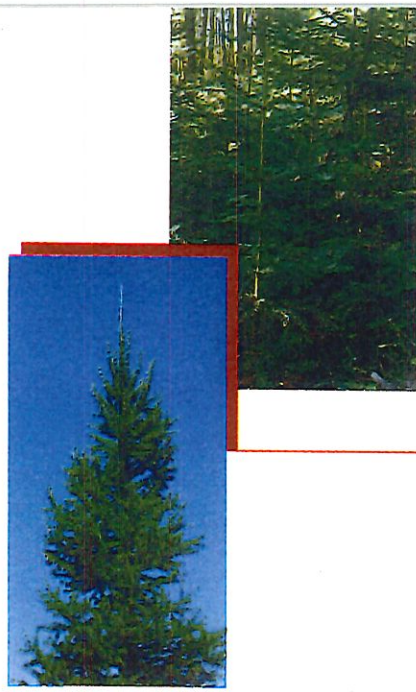
Under even-aged silvicultural systems, there is usually at least one thinning before starting another regeneration cycle. A thinning removes trees to reduce stand density. The primary purpose of a thinning is to reduce competition and enhance the growth of remaining trees. Thinning can also remove suppressed or undesirable trees, improve species composition, harvest trees that are likely to die, reduce insect and disease problems, improve wildlife habitat, or help reach other environmental goals. While stand regeneration is not an immediate goal of thinning, it should be considered in order to make sure you are leaving desired species for seed sources if you intend to rely on natural seeding in the future.

A thinning may be either *pre-commercial*, when trees are too small to be sold for wood products, or *commercial*, when trees are large enough to be sold. Stocking level (the space left between trees) can be varied according to site needs and management objectives.

SPECIES

Regardless of the type of harvest or thinning, remember that seeing a tree in the forest doesn't always mean it's a good species to favor. Favor those tree species that are **best adapted to the site** over the **long term** and meet your management objectives.

Forests grow and develop in a process called *succession.* Succession commonly starts with *shade intolerant* species such as pines or larch. These trees compete by growing very fast, taking full advantage of space created by a disturbance, such as a wind storm, insects, disease, or fire. Historically, the most common disturbance in the Inland Northwest has been fire.



Shade Intolerant Tree Species
(tend to occur earlier in succession)

- *western larch*
- *lodgepole pine*
- *ponderosa pine*
- *western white pine*
- *Douglas-fir*
- *Engelmann spruce*
- *subalpine fir*
- *grand fir*
- *western red cedar*
- *western hemlock*

Shade Tolerant Tree Species
(tend to occur later in succession)

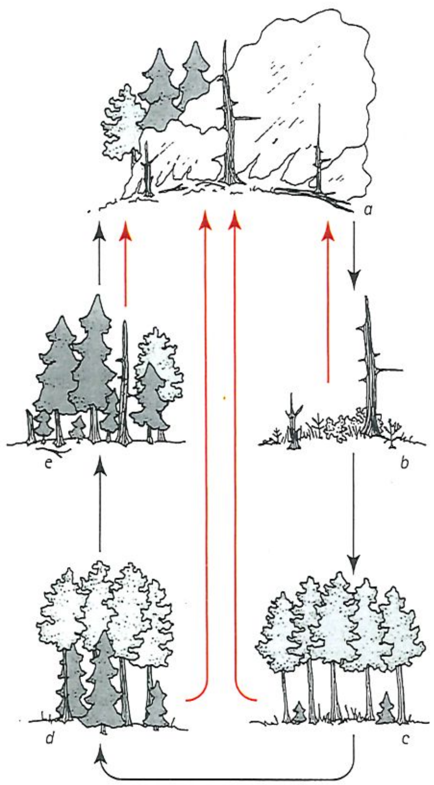
Shade tolerant species (e.g. grand fir - top) may survive shade to grow faster and "release" later if they were not overly suppressed. Shade intolerant species (e.g. larch - middle) grow very fast and take quick advantage of open space created by disturbance.

Over time, other species that are more *shade tolerant* become more prominent in the stand. This process continues (barring more disturbance). The end result is a *climax forest*, which is dominated by the most shade tolerant species that the site can support.

Succession follows different paths, depending on a site's moisture, soil, and other factors. On a moist site, succession might climax in a canopy of cedar and hemlock trees. On a drier site, Douglas-fir might be the climax species.

Historically, many Inland Northwest forests never reached the climax stage. A stand replacement fire or some other disturbance interrupted and started the process of succession all over again.

Succession in moist forests of the Inland Northwest/Northern Rockies

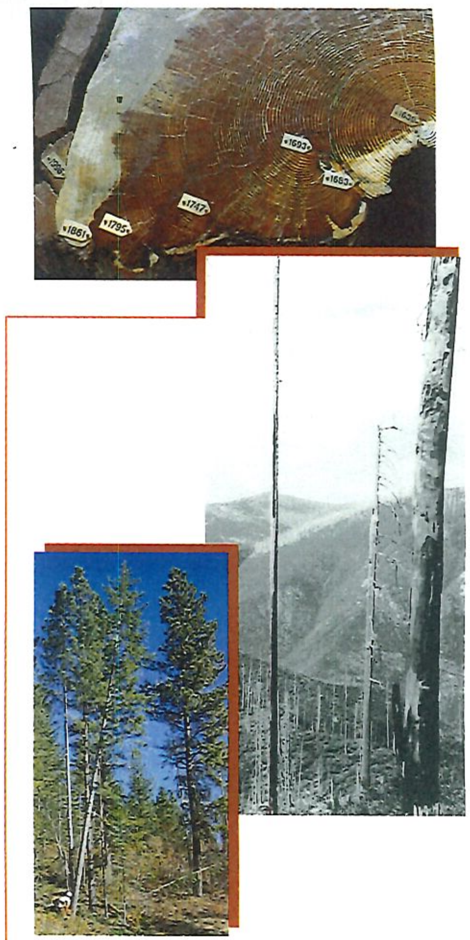


a. Fire
b. Grass, brush, young trees
c. Shade intolerant trees dominate
d. Shade tolerant trees increasing
e. Climax forest (with shade tolerant trees dominating)

Succession in western forests has also been shaped by ground fires, which occurred every 5 to 60 years, depending on the site. Ground fires killed small trees coming up in the understory and left large trees with thick, fire-resistant bark. Historically, drier sites rarely had stand replacement fires, because frequent ground fires reduced fuels and maintained open stands of ponderosa pine.

