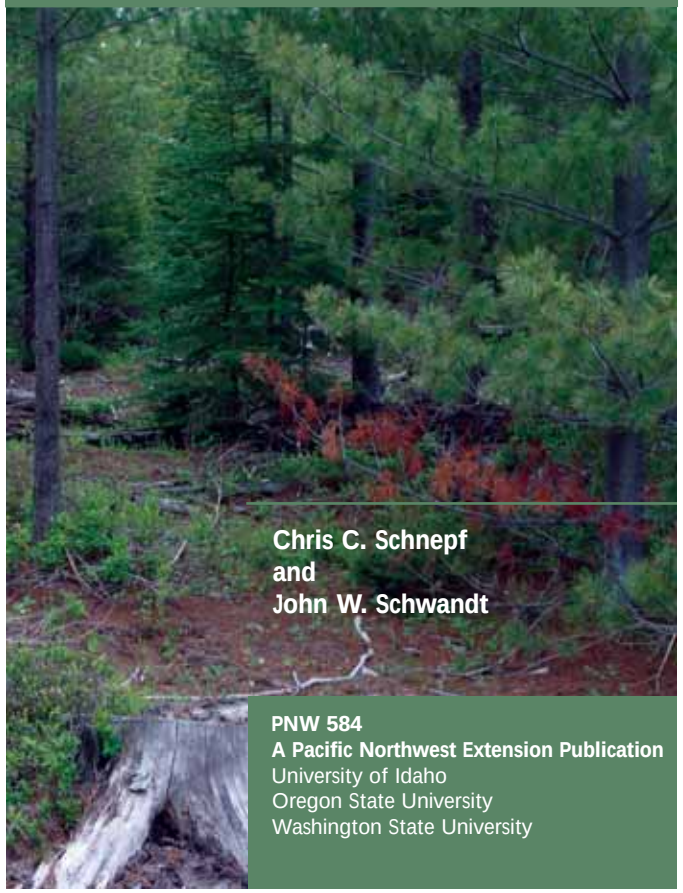
Pruning Western White Pine

A Vital Tool for Species Restoration



Chris C. Schnepf
and
John W. Schwandt

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University of Idaho
Oregon State University
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Cover photo

Pruning white pine (left) can reduce mortality from white pine blister rust (right).

Acknowledgments

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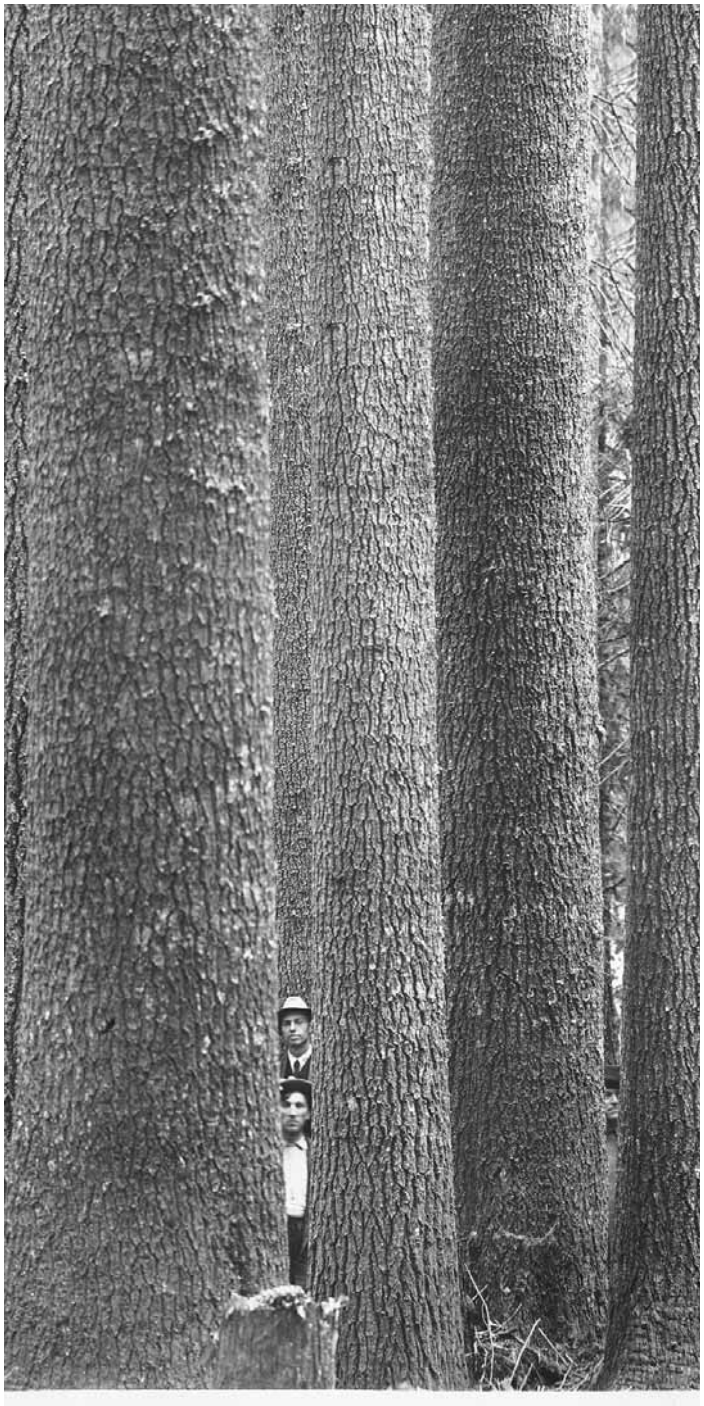

INTRODUCTION

The beauty and value of western white pine (*Pinus monticola*) inspired legislators to name it Idaho's state tree (fig. 1). White pine logs typically command some of the highest prices on the market. Historically, it was the primary species on over 5 million acres in the Inland Northwest and a major stand component on millions more. White pine resists root disease—the bane of Inland Northwest forests today—much better than do grand fir and or Douglas-fir, the species that have tended to fill its largely vacated ecological niche.

