THE WOODLAND WORKBOOK

LOGGING

EC 1124 • Revised June 2009 $2.50

Safe and Effective Use of Chain Saws for Woodland Owners

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Contents

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The previous edition of EC 1124, authored by John Garland, was titled "Felling and Bucking Techniques for Woodland Owners."

Using a chain saw safely and effectively promotes efficiency in clearing brush, cutting firewood, harvesting, and any other woodland activity requiring the use of a chain saw. However, chain saws are dangerous! Using them requires a satisfactory level of physical conditioning and adequate skill in using and maintaining a saw.

This publication is not an in-depth manual on felling and bucking (cutting felled trees into certain lengths). Instead, it is a guide to the basic principles and procedures in operating a chain saw. Its intent is to help you improve your basic skills, recognize potential dangers, and know when to seek professional assistance during manual timber felling and bucking operations. Additional information is available through chain saw manufacturers, saw chain distributors, and other sources; see *For More Information*, back page.

Proper felling and bucking also have a substantial effect on log recovery (how much merchantable wood you get from the tree) and, therefore, on revenue from timber sales. These topics are covered only briefly in this publication; for more information, see OSU Extension publication "Selling Timber and Logs," EC 1587 (see last page).

You can develop general skills in effective chain saw use by cutting trees that are already on the ground. This also will help improve bucking skills. To acquire safe and proper techniques for felling trees, it is best to begin practice sessions with an experienced timber cutter. For initial felling and bucking experience, begin with straight trees of sound, green wood on relatively flat ground.

Caution: never work alone with a chain saw! Always have someone nearby to provide immediate assistance in case of an emergency.

Tools and Supplies

Well-maintained equipment is necessary to successfully complete any job. Essential equipment and protective clothing for safe, productive use of a chain saw include:

- Hardhat
- Hearing protection
- Safety chaps or special pants containing protective inserts

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- Gloves
- Boots (professionals use caulked boots, for more secure footing)
- Fire extinguisher
- A 3- to 5-lb, single-blade axe
- Saw gas and bar oil
- Wedges (soft plastic)
- First-aid kit

Consider also having additional equipment and supplies such as:

- Plumb line (a string with a weight at the end, to provide a vertical line for determining the lean of a tree)
- Peavey or chain (to free hangups)
- Eye protection (screens, glasses, or goggles)
- Additional bar and saw chain(s)
- Chain file with handle and a proper filing guide and gauges. (Manually sharpening saw chains is difficult. It is better to have extra chains for use in the field. Upon returning home or to the saw shop, sharpen them with an electric grinder made especially for saw chains.)

Chain saws

Your chain saw should be in good working order and new enough that parts can be found when the saw needs maintenance and repair. If in doubt, check with a local saw shop. Do not attempt a task as dangerous as operating a chain saw with poorly functioning equipment. Check that:

- The chain brake is functioning properly.
- Saw dogs (sharp, pointed teeth) are attached to the saw housing near the base of the bar.
- The bar is as long as the diameter of the largest tree you will cut.
- The chain has been sharpened correctly. Correct sharpening lessens your fatigue and ensures that cuts are straight and remove wood "chips" rather than sawdust.

We cannot overemphasize the importance of a well-maintained bar and chain. The size of the power head (motor) of a chain saw is not nearly as important for safe and effective cutting as a well-maintained bar and sharp saw chain. Immediately replace a saw chain at the first sign that it has become dull, damaged, or unable to cut straight.

Timber Felling Plans

Chain saws are used in a myriad of woodland activities but none more important, or dangerous, than timber felling. The way you fell and buck timber influences the entire harvesting operation, both logistically and financially. Make felling and skidding plans *before* cutting begins (Figure 1). A planned system of skid trails, combined with proper felling-to-lead (see below), can greatly help you skid logs to an access road; also, they will help protect your residual trees and your soil by limiting the impact on the logging area.

"Felling-to-lead" is cutting your timber so that it falls in a certain direction. For either ground-based skidding or cable yarding, trees felled-to-lead are angled about 30 to 45 degrees to either side of the skid trail or skyline cableway. This pattern reduces timber breakage and damage to the remaining stand. It is particularly useful for thinning operations or partial cuts. In cutting small timber, either tops or butts of trees may face the skid trail. In a clearcut operation, trees are felled into the open area rather than into standing timber.