On many forests we have altered the natural pattern of succession by: (1) excluding fire, (2) preferentially harvesting shade intolerant species, such as pines and larch, and by (3) introducing exotic plants, insects, and diseases, such as white pine blister rust.

These factors have created denser forests with more shade tolerant trees than in the past, when fires resulted in higher proportions of wider-spaced, shade-intolerant species. In some cases, past grazing practices have affected forests as well.



Ground fires and stand replacing fires were historically common in the Inland Northwest. Scars on the cross-section of the tree (top) are from five ground fires in the Idaho Panhandle National Forest. The 1910 fires (middle, taken in the thirties) included extensive stand replacing fires. Preferentially cutting shade tolerant trees (bottom) can partially compensate for fire exclusion.

What does all this mean when choosing species that were well adapted to the site? Partial harvests tend to favor shade tolerant trees. Shade tolerant species tend to be less adapted to drought cycles and, consequently, less resistant over the long term to insects and disease. If we want healthy forests—and we want to limit wildfires—we must compensate for the lack of fire by preferentially cutting shade tolerant trees, especially on drier sites. We can also choose silvicultural systems that allow more light into stands, so shade intolerant trees can establish and grow better.

It is also good to favor a mix of species across the forest, within the range of species that are well adapted to the site for the long term. If you don't have much of a mix to start with, and you know the site will support different trees, pay extra attention to leaving individual trees of infrequent but well-adapted species. You can also reintroduce such species by planting.

TREE GROWTH AND FORM

If you want a better genetic pool in your forest and you are relying on natural regeneration rather than, or in addition to, planted seedlings, you must leave higher quality trees for seed.

Foresters consider many criteria in side-by-side comparisons of adjacent trees, to decide which trees to cut and which to leave. In addition to desired spacing and species, *leave trees* are chosen based on: (1) their ability to produce a larger volume of higher quality wood, and (2) the likelihood they will pass on desirable characteristics to tree seedlings, thus improving the genetic quality of the forest. In fact, *successive partial harvests made without considering leave tree quality often erode the genetic quality of forest trees.*

In general, cut "the weak, the sick, and the lame" and leave higher quality trees. Leaving trees with more vigorous growth and better form promotes a higher return in future harvests, because they grow faster, are stronger, and produce logs with higher quality wood. These trees may also pass on their characteristics to new tree seedlings. To decide what to leave, look for characteristics that indicate vigorous growth, stronger structure, and more usable wood.

Leaving the best trees promotes greater returns in future harvests and can improve stand genetics as superior trees pass their genes on to new trees.

In the forest, we can only choose leave trees on the basis of characteristics we can see. It is often difficult to determine the degree to which those differences are due to genetics (which means the trait is heritable) or its environment. For example, a tree may have large branches because of genetics, or because it has grown in an open environment, or both.

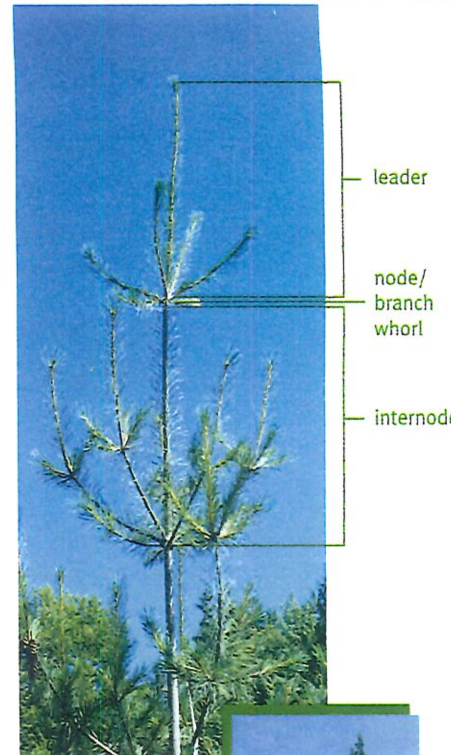
It doesn't necessarily matter whether a tree's characteristics are primarily due to environment—cutting poor quality trees creates more space for higher quality adjacent trees that promise better growth.

It may be acceptable to leave a poorly formed tree to grow when it is the only tree available to use the space and you plan to remove it in another cut (before relying on it for seed). You may not be able to solve all stand problems in one cutting, but you can slowly improve the forest. Your ultimate goal is high quality growing stock.

NOTE: The following ratings are used as a general tool to weigh multiple criteria when choosing leave trees. They are based on: genetic inheritance, importance to tree structure/health, or likelihood of characteristic affecting other trees (e.g. mistletoe). They should be adjusted as needed according to specific site conditions and management objectives. Talk to local foresters about adjusting these ratings for your locale.

★★★ **Very Important**
★★☆ **Important**
★☆☆ **Somewhat Important**

TREE GROWTH AND FORM



A long leader (top) or sharply pointed top (bottom) indicates good height growth—a key trait to look for in leave trees.

height growth

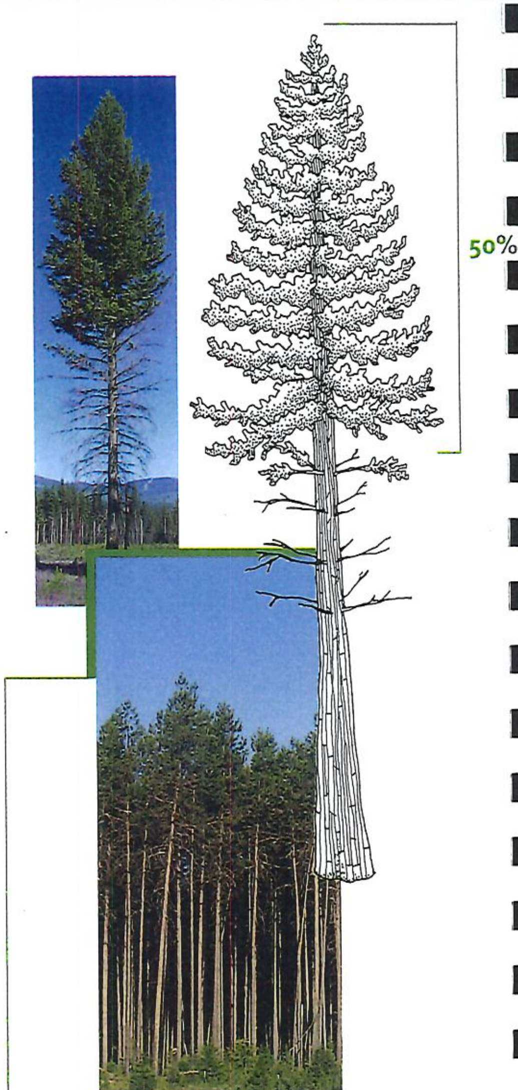
One way to assess height growth is to look for sharply pointed top. Trees with sharply pointed tops are generally more actively growing in height. Trees that are growing slowly in height often have more flat or rounded tops.