Sadly, white pine is now the primary species on less than 5 percent of its historical range, largely because of mortality caused by a disease called white pine blister rust. Restoring white pine is an important goal on many forests, and pruning is one tool that can help. This publication is intended to help forest owners and managers make decisions about pruning to reduce blister rust mortality in young, 10- to 25-year-old white pine.

Figure 1. Western white pine (*Pinus monticola*)

Figure 2. "Flagging" branches, brown and dying, are often the first visible sign of blister rust infections.

Figure 3. Blister rust cankers are sunken or swollen areas of infected bark, often with streaming pitch.

WHITE PINE BLISTER RUST

The fungus that causes white pine blister rust (*Cronartium ribicola*) came to western North America in 1910 on infected seedlings from Europe. The disease devastated western white pine because the trees had very little natural resistance. Blister rust also attacks other native North American five-needle pines, including whitebark pine, eastern white pine, limber pine, bristlecone pine, and sugar pine.

Spores of the blister rust fungus infect white pine through the needles. The fungus then grows into the main branch. As the fungus grows, it typically kills the branch from the infection to the branch tip, creating a "flag," a branch that is dying and turning brown (fig. 2). This flag is commonly the first obvious evidence of blister rust infection. The fungus grows down the infected branch to the bole (also referred to as the tree's "trunk" or "stem"), eventually killing the tree above that point. Upon closer inspection of a flagging branch, you will usually find a "canker"—an area of sunken or swollen tissue where the infection started. You will also often see pitch streaming around cankers, particularly where the disease has spread to the bole (fig. 3). In the spring, you may also see pustules of orange spores called "aecia."

Fortunately, blister rust does not spread directly from tree to tree. It requires a shrub in the genus *Ribes* (gooseberries and currants) as an alternate host to complete its complex life cycle (fig. 4). In the Inland Northwest, the most common native ribes plants are sticky currant (*Ribes viscosissimum*) and prickly currant (*Ribes lacustre*).

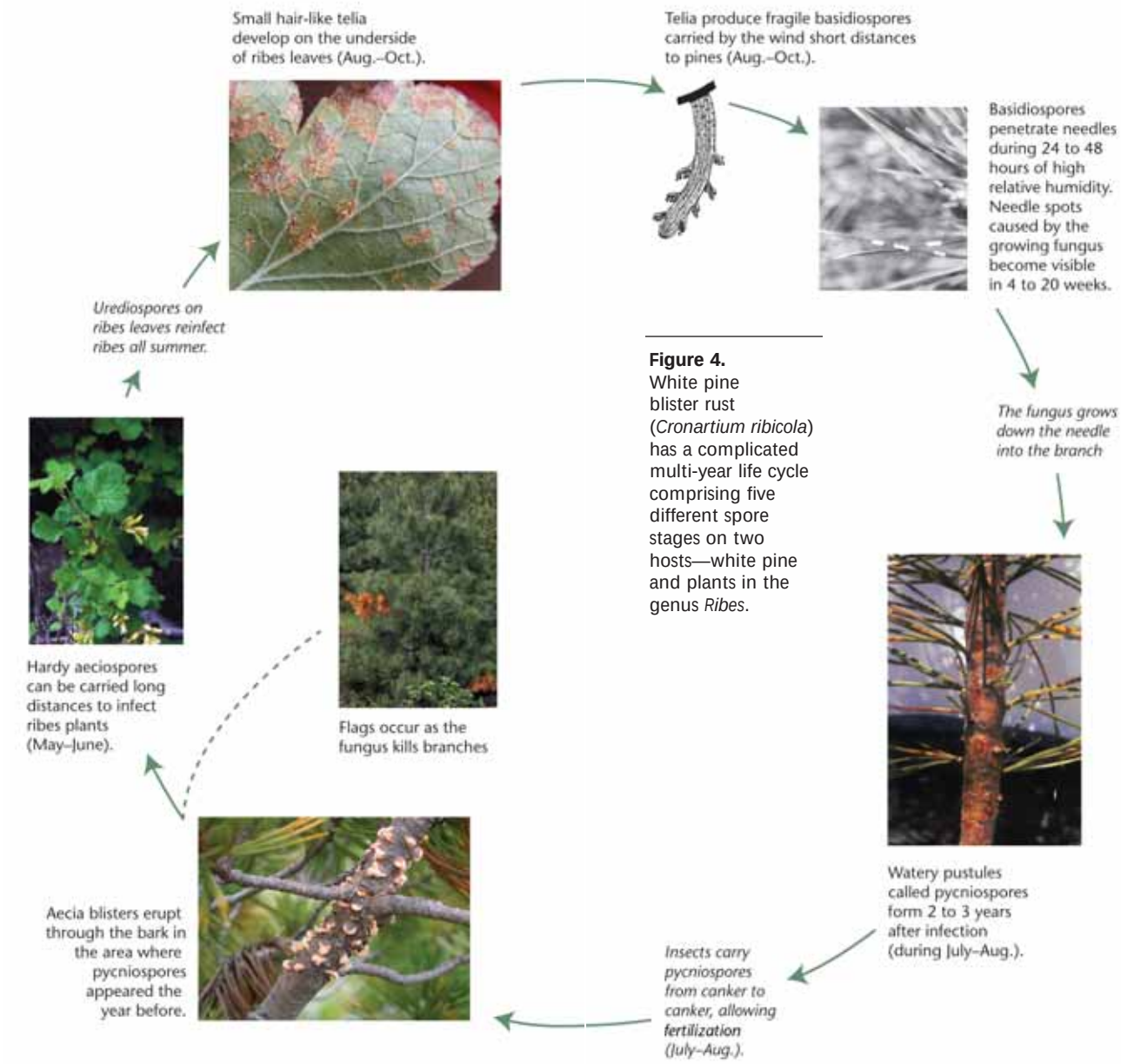

Figure 4.
White pine blister rust (*Cronartium ribicola*) has a complicated multi-year life cycle comprising five different spore stages on two hosts—white pine and plants in the genus *Ribes*.