Trees felled out-of-lead typically are angled 90 degrees or more away from the skidding direction. During skidding, timber must be pulled toward the desired direction of travel. If timber is pivoted into a skid trail, worker safety is jeopardized, and the pulled timber can badly scar standing trees or destroy young regeneration.

If falling trees brush standing timber, limbs or tops may break off and be propelled back toward the person who is cutting. Those tree fragments, which loggers call "widow makers," may hang dangerously overhead from standing trees and may fall unexpectedly.

In thinning, pay special attention to overhead hazards. Work up the hill and across the slope to minimize hazards from logs or trees sliding or rolling toward you.

Evaluate Working Conditions

Hazardous conditions

Under some conditions of weather and terrain, timber felling should be considered unsafe. When conditions are unsafe, inexperienced cutters should either seek help from a professional or postpone activities. Professionals can minimize risks that may be life-threatening for beginners. Unsafe conditions include:

- Gusting or intermittent wind, which may be sufficient to tip a tree in the wrong direction at unexpected times. If tree tops are moving, do not attempt to fell timber.
- Fog, which hampers vision up into the tree crown, making it difficult to see detached limbs and to determine the lean of a tree. Fog also makes it difficult to detect obstacles on the ground. Obstacles may break felled trees and/or force you into unsafe bucking positions.
- Snow and ice, which make it difficult to navigate terrain and may cause limbs or tree tops to suddenly fall.
- Steep and/or uneven slopes, which make it difficult to determine direction-of-fall and to escape dangerous situations quickly.

Danger trees

Trees that present special felling hazards are termed "danger trees." Skills and experience beyond those of a beginner are required to fell these trees. Danger trees include:

- Dead or rotten trees that remain standing—often called snags—constitute a serious hazard to your safety. Snags often have problems with butt rot, loose bark and limbs, and unstable tops. Wind can topple snags without warning. Due to snags' deterioration, they can react unpredictably to standard cutting techniques. They should be felled only by an experienced cutter.
- Trees with "pistol butts" (a sharp curve or hook at the base of the tree stem) are found on slumps and slides. Their distinct shape results from not being able to grow in the normal, vertical direction. These trees require special consideration because they are on unstable ground and may uproot when being felled.
- Trees with brittle or rotten heart wood require the attention of an experienced cutter. Many hardwoods, particularly alder and maple, contain these characteristics, but often you can't detect them just by looking at the outside of the tree. Always take extreme care when cutting these species!
- Utility lines, buildings, or trees adjacent to roads can cause special problems. Professionals use special cutting techniques, wedges, hydraulic rams, or cables attached to machinery to cope with these issues.
- Exercise caution when attempting to fell or buck timber in situations where you have no experience and "feel" uncomfortable. If you are unsuccessful, your attempt may cause additional danger to a professional you later hire to resolve the problem.

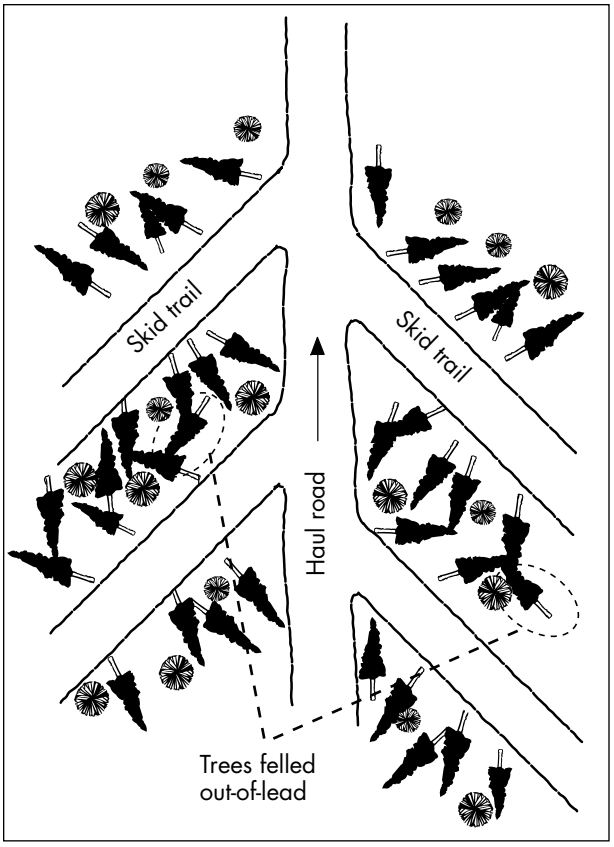


Figure 1.—A planned felling pattern (not to scale).