Another way to assess height growth on white and ponderosa pines is to look at the leader and the internodes. Every year these pines put on a clearly identifiable vertical shoot called a *leader* and a new set of horizontal branches called a *whorl*. These horizontal branches grow from *nodes*. The distances between nodes are called *internodes*. An internode usually represents one year of growth in height on these species. Longer internodes or a long leader on top of the tree indicate more vigorous growth.

Good height growth is one of the most important traits to look for in leave trees. Tree height is a better indicator of the growth ability of the tree than tree diameter, which is more affected by spacing and crown form.

Height growth can also be estimated by measuring internodes on Douglas-fir, true firs, and other conifers, but other species can be more difficult to assess because they put out internodal branches and/or false whorls as well as nodal branches.

Importance: ★★★



Leave trees with at least a 30-40% crown ratio (top). Silvicultural options are more limited if you wait to thin until all the trees in a stand have small crowns (bottom).

crown ratio

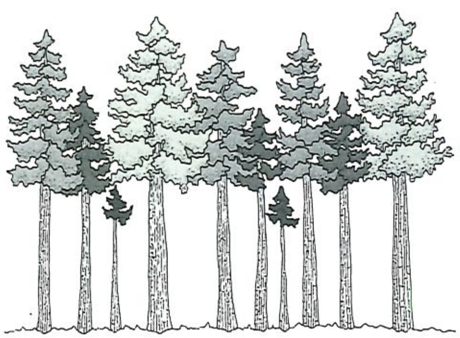
A *crown* is the portion of the tree with live branches. The *crown ratio* is the percentage of a tree's height with living branches. For example, a 50 percent crown ratio means that 50 percent of the tree's total height has living branches.

Leave trees with at least a 30 to 40 percent crown ratio. Trees with smaller crowns are less able to take advantage of the growing space provided in thinnings and partial harvests. It is also good for the crown to be fairly symmetrical rather than lopsided.

If all the trees in a stand have small crown ratios from growing too close together for many years, thinning can be risky. Such stands can sometimes be thinned in small increments over a period of years to help remaining trees develop larger crowns and become more *windfirm* (able to withstand strong winds). If this is not feasible, a clear-cut and re-planting is a reasonable alternative.

Importance: ★★★

canopy



crown class

Generally, we identify an individual tree's position in a stand by describing its *crown class.*

Trees compete below the ground for water, nutrients, and space, and above the ground for light. As trees compete with each other, the poorer competitors' crowns lag behind in the forest canopy relative to the better competitors.

Trees with crowns that extend above the general canopy level of the stand, and get sunlight from above and sides, are called *dominants.*

Trees forming the general level of the crown canopy, that get sunlight from above and a little light from the sides, are called *codominants.*

Trees with crowns that have begun to lag below the canopy, but are still receiving some sunlight from overhead, are called *intermediates.*

Trees with crowns that have lagged completely below the general canopy are called *suppressed.*

In most cases, leave dominant and codominant trees rather than intermediate or suppressed trees.

Suppressed trees are more likely to be windthrown (top) after harvest, especially in a formerly dense stand. Suppressed trees (bottom) are also often unable to take advantage of additional light, water, and nutrients after adjacent trees are removed.

Dominants and codominants usually have fuller crowns and can, therefore, make better use of the additional light, water, and nutrients after adjacent trees are removed. Because they are higher in the forest canopy, they have been more exposed to wind and will be more windfirm when adjacent trees are cut.

In an uneven-aged stand, crown differences may be more a product of tree age or species differences than competition; there may not be as much genetic gain. However, dominant and codominant trees' ability to use growing space and withstand wind would still apply.

Importance: ★★★

Trees with pointy tops (left) tend to be younger than flat or round-topped trees (right). Old ponderosa pine bark is "plate-like" and orange to yellow (top); younger ponderosa bark is gray to black (bottom).

tree age

To improve stand vigor and growth, keep younger, more vigorous trees rather than older trees whose growth has slowed.

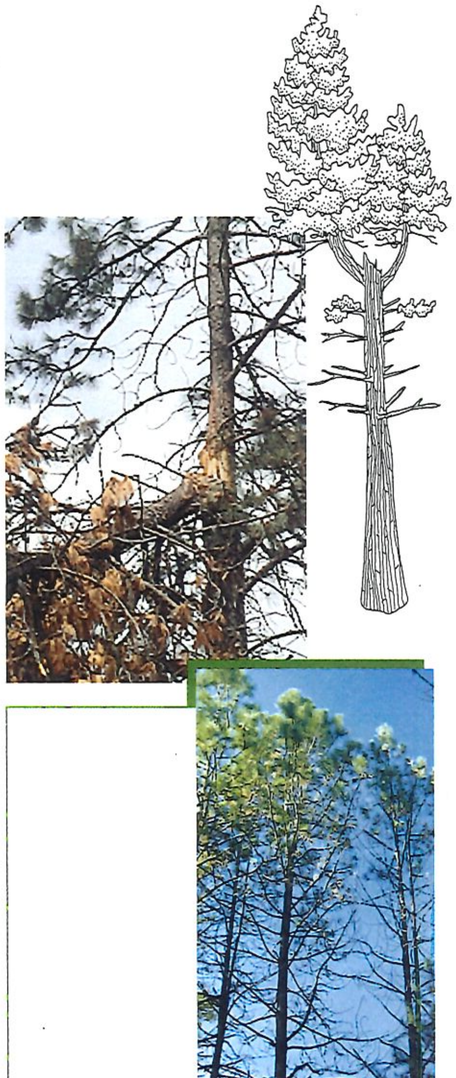
While you can use an increment borer and count growth rings to determine age, that is usually impractical to do for every tree in the stand.