Figure 5.
Ribes eradication was attempted to control blister rust.

Figure 6.
Tree breeding programs have produced white pine that are much more resistant to blister rust than wild trees.

COMBATING BLISTER RUST

From 1924–1966, blister rust control efforts concentrated on attempting to eradicate ribes plants in and near white pine forests (fig. 5). Managers believed removing ribes would break the pathogen's life cycle and stop it from spreading. Ultimately, this method was abandoned because ribes was difficult to eradicate. Only a few plants were needed to maintain the fungus, and seeds remained viable for decades on the forest floor.

Breeding naturally occurring rust resistance into tree seedlings, as is done with cereal crops such as wheat, has been more effective (fig. 6). In the 1930s, foresters began noticing white pine trees scattered through the forest that appeared to be resisting the rust. Starting in 1949, they collected pollen and seed from these trees to start a white pine breeding effort.

Figure 7. Planting blister rust resistant seedlings is critical to white pine restoration.

Figure 8. Natural white pine regeneration can be abundant where seed sources are present.

The Inland Empire Tree Improvement Cooperative's breeding program now produces white pine seedlings that are much more resistant to blister rust than naturally seeded white pine, though infection varies widely by planting site for reasons that are not yet understood. These resistant trees have a variety of defense mechanisms, such as resisting initial infection, shedding infected needles, and slowing canker growth. Fortunately, white pine is widely adapted, so the same seed source can be planted across relatively wide geographic areas.

Planting resistant seedlings in conditions where they will thrive is critical for restoring western white pine to northwestern ecosystems (fig. 7). But what about naturally regenerated white pine? These trees have a much lower level of rust resistance than the improved trees, but there is an ecological advantage to keeping some of them (fig. 8). Because they are offspring of trees that survived white pine blister rust, they may harbor genes for blister rust resistance that have not yet been included in white pine breeding programs. Maintaining these trees will add to the genetic diversity of western white pine.

Figure 9. Branches closest to the ground are most vulnerable to rust infection.

Figure 10. Pruning white pine up 8 to 10 feet can reduce blister rust mortality by half.

PRUNING TO COMBAT BLISTER RUST

Blister rust infects white pine only through green needles during prolonged periods of high relative humidity. Green branches closest to the ground are at highest risk (fig. 9) because environmental conditions for rust infection are more favorable (higher humidity and protection from wind). Young trees are especially vulnerable because blister rust infections on low branches can quickly reach the bole.

Pruning lower branches (fig. 10) greatly lowers the risk of blister rust infections because it removes those needles as infection sites. In studies by the U.S. Forest Service throughout northern Idaho, pruning the lowest 8 to 10 feet of 20-foot tall, 15-year-old naturally seeded white pine decreased blister rust mortality by nearly 50 percent over the next 30 years, compared with nonpruned trees.

DECIDING WHETHER AND HOW MUCH TO PRUNE

Pruning is an expensive practice in both money and time. Ask yourself a number of questions before deciding to prune.

Are my trees younger than 25 years?
Pruning is generally most effective on trees younger than 25 years (fig. 11). If the trees have grown tall and dense enough to self-prune branches below 8 feet, there is little point in pruning if the primary objective is to reduce blister rust mortality. It is the live branches growing from the bottom 8 feet of the bole that have the greatest risk of blister rust infection. Branches higher than 8 feet get infected, but much less frequently.

Figure 11. Pruning is most important for white pine with green branches lower than 8 feet.

How many trees on the site can I save by pruning? Before pruning, survey the stand to determine the number of white pine and their blister rust status. If a large percentage of trees have "lethal" cankers (bole cankers or branch cankers with margins within 4 inches of the bole) pruning may not be worthwhile. See appendix 1 for how to distinguish blister rust cankers from other deformities.

If very few trees have cankers, it may be smart to delay pruning, particularly if you are paying someone to do the pruning and will be checking the trees frequently. Don't presume that because you find few cankers in one survey that the trees will remain free of blister rust. Blister rust frequently infects in "wave years"—when cool, moist conditions through the summer and late fall and delayed frosts provide ideal conditions for blister rust infections. Even susceptible trees may go several seasons with no infections then develop many infections in one year when conditions are just right. Therefore, monitor your young white pine for blister rust every 2 to 3 years (fig. 12 and appendix 2).

Once you know how many trees per acre are uninfected, as well as how many have prunable or lethal cankers, you can make a wiser decision about pruning. A dense stand may have many infected trees but still enough clean trees to satisfy management objectives. In that case, pruning may be unnecessary or delayed. In a lightly stocked stand, every white pine may be needed to maintain the desired number of white pine per acre. In that case, pruning may be warranted even if the number of infected trees is small.

Figure 12. Young white pine should be examined for blister rust infections every 2 to 3 years.

Does my site have a low or high potential for new blister rust infections?
Rust hazard, the favorableness of the particular site for the development of rust, can be assessed by studying current levels of rust infection and counting the ribes plants on the site (fig. 13). A large ribes population (more than 100 ribes plants per acre) can provide a constant source of rust spores to infect even pruned trees for many years. To learn how to identify ribes, see appendix 3.