- Mark any potentially hazardous tree or unresolved problem with highly visible, colored flagging (special "danger tree" flagging is available). This warning will alert others to a dangerous situation.

Assess the Tree

Before felling any tree, inexperienced chain saw operators should go through a mental checklist similar to the one on the back page). Failure to recognize a key piece of information could threaten your safety as well as that of a professional cutter who may be needed in the event of an unresolved situation.

Always begin the felling process by determining tree lean. You invite disaster by cutting a tree without first evaluating its lean. Each tree is unique, and you cannot assume the direction a tree will fall naturally until you carefully examine each factor in the Summary Checklist (see last page).

Estimate the amount of lean using a plumb line made from a small weight and a piece of string (Figure 2). To determine the tree's natural direction of fall, look at its lean from at least two sides that are at right angles to each other; if the tree is on a slope, uphill from the tree always counts as one side. Note: trees growing on slopes tend to lean downhill, though often on first examination they may appear to lean uphill or be straight. This illustrates the importance of using a plumb line.

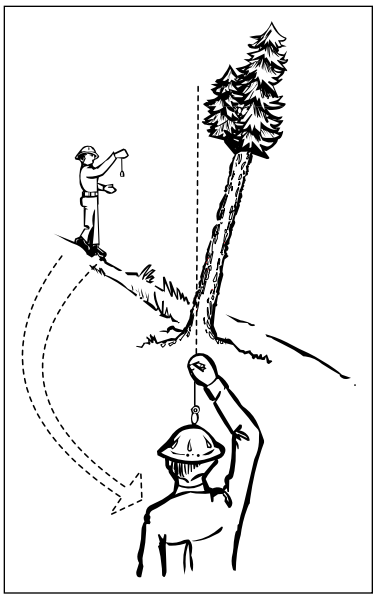


Figure 2.—Using a plumb line to determine the lean of a tree.

If the natural lean is toward the chosen direction-of-fall, use standard cutting techniques. Special cutting techniques (see "Problem Trees," page 12) will be required if the natural lean is away from the desired direction-of-fall.

Another factor that may influence direction-of-fall is the pattern of limbs. Limb loading—limbs growing primarily on one side of the tree—will pull a tree out-of-lead as it falls unless you use special cutting techniques. Also, limbs from adjacent trees may interlock, making it difficult to start the target tree's fall in the desired direction.

As you examine a tree for lean and limb loading, check also for loose bark and loose limbs hanging overhead. Snags and trees with overhead hazards are particularly dangerous. Saw vibration or tree movement can release the objects, causing them to crash down. If cutting such trees, arrange for an additional person to watch overhead and warn of hazards.

Before making your felling cuts, always determine whether the tree has rot. Maximum control of a tree during felling requires that you cut into sound wood. Felling cuts in areas with rot can cause a tree to split or shatter, with potentially serious results for your safety.

Check for rot by boring into the tree. Caution! Be sure to maintain firm saw control to prevent chain saw kickback. Keep the saw perpendicular to the ground and make the boring cut by pushing the saw bar directly into the tree stump within the area suspected of containing rot (Figure 3). This cut will not affect felling cuts or tree control *if* you cut below the planned felling cuts. Check for rot by boring once only. If you do not find rot, proceed with felling the tree.

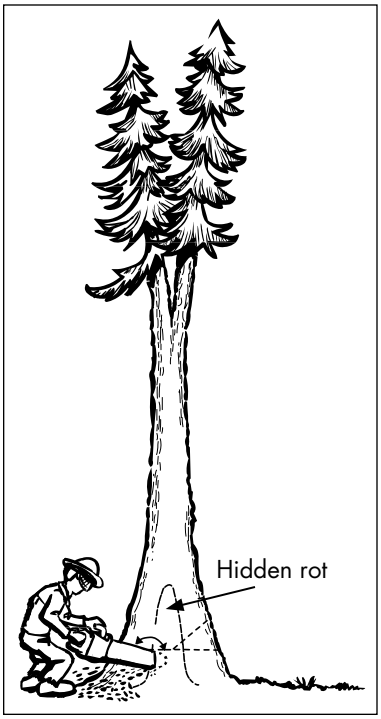


Figure 3.—Boring the stump to detect rot inside.

Cuttings from rotten wood will feel softer and be finer, resembling sawdust. Cuttings from sound wood will feel firm and be coarser, resembling chips. If rotten wood is present, consider changing the direction-of-fall so that the tree will fall in the direction of its natural lean.