One way of judging the relative age of a tree is by looking at its top. Trees with sharply pointed tops tend to be younger than flat or round-topped trees.

Age can also be roughly inferred from bark characteristics. A small diameter tree with bark that looks like one of its old cousins is likely a slow growing, older tree. For example, old ponderosa pine bark is plate-like and orange to yellow, while younger ponderosa bark tends to be more gray to black.

Don't forget: a large tree is not necessarily an old tree and a small tree is not always young. You may also want to keep some older trees for wildlife or other values.

Importance: ★★☆



Forks create a weak point, where the tree is more likely to break from heavy wind or snow (top). Forked trees are more likely to have offspring with forks (bottom).

forked tops

Remove trees with forked tops or broken tops (these often become forked later).

Forks create a weak point in the tree, where it is much more likely to break from heavy wind or snow loads. Forks also make trees less valuable at harvest. Even if the fork happens to occur where the log will be cut, the value of one large diameter log is usually greater than that of two small logs that grow from the same fork.

A forked tree is also more likely to have offspring with forks. Even if the fork was caused by porcupine damage, there may be a genetic component because some trees are more likely to recover from top damage by forming a single top while others are more likely to form multiple tops. Moreover, there is often a genetic dimension to insect, disease, or animal damage resistance.

Leave a forked or broken top tree only if it will provide valuable wildlife habitat, or it is growing more vigorously than its neighbors and you plan to harvest it in another entry, before relying on it for seed.

Importance: ★★★

Poor foliage quality and vigor (right trees on top and in the middle), or sparse, thin crowns (bottom) may indicate insect or disease problems.

Poor foliage quality and vigor (right trees on top and in the middle), or sparse, thin crowns (bottom) may indicate insect or disease problems.

foliage quality and vigor

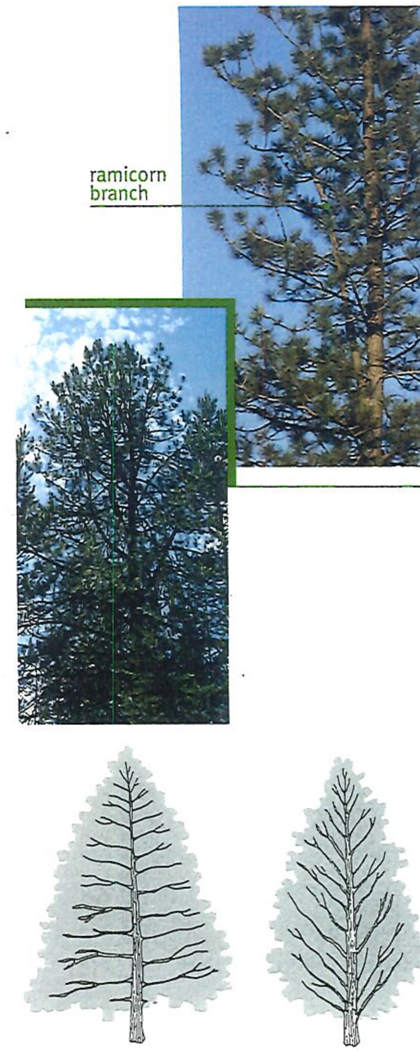
Leave trees with abundant, full needles, and good color and length for their species.

Trees with sparse, thin crowns or yellowish needles are often not growing well. These symptoms may also indicate insect or disease problems that will kill the tree before the next harvest entry.

Some needle loss is normal, particularly in the fall when many conifers drop their oldest needles. Some needle diseases cause older, interior needles to drop in the spring, but these trees usually survive. If you are unsure, a forester can help you determine whether a sparse crown is a permanent or temporary condition.

Poor foliage quality and vigor may also indicate poor site fertility. Consult with local foresters about fertilization or other possible responses to this.

Importance: ★★★



A ramicorn branch (top) creates a weak point in a tree. The "wolfy" tree (middle pine) would be less desirable for seed, but might be a good wildlife tree. Branch angles of 90° (bottom left) are preferred over sharper branch angles (bottom right).

branches

Look for strong branches. Ideally, lateral branches should grow 90 degrees from the tree trunk. Leave trees that put more of their growth into the main stem of the tree—trees with branches that are medium in diameter and length, rather than trees with overly large (wolfy) branches. Also, leave those trees that self-prune (shed) lower branches earlier than adjacent trees.

Branches with sharp angles form larger knots and are more weakly attached to the tree. They form places where a tree is more likely to break in a wind storm or under heavy snow loads. This is especially true for a *ramicorn* branch, which is a large, sharp-angled branch somewhat similar to a forked top.

Self-pruning trees grow clear wood sooner, and have less fire risk because there are fewer branches for fire to use as a ladder to spread up to the crown.

Trees grown in the open tend to have larger branches and do not self-prune as well. Also, some species (such as white pine or larch) tend to have more desirable branch habits than others (such as ponderosa pine).

Importance: ★★☆
★★★ **(ramicorn branches)**

Good cone production is especially important on species with infrequent seed years, such as larch (top). Excessive cone production in this thin-crowned Douglas-fir (bottom) indicates tree stress.

cone production

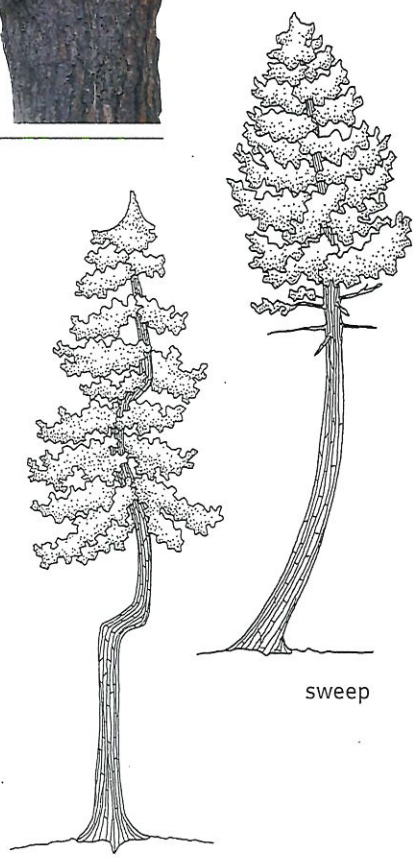
Leave vigorous, full-crowned trees with ample cones or other evidence of cone production, especially on species with infrequent seed years such as larch.