What are my objectives for the site?
If you are pruning for clear wood in mixed stands, you would probably prune 100 of the best trees per acre on the first pruning. But if you are concerned about root disease (white pine is much more resistant to root disease than Douglas-fir or grand fir), or for other reasons want to maximize white pine, you may want to prune more white pine to replace trees you will lose to rust and other factors even after pruning.

Should I prune "rust-resistant white pine"?
In most plantings of rust-resistant white pine seedlings, we expect at least half to survive blister rust without pruning. However, recent surveys have found plantings of rust-resistant seedlings with high infection levels. Pruning in these stands also should improve survival of these trees.

Figure 13. Abundant ribes create a higher blister rust hazard.

PRUNING YOUR WHITE PINE

When to prune—tree height

Pruning for blister rust can be started early, possibly when trees are 5 feet tall, but more typically when they are 10 feet tall (pruning up to one-half of tree height) (fig. 14). The sooner lower branches are pruned, the better chance trees have of escaping blister rust.

Season of pruning

Pruning for blister rust is easiest in the spring, as cankers are more visible, but bark slips more easily then, resulting in larger pruning wounds. Bark slippage is less likely when pruning with loppers or shears than with a saw.

Pruning in the winter may be helpful for pruning branches higher than 6 feet on already pruned trees. A deep, firm snow pack may help you easily reach branches 3 to 4 feet higher in the tree. Ultimately, the season of pruning is less critical than getting the work done.

Figure 14. White pine as short as 5 feet will benefit from pruning, but treatment typically waits until trees reach 10 feet.

Figure 15. A tree is considered nonprunable if the canker is less than 4 inches from the bole.

Figure 16. A water bottle and scrubbing brush make orange-colored canker margins more visible.

Figure 17. Dry (top) and moistened (bottom) canker.

Identifying lethal cankers

Do not prune trees with lethal cankers (fig. 15). A lethal canker is already in the bole or on a branch within a few inches of the bole, so it cannot be completely removed by pruning.

We generally do not recommend pruning if the margin of a branch canker is within 4 inches of the bole. However, if you have moistened and scrubbed the canker (fig. 16) and can see a well-defined margin that is at least 1 inch from the bole (fig. 17), it may be successfully removed if pruned immediately. If pruning is delayed a year, the canker will likely grow into the bole before it can be pruned.

Figure 18.

Excising bole cankers

A white pine with one bole canker that has not spread more than halfway around the main bole and is within 6 feet of the ground can be saved by "excising." This technique uses a specialized knife called a scribe to cut a ¼-inch channel through the bark (down to the wood) at least 1 inch beyond the visible margin of the well moistened and scrubbed canker. Excision starves the fungus by severing it from living tissue. The tree eventually grows over the dead tissue. Leaving pointed ends at the top and bottom of the excision speeds healing.

Excision is normally reserved for high-value individual white pine. Success depends on accurately assessing the boundaries of the canker. Remember, moistening and scrubbing cankers will help you correctly assess their boundaries.

Figure 19. Pruning one whorl and leaving stubs can mark a tree as having a lethal canker and being nonprunable.

Figure 20. Leaving a branch collar promotes pruning wound sealing.

Figure 21. Prune no higher than 50 percent of a tree's height.

Marking trees that have been identified as nonprunable by leaving long branch stubs on one whorl 3 to 4 feet off the ground helps you to avoid wasting time reinspecting the trees (fig. 19).

Making pruning cuts

Most forest pathologists recommend leaving a branch collar (the area of thickened tissue where the branch meets the bole) (fig. 20) when pruning to leave a smaller wound, promote quicker healing, and minimize decay. When using a saw to prune 1.5-inch-diameter and larger branches, make a small undercut to prevent bark from stripping as the branch is severed.

Painting pruning cuts is not recommended. Paint can trap moisture, providing a more favorable environment for decay.

Dipping the pruning blade in disinfectant to prevent disease spread is unnecessary when pruning for blister rust. The disease cannot spread from tree to tree; only spores produced on ribes can infect white pine.

How high to prune

Prune no higher than 50 percent of a tree's height (fig. 21) to maintain a healthy crown (e.g., on an 8-foot tree, prune up 4 feet). You can prune higher as the tree grows taller. If you see infected branches higher than your target pruning height, remove them as well or the lower pruning may be wasted. Pruning individual infected branches is sometimes referred to as "pathological pruning." Most blister rust reduction comes from pruning up the first 8 feet. Pruning higher than 8 feet is

Figure 22. Always check for and prune basal branches hidden in duff.

Figure 23. Remove epicormic branchlets as well.

advised on steep slopes where branches on the uphill side are closer to a more favorable environment for infection.

Pruning ground branches and epicormic branches

White pine commonly has small branches growing close to the ground or partially buried in the duff and resurfacing with green needles a foot or more from the tree (fig. 22). Remove them. They are easy to miss if you don't "root around" at the base of the tree. White pine occasionally produces small sprouts on the bole (epicormic branches) (fig. 23), which must be removed as well.

Pruning dead limbs

Dead limbs have no green needles, so they are no longer a source of entry for white pine blister rust. However, research has found that branches killed by a blister rust canker may contain active fungal tissue that will continue to grow toward the bole for several years. Therefore, remove dead branches as well as live ones when pruning. Pruning dead limbs will also reduce fire risk and create a more open, park-like aesthetic.

Pruning other species

You may be tempted to prune tree species growing with white pine for aesthetic or other reasons. If reducing blister rust is your primary concern, avoid doing so. Shade from the lower branches of other species helps suppress ribes and reduce sunscald and may impede movement of blister rust spores in the stand.