If trees have butt swell, be sure felling cuts penetrate beyond the swelled area and into the area directly under the upper bole (Figure 4). Snow break, prior damage, double trunks, or other abnormal physical characteristics may indicate rot or weakened wood fiber, so always proceed with extreme caution when felling these types of trees.

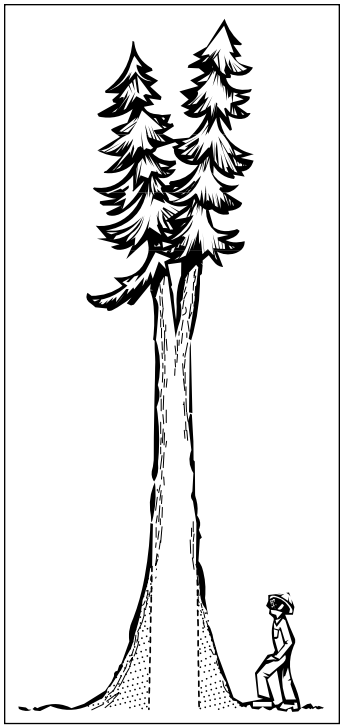


Figure 4.—If trees have butt swell, be sure felling cuts reach into the area directly under the upper bole.

Escape Path

Clear an escape path from each tree you plan to fell. A clear, unobstructed path will enable you to move quickly to a safe position after dropping the saw behind the stump, away from the direction-of-fall. Your path should angle 45 degrees backward and away from the direction-of-fall (Figure 5). The closer you remain to the stump, the greater the potential for an accident. Accordingly, the escape path should be free of brush and other obstacles and extend as far from the stump as possible.

Sometimes, obstacles around the base of a tree may obstruct your escape or create awkward felling positions. Normally, stumps are cut as low to the ground as possible. However, if a stump has been left high enough that it jeopardizes your safety, you may need to cut it lower. This lets you maintain a standing position necessary to escape quickly.

Get professional help if rocks, multiple stems growing from one stump, steep slopes, uneven terrain, or other obstacles hinder your ability to perform the steps in the Summary Checklist (back page). There are no shortcuts to protect your safety when operating a chain saw.

Tree Felling

Undercut

The first step in felling any tree is to make the undercut (Figure 6, page 6). The undercut is a notch cut in the tree that allows a tree to safely fall. It is the foundation of the entire felling process, and allows you to guide a tree in a preferred direction-of-fall. A properly excuted undercut not only gives you the opportunity to successfully fell the tree in the desired location, but it also maximizes safety. A poorly executed undercut reduces safety and greatly diminishes the accuracy of the direction-of-fall.

To effectively complete an undercut, your saw should be equipped with "saw dogs" to help grip and hold the saw's position (Figure 7, page 6). Using saw dogs, you can maintain constant contact between the saw bar and chain and the wood being

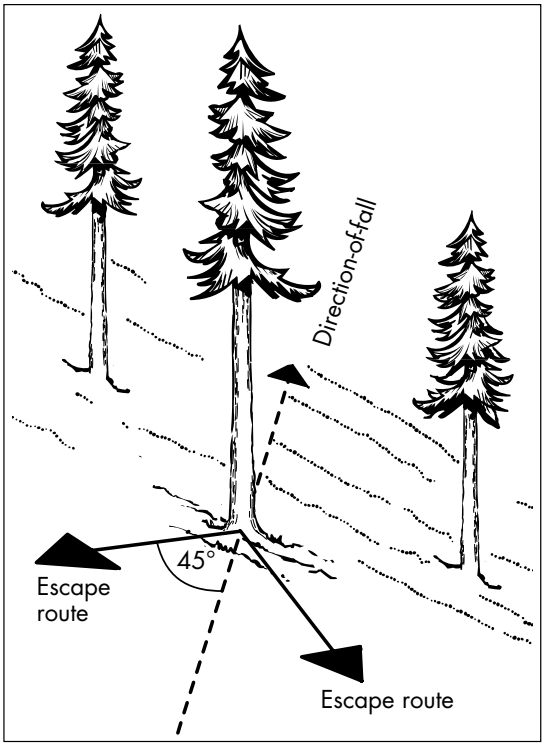


Figure 5.—Safety requires clear, unobstructed escape paths.

cut. Saw slippage is reduced while your personal safety is greatly improved.