If you are not relying on natural tree seeding for reproduction, cone production may become less important.

If the tree's crown is sparse, or the tree shows other signs of low vigor, don't favor it for the sake of cone production, unless you plan to remove it within a couple of years.

Importance: ★☆☆

hip canker



sweep

crook

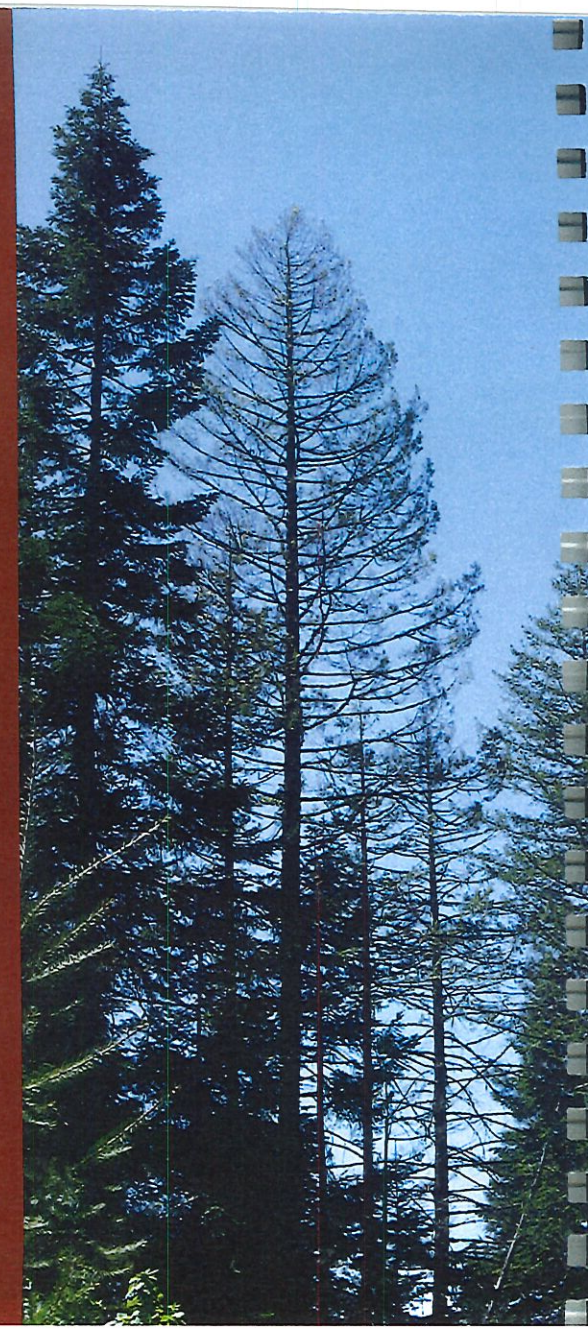
This "hip canker" (top) forms a weak point in the tree.

bole

Leave trees with straight boles (trunks) rather than trees with *crook, sweep, excessive taper,* or other deformities.

Crooked or swept trees tend to be weaker structurally and produce fewer boards. Stem form can be highly influenced by environmental factors. Trees on steep slopes often have more sweep. Otherwise, sweep may be genetically influenced. Open-grown trees tend to have more taper. Some species such as western red cedar also tend to have more taper.

Importance: ★★☆



INSECTS AND DISEASE

Native insects and diseases are a natural part of the forest. Every tree species has insects and diseases that attack it, particularly when a tree is stressed by drought or other factors. However, sometimes these organisms damage more trees than we can accept, especially if we have unintentionally created a favorable environment for them (by allowing forests to become too dense or heavily composed of less-adapted tree species).

The best insurance against forest insect and disease problems is to leave the best species for the site at an adequate spacing. Having done that, try to remove individual trees with high risk of insect or disease problems. In some cases, removing trees with insect or disease symptoms can help improve forest health by reducing the population of a detrimental organism. Removing these trees creates more growing space for the remaining healthy trees, helping them to grow more vigorously and making them less vulnerable to insects and disease. Finally, leaving trees that are less affected by damaging organisms also promotes genetically inherited insect or disease resistance.

Leaving the best species for the site, at an adequate spacing, is the best insurance against forest insect and disease problems. Native insects and fungi (bottom) are a natural part of the forest—most do not kill trees.

Forest insect and disease problems are often difficult to diagnose and treat. A forester can help you respond to the variety of conditions that allow insects and diseases to threaten forest health. However, there are some symptoms you should watch for as you cut individual trees.

Bark beetles are small insects (top) that feed in the inner bark of a tree. Tree crowns fading from yellow, to red, to brown (middle) often indicate bark beetles. "Pitch tubes" (bottom left and right) from pine bark beetles.

bark beetles

Bark beetles are a common problem in western conifers, especially in overstocked stands. The first symptom you'll notice is individual trees or groups of trees with crowns that are fading to yellow, to red, to brown. On pines, you may see thumbnail-sized globs of pitch mixed with boring dust called *pitch tubes* on the trunk. On Douglas-fir, you may see long *pitch streaming* from high in the trunk of the tree, or boring dust in the bark crevices. In true firs (trees in the genus *Abies*—e.g., grand fir, white fir, etc.), you may see uplifted pieces of bark from previous and grown-over attacks by fir engraver beetles. On many species, you may also see small, white, popcorn-like conks from *pouch fungus*, a sapwood decay fungus that is carried into the tree by bark beetles.

Bark beetles bore into bark and feed in the phloem (inner bark). They lay eggs there, which hatch into larvae that feed as well. Bark beetle feeding can girdle the tree and kill it. Tree death is hastened by blue stain fungi, which is carried into the tree by bark beetles and plugs the water conducting tissues in the sapwood.