Figure 24. Turpentine beetles are ¼-inch-long reddish bark beetles.

Figure 25. Pruned white pine occasionally may be attacked at the base by red turpentine beetles.

Slash hazard

If pruned branches are considered a fire hazard, scatter them.

White pine branches are not large enough to harbor tree-killing bark beetles. However, there have been isolated cases of turpentine beetle (*Dendroctonus valens*) attacking up to 20 percent of a stand of pruned white pine (fig. 24). Although they usually attack at the base of the tree, it is presumed they are attracted to the pitch from pruning cuts (fig. 25). Fewer than 5 percent of trees have been killed, so losses to turpentine beetle are far outweighed by trees saved by preventing blister rust.

Figure 26.

"Buck-rub"

Occasionally deer, elk, or moose kill pruned trees by using them to rub velvet off their antlers. Tree losses can be significant, especially along game trails. Some forest owners are experimenting with leaving long branch stubs to make the trees less attractive for rubbing and to reduce antler contact with the bole. As long as no needles are left on the branches, the objective of eliminating entry points for blister rust has been met.

Sunscald

Bark on the main bole may not be thick enough to prevent sunscald when the bark is suddenly exposed to direct sunlight after pruning (fig. 27). Depending on the density of shade removed, direct sunlight may kill varying amounts of tissue until the bark thickens. Sunscald usually is restricted to the southern and southwestern sides of the bole, so trees are rarely killed. However, sunscald can produce a long wound that attracts wood borers and decay fungi and may reduce wood quality.

Because white pine is usually pruned to reduce blister rust when the tree is young and relatively exposed, sunscald damage should be minimal. When pruning older white pine, you can reduce sunscald injury by pruning more gradually over a period of years and by not combining thinning and pruning in the same year.

Figure 27. Sunscald is common on white pine but rarely kills the tree.

Figure 28. Hand shears are often adequate for pruning small branches.

Figure 29. Loppers may be needed on larger white pine branches.

Figure 30. By-pass blades (left) make cleaner cuts than anvil-style blades (right).

PRUNING TOOLS

Shears/loppers

For young trees, hand shears are often adequate (fig. 28) as branches typically average less than ½ inch in diameter. Some hand shears have a ratchet mechanism that allows larger cuts.

For larger diameter branches, loppers work well (fig. 29). New-Zealand-style loppers (sometimes marketed in the U.S. as “heavy-duty brush cutters”) can cut larger-diameter branches than conventional loppers. On both hand shears and loppers, by-pass blades make a cleaner cut than anvil-style blades (fig. 30).

Hand saws

Saws are also useful pruning tools and come in many forms. Saws with chainsaw-style teeth are easier to sharpen than triangular teeth, but the newer, aggressively serrated teeth may cut faster. Saw blades may be mounted on simple handles, folding handles, or ax handles.

Pole saws

For pruning higher than 6 feet, pole pruning saws are effective (fig. 31). Be sure to check the weight and springiness of the pole. The best pruning poles are lightweight and rigid rather than flexible.

Mechanized pole pruners with a small chain saw on the end of a pole are more expensive, heavy, and can take more time in repair and maintenance. Power saws with the engine mounted on a backpack are a lighter alternative. Power-pruning tools may damage the tree more easily if not used carefully, especially if the user becomes fatigued.

A hard hat and safety glasses are important safety gear for pruning higher than 6 feet.

Equipment sources

Hardware and garden stores stock many pruning tools. Specialized forest pruning tools should be available through your local chainsaw shops. Also, check forestry supply catalogs or Internet sites.

Figure 31. For pruning higher than 6 feet, use pole pruning saws.

SILVICULTURAL AND ECONOMIC CONSIDERATIONS

Pruning is a costly practice. To get the most benefit, integrate pruning white pine with other silvicultural activities on the site (fig. 32).

Site preparation

Although eradicating ribes is not a practical way to control blister rust, much of the rust infection in young stands comes from local ribes populations, and the amount of ribes on the site influences blister rust mortality. If possible, avoid or minimize practices that stimulate ribes. These include opening the forest floor to more sunlight than necessary, overly aggressive site preparation, hot burns, and activities that heavily disturb the duff (for example, careless log skidding).

Thinning and pruning

Forest stands pruned for clear lumber are thinned to maximize clear wood grown on the pruned trees. Thinning also allows you to favor desired species in addition to white pine.

Normally, you would thin a year or two prior to pruning to give trees time to use the increased light, moisture, and nutrients to develop faster growth and seal pruning cuts. When thinning in conjunction with blister rust pruning, however, prune first. Pruning requires a closer inspection

Figure 32. White pine frequently grows in combination with other species such as larch.

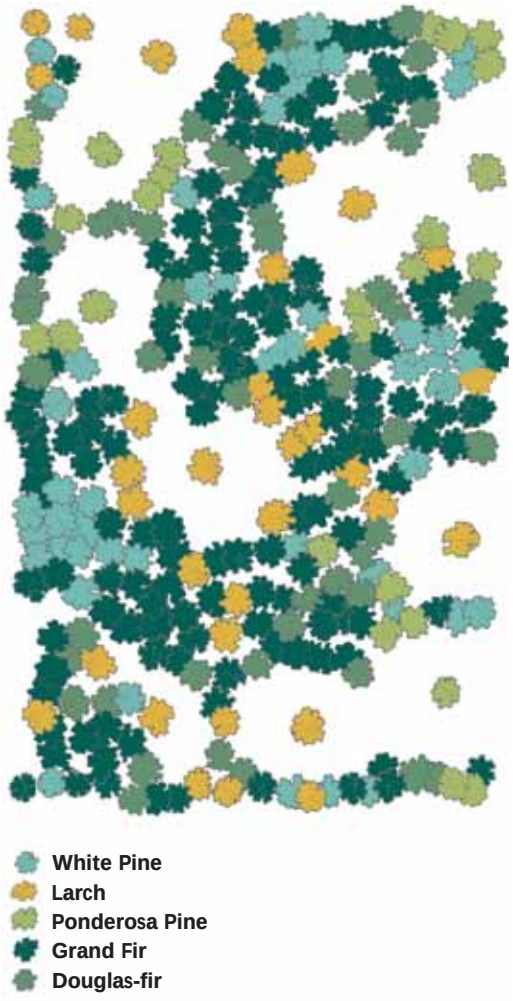

Figure 33. "Daylighting" releases larch and ponderosa pines while retaining more understory shade.