Sighting direction-of-fall

Chain saw handlebars are used as a sighting mechanism, and most saws have "sight marks" imprinted on the saw housing. When making your undercut, sighting down the handle of the saw or along the sight marks will allow you to aim a tree toward its desired direction-of-fall. Become familiar with your particular equipment and its sighting accuracy. Check where the tree falls in relation to the sight on your saw.

Figures 6a–b.—A Humboldt-style undercut.

Matching saw cuts

Before making any undercut, it's vital to understand the importance of matching saw cuts. To control a tree's direction-of-fall, your felling cuts cannot overlap. Ideally, they will match perfectly. As a tree tips toward the desired direction-of-fall, properly matched cuts will close uniformly along their line of intersection.

With an axe or your chain saw, clean or smooth away the bark where the cuts are intended to match. Use a heavy crayon to sketch the shape and location of your undercut. It is a good idea to have a person on the opposite side of the tree, to alert you if corrections are needed to match saw cuts.

If your cuts do not match, the differing rates at which each side of the undercut closes will dramatically alter the tree's direction-of-fall. The tree could split vertically, creating an extremely dangerous situation known as a "barber chair" (Figures 8a–b). When a tree splits vertically, all control is lost, the stem(s) suddenly and violently become partially or totally separated, and severed sections can fall in any direction.

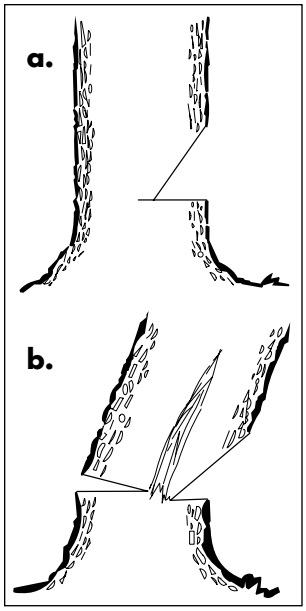
Figure 7.—Saw dogs, the sharp teeth on the left side of this saw, greatly improve your safety and cutting accuracy.

Types of undercut

Three types of undercuts are common in felling timber: the conventional, the Humboldt, and the open-face (Figures 9a–c).

Conventional undercuts

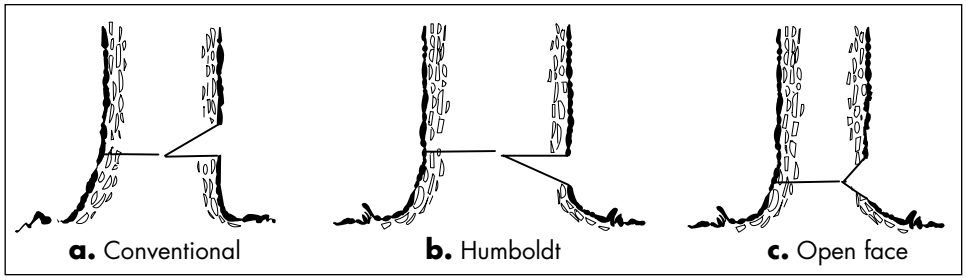
The conventional undercut (Figure 9a) is accepted worldwide, and many believe it is the easiest for beginners to learn. After evaluating cutting conditions and the tree's characteristics, select a direction-of-fall and make a horizontal cut at right angles to your intended direction-of-fall, sighting with your saw's handle or sight marks. The depth of this cut should be approximately one-third of the tree's diameter.



Figures 8a–b.—If upper and lower undercuts are not matched (a), the falling tree could split dangerously into a "barber chair" (b).

Angle the next cut so it meets the deepest point of the horizontal

cut exactly at both corners. In so doing, you will cut free a wedge of wood. After some practice, you may be able to anchor the saw at the deepest point of the initial cut on the side nearer you and match your cuts with greater accuracy.



Figures 9a–c.—Conventional, Humboldt, and open-face styles of undercut.

Once the cuts match, remove the wedge of wood with your axe. After removing the wood, place your saw in the undercut, and use the saw's sight to confirm the desired direction-of-fall. If the tree would fall out-of-lead, determine which side of the tree you need to undercut further to make the needed corrections.

To correct a cut, on the horizontal face of the initial cut remove additional wood from whichever side will ensure the desired direction-of-fall. Then angle the next cut to once again meet the deepest point of the horizontal cut exactly at both corners. Cut about one-third of the tree's diameter during the first undercut, leaving enough wood to correct the initial undercut if necessary. You can remove up to one-half the tree's diameter without compromising your safety.