INSECTS AND DISEASE

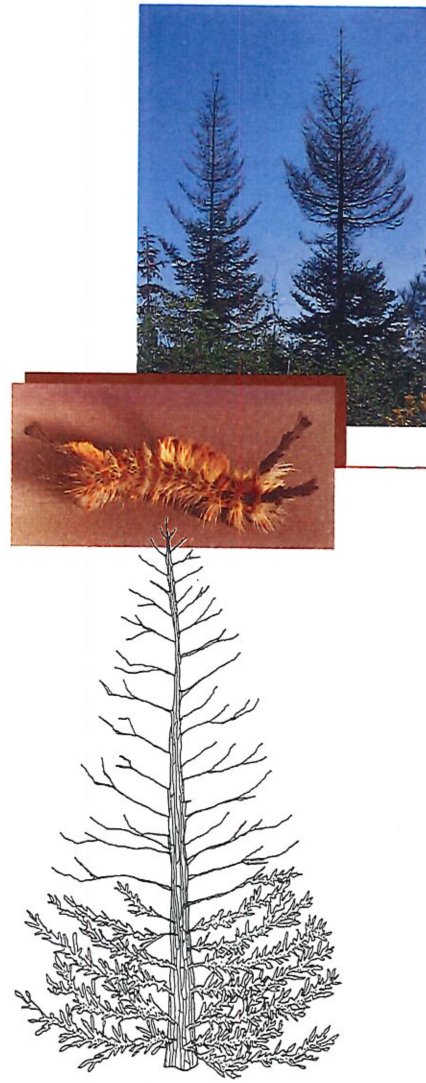
Boring frass (top) from Douglas-fir beetles. Uplifted or bubbled bark (middle) from past fir engraver beetle attacks which have degraded the wood underneath. Pouch fungus conks (bottom).

Many times, beetle attacked trees can be salvaged (harvested) before they lose too much value. Don't just take the dead trees when salvaging. Look also for evidence of attacks on nearby green trees. Thinning the rest of the stand can increase trees' vigor and enhance their resistance to bark beetles.

If beetles have killed a tree and their offspring have gone, it can be left for wildlife.

Large pinkish pitch tubes confined to the bottom six feet of a pine indicate turpentine beetle, a bark beetle that seldom kills trees.

Importance: ★★☆



Mature Douglas-fir tussock moth larvae (middle). Consider removing trees with tops killed by defoliators (top, bottom).

defoliators

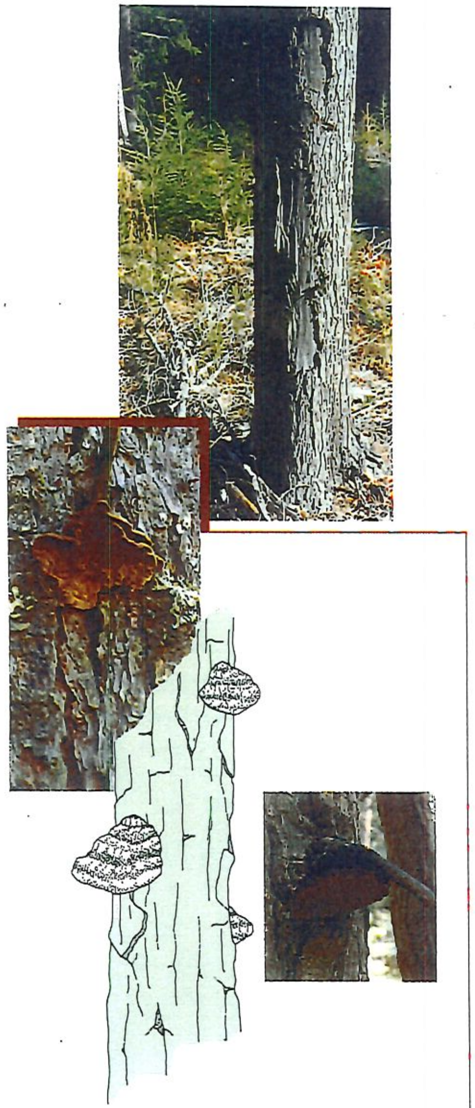
Western spruce budworm, Douglas-fir tussock moth, and other defoliating insects eat conifer needles. Their feeding can slow the tree's growth, kill the top, or even kill the whole tree.

Many times, a tree can survive some defoliation. However, if a tree is so heavily denuded that survival is unlikely or a dead top will result, cut it unless you want to keep it for a wildlife snag.

Defoliation survival often varies by locality. Heavy defoliation often occurs where marginally adapted species dominate a site. A local forester experienced with these insects can help you decide how well your trees may recover from defoliation.

Removing heavily defoliated trees can also give an added advantage to any trees that resisted insect damage—to pass on any genetic characteristics that may have accounted for their resistance.

Importance: ★★☆



Scarred hemlock and true firs (top) are more vulnerable to stem decay. Conks from stem decay: white pocket rot Phellinus pini *(middle) and Indian Paint fungus* Echinodontium tinctorium *(bottom).*

stem decays

Conks are the fruiting bodies of wood decaying fungi. They are often the most visible evidence of stem decays, which rot the heartwood of a tree, making it weaker structurally and unusable for wood products. Remove trees with conks or those you suspect of having stem decay.

Trees with stem decay are infected long before you see conks. If a site has strong potential for stem decay problems, preemptively cutting older trees of the species most likely to be infected salvages more wood before the decay worsens. Favor tree species less likely to be infected.

Also remove physically damaged trees. Because hemlock and true firs with scars from logging or other causes are more vulnerable to stem decays, it is better to give that growing space to trees with less risk of disease.

If the tree will make a good wildlife snag, and will not interfere with your silvicultural objectives, consider leaving it. Leaving trees with conks will not increase infection of nearby susceptible trees.

Importance: ★★☆

Branch flagging (top) from white pine blister rust; Blister rust canker on main stem (middle); Blister rust branch canker (bottom).

white pine blister rust

White pine blister rust is a non-native disease that starts in the needles of a white pine and spreads down the branch to the trunk where it kills the tree above that point. The first visible evidence of blister rust infection is flagging branches. You will also usually see pitch streaming around cankers. Cankers are sunken or swollen areas on branches or the bole (trunk). Cut white pine trees with severe blister rust infections unless you want to leave them for wildlife or other values.