for cankers than does thinning. If you thin first, you may accidentally cut prunable trees and leave cankered, unprunable trees. Thinning slash may also hide lower branches.

The value of thinning must be balanced with its potential to increase ribes populations. *Thinning without pruning has increased blister rust mortality* because lower branches lived longer and more understory light increased ribes.

When thinning young mixed conifer stands containing white pine, it may pay to ignore white pines when spacing the trees (sometimes refered to as "ghosting" white pine).

Researchers are now studying ways to favor ponderosa pine and larch in mixed stands while maximizing white pine survival by thinning around individual larch and ponderosa pine—sometimes referred to as "daylighting" trees—rather than by thinning throughout the stand (fig. 33). As long as white pine is not overtopped by other trees, it should remain a component of the stand. Leaving the stand thicker around white pine aids self-pruning, lessens sunscald, and reduces ribes populations. Risk of overstocking is low because, even with increased self-pruning, some white pine will probably be killed by blister rust. Leaving some thickets of young trees will also benefit wildlife species such as snowshoe hares and the lynx that prey on them.

Pruning for clear wood

Most blister rust reduction comes from pruning up the first 8 feet. Pruning higher provides less rust prevention per branch cut. However, additional pruning up to 18.5 feet (or more for metric log lengths) creates a large, potentially valuable white pine log with a high percentage of clear wood at harvest (fig. 34).

Pruning for clear wood is typically done in two or three entries. For the additional pruning, prune only 50 to 100 trees per acre. Pruned trees must grow for at least 20 more years to produce adequate clear wood. It is also important to keep detailed records and use tags or paint to mark pruned trees.

Leave a branch collar when pruning white pine for blister rust. Generally, you will be pruning branches when the bole is small enough to stay well within the 4-inch knotty core—sometimes called "DOS" (diameter outside stubs)—desired for clear wood production. If you leave long stubs to reduce the impact of antler rubbing, be sure to cut them off before the bole is 4 inches thick.

For more information on pruning for clear wood, see Oregon State University publication EC 1457, *Pruning to Enhance Tree and Stand Value*, available online at http://eesc.orst.edu/agcomwebfile/edmat/EC1457.pdf

Figure 34. Pruning higher than 8 feet has less effect on blister rust mortality, but may create a more valuable log.

Figure 35. White pine tips are used in floral arrangements.

Figure 36. Bough harvesters are interested primarily in white pine tips.

Selling white pine boughs

One way to offset the cost of pruning is to sell boughs for use as floral and Christmas greens (fig. 35). If bough prices are high enough, pruning can actually generate income.

Bough harvesters typically prefer to clip only the ends of the best branches rather than cut all branches back to the main bole. You may have to negotiate a reduced price for the boughs in return for pruning branches all the way back to the main bole, pay the bough collector a small amount for this type of pruning, or allow the collection of additional boughs from trees cut in an integrated thinning and pruning effort (fig. 36). Another option is to have bough harvesters prune branches back to the point where they have no green needles. Such pruning won't produce clear wood, but it will reduce blister rust infection.

Fertilization

Forest owners in western Washington have experimented with fertilizing forest understories to improve the quality of floral greens. Fertilization also might improve the quality of white pine boughs. Will buyers pay a premium for lusher, more richly colored boughs?

Fertilization during the first few years will also increase the height growth of the tree. Longer internodes mean fewer branch whorls to prune and, consequently, cheaper pruning. Individual tree fertilization (rather than broadcast application) may also help white pine grow above competing shrubs (including ribes) and shade them out more quickly (fig. 37).

Cost sharing

A number of government cost-sharing programs help family forest owners implement improved forest management practices. Funding fluctuates yearly, but when available may pay for 25 to 75 percent of the practice. Check with your state forestry office regarding local programs.

Tax considerations

Family forest owners may be able to take advantage of income tax benefits by documenting time spent pruning as proof of their active investment in their forest property. Contracted labor, pruning tools, and other pruning costs may provide additional opportunities for favorable tax treatment. For more information go to the National Timber Tax Website (http://www.timbertax.org).

Figure 37. Fertilization may increase height growth and decrease the number of whorls to prune.

CONCLUSION

Western white pine is a valuable species economically, ecologically, and culturally. Pruning can significantly improve white pine survival. Pruning can also be a very satisfying activity—you'll hear no noise from chainsaws, see an immediate, visible improvement in the forest, and work at your own pace at nearly any time of the year (fig. 38). It is also a relatively safe practice, so it is easier to involve the whole family or provide work for young neighbors or fundraising opportunities for nonprofit groups.

Pruning is a vital tool for restoring western white pine to Inland Northwest forests. Even where trees are never harvested, pruning reduces long-term fire risk, improves access, and creates the more open park-like aesthetic that many forest owners value.

Figure 38. The whole family can participate in pruning as a form of forest stewardship.

Figure 39. If in doubt, moisten and scrub cankers; orange discoloration reveals blister rust.

Figure 40. Sunscald may be confused with blister rust bole cankers.

Figure 41. Antler rubbing causes irregular bark shedding. No yellow-orange canker margin will appear upon scrubbing the bark.

Figure 42. Rodents commonly chew on blister rust cankers, but they do not remove the infection.

APPENDIX 1:
Identifying blister rust cankers

Correctly distinguishing white pine blister rust cankers from abnormalities caused by other agents is critical to white pine pruning decisions. If you are not sure, moisten the bark, scrub the deformity, and check for orange discoloration to confirm the presence of blister rust (fig. 39).

Sunscald

In white pine stands that have been opened up by thinning, pruning, or both, the south-facing side of the tree can sometimes be damaged by sunscald. Sunscald occurs primarily on south-facing slopes when sun-warmed tree tissue becomes active by day then freezes at night (fig. 40). White pines usually grow over sunscald injury. If you don't see any obvious shrinking, swelling, or spore eruption and the disfigurement is on the south side of the bole, it is probably not blister rust.

Animal damage

Deer, elk, and moose sometimes use young white pine to rub the velvet from their antlers (fig. 41). Mice, squirrels, and other rodents gnaw on trees occasionally. Rodents especially like to chew on blister rust cankers because they are high in sugars. The rodents rarely remove all the infected tissue, so consider the canker alive even if you see evidence of extensive rodent chewing (fig. 42).

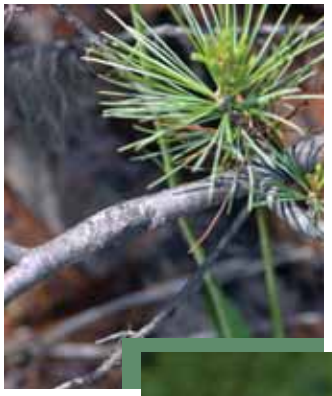

Figure 43. Physical damage can cause branch swellings that look slightly like blister rust cankers but lack their characteristic yellow-orange margin.

Figure 44. Blister rust rarely kills small branch tips.

Physical damage

White pine that are physically damaged by snow, hail, or other causes may exhibit some pitching and thickened tissue in the area of the damage (fig. 43). This damage is usually very localized and will not have the yellow-orange margin characteristic of blister rust cankers.

Needle diseases and branch tip die-back

Needle diseases can sometimes kill many needles, creating the appearance of flags. The damage is usually confined to the lower inside portions of the tree. The current season's growth is usually unaffected. Occasionally, small branch tips may also be killed by insects, disease, drought, or other factors (fig. 44). Blister rust rarely kills branch tips alone; always check for cankers.

Figure 45. Aerial photos can be useful in mapping out plot locations.

APPENDIX 2:
Monitoring for blister rust

Monitoring is best accomplished by measuring trees on a systematic grid of plots across the stand (fig. 45). Fixed plots allow you to calculate infection level and tree density, both of which are crucial in making pruning decisions. Three 1/100-acre plots per acre are standard for measuring reforestation stocking. For more information on setting up these types of plots see Oregon State University publication EC 1133, *Mapping and Managing Poorly Stocked Douglas Fir Stands*, available online at http://eesc.orst.edu/agcomwebfile/edmat/EC1133.pdf.

WHITE PINE BLISTER RUST MONITORING FORM

Plot No.	Clean white pine	Prunable white pine	Nonprunable white pine	Larch	Ponderosa pine	Cedar	Other conifers
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

Figure 46. Sample of white pine blister rust monitoring form.

Use a map, compass, and tape measure to identify plot centers. Do not adjust the location of a plot because it is very brushy or barren; doing so will bias your sample and provide less accurate estimates.

From each plot center, measure out a circle with a radius of 11 feet, 9 inches (the area of the circle is 1/100 acre). Many foresters use a wooden stick this length to facilitate plot measurements. Within each plot, count the number of acceptably formed and sized trees in each of the following categories (fig. 46):

—White pine with no visible cankers ("clean")
—White pine with prunable cankers (see page 21)
—White pine with lethal cankers (nonprunable) (see page 21)
—Trees of other desirable species (such as western larch or ponderosa pine)

After finishing the survey, calculate the average number of trees per acre in each category (divide the total number of trees in each category by the total number of plots, then multiply by 100). For example, if you measured 45 1/100-acre plots on a 15-acre stand and tallied 47 clean and 8 prunable white pine, you have 104 clean and 18 prunable white pine per acre (47/45 x 100, and 8/45 x 100).

Figure 47.
Prickly currant (*Ribes lacustre*) has small, sharp prickles and small, glossy-green leaves.

Figure 48.
Sticky currant (*Ribes viscosissimum*) has velvety leaves covered with soft, sticky hairs on both sides.

Figure 49.
Ribes leaves and leaves of similar plants. From top to bottom: sticky currant, prickly currant, raspberry, Rocky Mountain maple, ninebark, ocean-spray, and thimbleberry.

APPENDIX 3:
Identifying ribes—The alternate host

Ribes can be difficult to identify. Ribes plants are typically 2 to 3 feet tall but grow as tall as 7 feet. They have small, maple-like leaves and small, pea-sized fruits developing in late summer. A number of ribes species are found in the Inland Northwest, but prickly currant and sticky currant are the most common in forests. Prickly currant (*Ribes lacustre*) is distinguished by many small, sharp prickles and small glossy-green leaves (fig. 47). It also has dark purple berries covered with hairs.

Sticky currant (*Ribes viscosissimum*) has a "velvety" leaf covered with soft, sticky hairs on both surfaces (fig. 48). It feels moist to the touch and has blue-black, sticky berries.