Trees with bole cankers or many cankers close to the bole will die soon. If a tree has no cankers or only branch cankers, more than two feet from the bole, consider keeping it, as it may be successfully resisting the rust. Pruning the lower branches of white pine provides additional blister rust prevention.

Importance: ★★☆

Basal pitching (top) from Armillaria root disease; Sparse, thinning crown (middle) from root disease; Root disease predisposes trees to windthrow (bottom).

root diseases

Root diseases are a problem in many Inland Northwest forests, partly because of the large percentage of Douglas-fir or true firs on sites better suited to pines and other shade intolerant species. A sparse crown with poor growth may indicate a tree with root disease. Other symptoms include pitching at the base of the tree and trees fallen in all directions, with badly decayed roots.

Cut trees that appear to be affected by root diseases, unless you want to leave them for wildlife snags or other values.

The main goal on root disease sites is to encourage shade intolerant species, such as larch or pine, which are more resistant to root diseases. Root diseases can be particularly difficult to diagnose and treat. A forester can help you with identification and treatment.

Importance: ★★★

Witches brooms (top) on larch; Mistletoes can severely limit tree growth (middle); Dwarf mistletoe plant (bottom) on ponderosa pine.

witches brooms

Witches brooms are large, dense masses of branches that can be caused by several diseases and conditions. They are most commonly caused by dwarf mistletoes—parasitic plants that reduce the health of many of our native conifers, especially pines, larch, and Douglas-fir.

Cutting or girdling trees infected with mistletoe will prevent the mistletoe from infecting smaller trees of the same species growing near them.

Importance: ★★★

FOREST STRUCTURE AND FUNCTION

A forest ecosystem is a complex of living and non-living elements which interrelate. An ecosystem can be small (like your backyard) or large (like the planet earth). It depends on the range of individual species or group of species being discussed (e.g.: a salmon stock or a forest type), geology (e.g.: a mountain range or watershed), and other issues.

Perhaps what is more important than ecosystem size is the ecosystem *concept*—that most biological organisms and other natural resources in an ecosystem are interrelated one way or another. Everything you do with both living and dead trees impacts both positively and negatively many other biological organisms, which may or may not live directly on your property. The impacts can vary from slight to profound.

Ecosystems are dynamic and complex. We are constantly learning more about sustaining them. We can strengthen or weaken forest ecosystems by modifying forest structure in partial harvest practices.

A soft snag (top); Snags are used by many wildlife species such as the osprey (middle) and pileated woodpecker (bottom).

snags

Many forest organisms benefit from both horizontal and vertical diversity. *Horizontal diversity* is created by large and small habitat patches of different successional stages distributed across a landscape. Horizontal diversity is thus affected by the disturbances you and other landowners create through silvicultural practices and other land uses. Some forest species also need *vertical diversity*, which is formed by living and dead standing trees.

Snags are dead standing trees that benefit cavity-nesting animals and the species they feed on. A *hard snag* has intact bark and firm wood. A *soft snag* has some bark remaining and the wood is beginning to decay and soften.

Trees don't live forever. When they die, they don't stop being important to forest structure and function. Leaving hard snags, soft snags, and green trees (for future snags) distributed over the area will benefit birds, bats, and other wildlife. Leave snags from a diversity of species (usually the bigger the better).

Potential snags can be girdled (middle) to prevent a tree from producing seedlings; Trees with stem decays (bottom) are good candidates for snags.

Many people prefer to leave the least valuable trees on the site for snags, especially if they already show signs of animal use, such as woodpecker activity or cavities. Trees that are heavily affected by insects and disease are often good candidates for snags, especially if they are too deteriorated to be of much value for wood.

Leaving low-value, living snags can present a conflict, if those trees have undesirable genetic characteristics. One option is to *girdle* these trees in order to kill them so they provide habitat without passing their genes on to seedlings. Another option is to leave living wildlife trees at the edge of the stand where they will have less effect on reforestation.

Logs on the ground eventually improve forest soils (top) and are used by wildlife such as this pine marten (middle). Logs with extensive decay (bottom) are good candidates to leave on site.

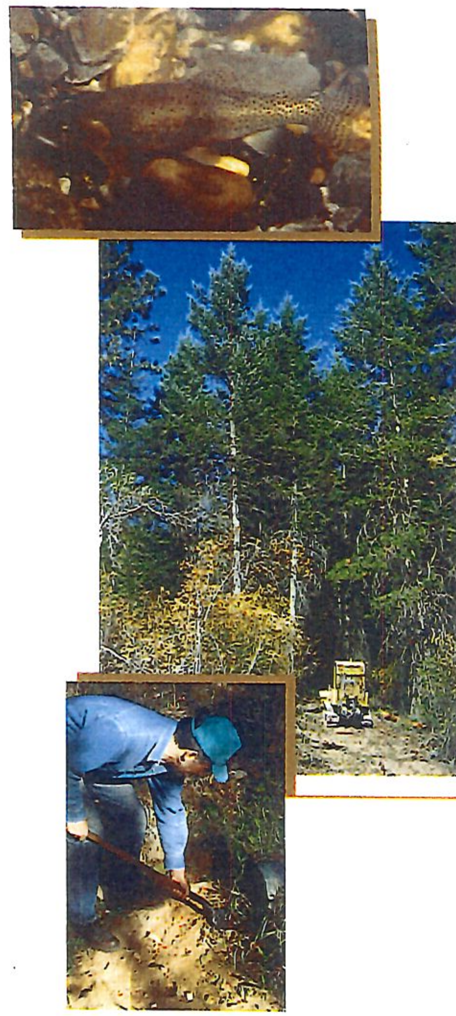
organic debris

Organic debris includes needles, branches, and stemwood left on the ground. Stay within fire hazard limitations, but try to leave as much debris as possible spread throughout the site.

Wood left in the forest is not necessarily wasted. Forest scientists are learning more and more about the importance of leaves, branches, and large pieces of logs left scattered across the site for nutrient cycling and forest growth.

Logs on the ground also provide important habitat for a variety of beneficial forest organisms and fungi. Larger logs with bark are usually preferred.