Many forest plants are frequently mistaken for ribes. The plants described here all have vaguely maple-like leaves and occur as shrubs of varying sizes (fig. 49). Also, many plant characteristics, such as leaf size and color, change with the season and the site (smaller and paler on dry sites or earlier in the season). These tips should help you quickly distinguish these plants from ribes. Flowers are an excellent way to distinguish among many of these plants, but are typically not available very long, so we have focused on other plant characteristics.

Figure 50. Ribes (left) doesn't have a large pith, as compared with thimbleberry (center) and ocean-spray (right).

Figure 51. Ribes (left) is distinguished from ninebark (right) by the latter's brown, shredding bark.

Figure 52. Ninebark is distinguished by its clusters of dry, brown fruits.

Figure 53. Ocean-spray has dense, pyramid-shaped clusters of tiny flowers that turn brown and hang on through the winter.

Thimbleberry *(Rubus parviflorus)*

In early summer, thimbleberry's young undeveloped leaves make it easy to confuse with sticky currant. Later in the summer, this plant is easily distinguished by its large leaves (4 to 6 inches across). Thimbleberry leaves are soft, but they are not moist like sticky currant's. Thimbleberry stems have a large pith, while ribes stems are woody (fig. 50). In mid-summer thimbleberry has half-dollar-sized white flowers that later develop into large, vivid scarlet berries similar to raspberries.

Ninebark *(Physocarpus malvaceous)*

Unlike ribes, ninebark has brown, papery, shredding bark (fig. 51). Older bark on sticky currant also shreds, but it is more reddish. Ninebark usually has clusters of dry brown fruits (not berries) (fig. 52). Ninebark also has hairs underneath the leaf that look star-like when magnified by a hand lens.

Ocean-spray *(Holodiscus discolor)*

Ocean-spray is typically a larger shrub than ribes, with clusters of arching stems. It is also distinguished by coarsely toothed leaves that are more oak-like than maple-like; a large, white, spongy pith; and dense, pyramid-shaped clusters of tiny flowers that are white in summer then turn brown and hang on through the winter (fig. 53).

Figure 54. Raspberry's compound leaf (left) distinguishes it from ribes (right).

Figure 55. Rocky Mountain maple's opposite leaf arrangement (left) quickly distinguishes it from ribes' alternate leaf arrangement (right).

Raspberry ("Blackcaps") (*Rubus* spp.)

Raspberries are often confused with prickly currant due to their prickles. Raspberries frequently occur as a trailing vine, but you occasionally see single, upright, 2- to 3-foot-tall raspberry stalks—a form prickly currant takes as well. The key difference between the two is raspberry's compound leaf (with three leaflets) (fig. 54).

Rocky Mountain maple *(Acer glabrum)*

Rocky mountain maple (particularly when young) is occasionally confused with ribes because of its leaf shape. The quickest way to distinguish the two is to look at their leaf and branch arrangements; maples have an opposite arrangement; ribes have an alternate arrangement (fig. 55).

Sources

Patterson, P.A., K.E. Neiman, and J.R. Tonn. 1985. Field guide to forest plants of northern Idaho. U.S. Forest Service General Technical Report INT-180. 246 p.

Parish, R., R. Coupe, and D. Lloyd. 1996. Plants of Southern Interior British Columbia. Lone Pine Publishing, Redmond, WA. 463 p.

REFERENCES

For more information on the topics discussed here, please see publications listed below. Some of these should be available through your local cooperative extension system office.

Brannon, T. 2005. Basic hand and power forestry tools. Washington State University Cooperative Extension. http://ext.nrs.wsu.edu/handtools.

Emmingham, W., and S. Fitzgerald. 1995. Pruning to enhance tree and stand value. Extension Circular 1457. Oregon State University Extension Service, Corvallis. 12 p.

Fins, L., J. Byler, D. Ferguson, A. Harvey, M.F. Mahalovich, G. McDonald, D. Miller, J. Schwandt, and A. Zack. 2001. Return of the giants – restoring white pine ecosystems by breeding and aggressive planting of blister rust-resistant white pines. Bulletin 72. Idaho Forest, Wildlife, and Range Experiment Station, University of Idaho, Moscow. 20 p.

Green, D., M. Bondi, and W. Emmingham. 1997. Mapping and managing poorly stocked Douglas-fir stands. EC 1133. Oregon State University Extension Service, Corvallis. 8p.

Hagle, S.K., G.I. McDonald, and E.A. Norby. 1989. White pine blister rust in northern Idaho and western Montana: alternatives for management. General Technical Report INT-261. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Ogden, UT. 35 p.

Hagle, S.K., K.E. Gibson, and S. Tunnock. 1987. Field guide to diseases and insect pests of Idaho and Montana forests. Publication R1-89-54. U.S. Department of Agriculture, Forest Service, State and Private Forestry, Northern Region. 123 p.

Haney, H.L., W.L. Hoover, W.C. Siegel, and J.L. Greene. 2001. Forest landowner's guide to the federal income tax. Agriculture Handbook 718. U.S. Department of Agriculture, Washington, D.C. 157 p.

Neuenschwander, L.F., J.W. Byler, A.E. Harvey, G.I. McDonald, D.S. Ortiz, H.L. Osborne, G.C. Snyder, and A. Zack. 1999. White pine in the American West: vanishing species – can we save it? USDA Forest Service Rocky Mountain Research Station General Technical Report RMRS-GTR-35. 20 p.

Schwandt, J.W., M.A. Marsden, and G.I. McDonald. 1994. Pruning and thinning effects on white pine survival and volume in northern Idaho. P. 167-172 *in* Interior cedar-hemlock forests: ecology and management, Baumgartner, D.M., J.E. Lotan, and J.R. Tonn (eds.). Washington State University Cooperative Extension.

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