Some types of green woody debris (*slash*) left at the wrong time of year can provide a breeding ground for certain species of bark beetles, such as Douglas-fir beetles and pine engraver beetles (Ips). Their offspring later emerge from slash and often attack standing trees. If you plan to leave green slash larger than three inches in diameter, check with your local forester about bark beetle concerns.



Sediment from poorly maintained roads can degrade habitat for fish, such as for this cutthroat trout (top); Try to re-use old skid trails (middle) in partial harvest entries; Maintaining culverts (bottom) keeps roads useful and reduces road failures that produce sediment.

water quality

The aquatic parts of ecosystems are maintained by protecting riparian areas and by minimizing sediment sent to streams. A major source of forest stream deterioration can be sediment from forest roads. More roads and skid trails, and more use of them in repeated harvest entries bring a corresponding potential increase in sediment sent to streams.

You can compensate for additional road and skid trail use by designating fewer skid trails, in stable locations, reusing those trails in later harvests, and by using other less disturbing logging methods.

State forest practice laws set minimum standards for logging methods and for other forest practices to help enhance water quality. The Natural Resource Conservation Service can help identify critical areas of potential soil erosion. There are also a number of Extension publications and other resources to help you manage water resources more effectively.

PHOTO CREDITS

All photographs are from the *University of Idaho Cooperative Extension System* except:

Brent Flint (cover, p.16)
Museum of North Idaho (p.22 middle)
Idaho Department of Lands (p.48, p.54 top, p.60 top, p.66 middle, p.66 bottom)
U.S. Forest Service (p.56 top, p.60 middle, p.64 middle, p.64 bottom, p.66 top, p.74 bottom, p.80 top)
Adirondack Photography (p.78 middle)

VIDEO

This publication is a companion to the University of Idaho video titled *I want to log "selectively,"* from which it was adapted.

The video can be purchased for $24.95 from the Department of Agricultural and Extension Education, College of Agriculture, 1134 West Sixth Street, Moscow, ID 83844-2040.

I want to log "selectively" was developed with the assistance of the following members of a Quality Assurance Committee:

- Lauren Fins
  Professor, UI Forest Resource Dept.
- Norm Bratlie
  Bratlie Forestry, Inc.
- Steve Cuvala, IDL
- William E. Schlosser
  Extension Educator—Forestry,
  UI Cooperative Extension
- Jeff Pennick
  Sandpoint Ranger District, USFS
- Wes & Gertie Hanson, forest owners
- Dave McNelis, forest owner
- Richard Korst, forest owner
- Wayne Clizer, forest owner
- Al Farnsworth, forest owner
- Kim Duffy, forest owner
- Orrin Chapman
  logger/thinning operator
- Paul Barnhart
  logger/thinning operator
- Bill Morris
  logger/thinning operator
- Ray Mortensen II
  logger/thinning operator

The video script was also reviewed by:

- Dave Adams
  Professor, UI Forest Resources Dept.
- Steve Fitzgerald
  Forestry Agent, OSU
- Paul Oester
  Forestry Agent, OSU
- Peter Griessmann
  Area Extension Agent—
  Natural Resources, WSU
- Don Hanley
  Extension Forestry Specialist, WSU
- Ron Mahoney
  Extension Forestry Specialist, UI
- G. Kirk David
  Service Forestry Coordinator, IDL
- Bob Logan
  Extension Forestry & Natural
  Resources Specialist, MSU
- Mark Weadick, Silviculturist, IDL
- Don Gunter
  Silviculturist, Bonners Ferry
  Ranger District, USFS
- Bob Playfair, forest owner
- Ladd Livingston
  Forest Entomologist, IDL
- Bob Mathiasen
  Forest Pathologist, IDL
- John Schwandt
  Forest Pathologist, USFS
- Sandy Kegley
  Forest Entomologist, USFS
- Bill Wall
  Wildlife Biologist, Potlatch Corp.
- Kerry Reese
  Professor, UI Fish & Wildlife
  Resources Dept.
- W. Daniel Edge
  Extension Wildlife Specialist, OSU

RESOURCES

The following publications are also of value to those who want to implement partial harvests that improve forest health and meet landowner expectations. Some of these publications are downloadable from the internet addresses listed here.

University of Idaho

Genetic improvement of woodland ecosystems in the Pacific Northwest (BUL 774) $2.00

Evaluating wildlife habitat for managing private forest ecosystems in the Inland Northwest (BUL 60) $1.50

Calculating timber removal costs under ecosystem management (BUL 62) $1.50

Contracting for timber harvest under ecosystem management (BUL 63) $1.50

Diameter limit cutting: a questionable practice (CIS 630) $.25

Evaluating forest ecosystems for silvicultural prescriptions and ecosystem management planning (BUL 59) $1.50

Selling woodland timber: contract decisions (EXT 759) $.50

Ag Publications, University of Idaho, Moscow, ID 83844-2240, phone (208) 885-7982; fax (208) 885-4648; email: cking@uidaho.edu; http://info.ag.uidaho.edu

Washington State University

Timber harvesting alternatives (EB 1316) $1.50

Is there a place for fish and wildlife in your woodland? (MISC 132) $1.00

Managing ponderosa pine woodlands for fish and wildlife (MISC 158) $1.00

Managing small woodlands for cavity nesting birds (MISC 160) $1.00

Managing your timber sale (EB 1818) $1.50

Forest stewardship planning workbook—an ecosystem approach to managing your forest (PNW 490) $2.00

Bulletin Office, Cooperative Extension, Cooper Publications Building, Pullman, WA 99164-5912, phone (509) 335-2857; http://caheinfo.wsu.edu/pub_home_page/pub.html

Oregon State University

Using pre-commercial thinning to enhance woodland productivity (EC 1189) $2.00

Road construction on woodland properties (EC 1135) $2.00

Designated skid trails minimize soil compaction (EC 1110) $1.50

Impacts of forest practices on surface erosion (PNW 195) $.50

Slope stability on forest land (PNW 209) $.75

Thinning: an important timber management tool (PNW 184) $.50

Extension & Experiment Station Communications, Administrative Services A422, Corvallis OR 97331-2119, phone (541) 737-2513; http://eesc.orst.edu/agcomwebfile/edmat/