Humboldt undercuts

An undercut popular in the West is the Humboldt (Figure 9b). The horizontal cut of the Humboldt is made the same way as in the conventional undercut. Unlike the conventional method, the wedge of wood removed using the Humboldt is taken from the stump instead of the butt log.

Open-face undercuts

The open-face undercut (Figure 9c) originated in the Nordic countries and combines features of the conventional and the Humboldt. The wedge of wood removed using the open-face undercut comes from both the butt log and the stump. For greater accuracy in matching the deepest point of each cut, do *not* use saw dogs when making the open-face undercut.

Make an open-face undercut as follows. After sighting the tree's intended direction-of-fall, start with the top cut and cut downward at a 45-degree angle. To make the bottom cut, cut upward at a 45-degree angle, and as with all undercuts, be sure the cuts meet exactly at both corners. When cuts at the bottom and top intersect, they will form a 90-degree angle.

The depth of your cuts should equal about one-third the tree's diameter. It's important that the top and bottom cuts match and are not overcut at their corners. Open-face undercuts are used to fell many of the hardwoods and any species of tree with significant lean. A 90-degree angle undercut enables the tree to lean at a substantial angle before the two faces of the undercut meet as the tree falls. This increases safety by reducing the chances of creating a "barber chair" or of the tree's deviating from the intended direction-of-fall.

Back cut

The back cut is is the final cut that causes the tree to fall (Figure 10, page 8). The back cut is made horizontally, in conjunction with any of the three undercuts. The back cut must be at least as high as the horizontal cut of the undercut; many experienced loggers prefer to make it about 1 inch higher.

Caution! Do not make the back cut lower than the undercut. This would be extremely dangerous, because the tree could move backward, toward you, on the stump. When making your back cut on sloping ground, always work from the uphill side of the tree.

Before you begin the back cut, stop your saw and give a warning call. Indicate clearly your intended direction-of-fall. If other people are in the vicinity, do not proceed with the back cut until you have established communication, ensuring a safe position for everyone.

As you make the back cut, do not let it intersect the undercut. Instead, leave a hinge of uncut wood between the undercut and back cut. This uncut wood controls the

tree's direction-of-fall. A horizontal back cut whose hinge is 1 to 1.5 inches wide should be adequate to control a tree with a stump diameter less than 24 inches.

Insert a falling wedge in the back cut as soon as possible, to prevent the tree from sitting back unexpectedly on your saw bar. Make your back cut fairly quickly so that wood from the falling tree is not pulled from the stump or butt log. Continue quickly before unexpected winds adversely influence your intended direction-of-fall. As the back cut is progressing, take care to avoid cutting off the corners of your hinge wood. Glance frequently into the tree crown to check for hazards such as loose limbs or broken tops.

Besides being useful during the back cut, wedges also can help correct tree lean. If a tree has a slight lean other than the direction of the undercut, place a wedge in the back cut on the side of the lean. As you make the back cut, keep the wedge tight as you cut until you have the correct amount of hinge wood. If the tree remains standing, remove the saw and drive the wedge with your axe until the tree falls.

If small-diameter trees do not lean in the intended direction-of-fall, make the back cut before the undercut. This will enable you to better accomplish directional felling by first placing a wedge in the back cut, then continuing with the undercut. Practice this technique with an experienced cutter before attempting it on your own. As the tree begins to fall, place the saw behind the stump and move quickly along your predetermined escape path. Retrieve your saw after the tree is on the ground.

Occasionally, you may wish to fell a tree whose diameter is greater than the length of your saw bar. Then, you must make the undercut and back cut in a series of cuts, which preserves the strength of the hinge wood until you complete the back cut. This is an advanced cutting technique; consult an experienced faller before attempting it yourself.

Bucking Procedures

Bucking is cutting felled trees into certain lengths, for firewood or logs, as specified in a purchase order from a mill or sort yard. When bucking to specifications, make cuts square to the logs while correctly measuring log length. In order to maintain maximum log value, you must carefully evaluate each bucking situation.

When bucking, maintain a safe working position on the uphill side of the tree or previously bucked logs. The first step in safe log bucking is to determine the direction the log segments will move after you complete the cut. The basic principle is, cut the compression wood first.

The tree's position creates internal forces in its wood fibers. Figures 12a–c illustrate the difference between compression wood and tension wood. Compression wood (also called "bind") is along the inside of a curved or bent piece of wood. Compression wood

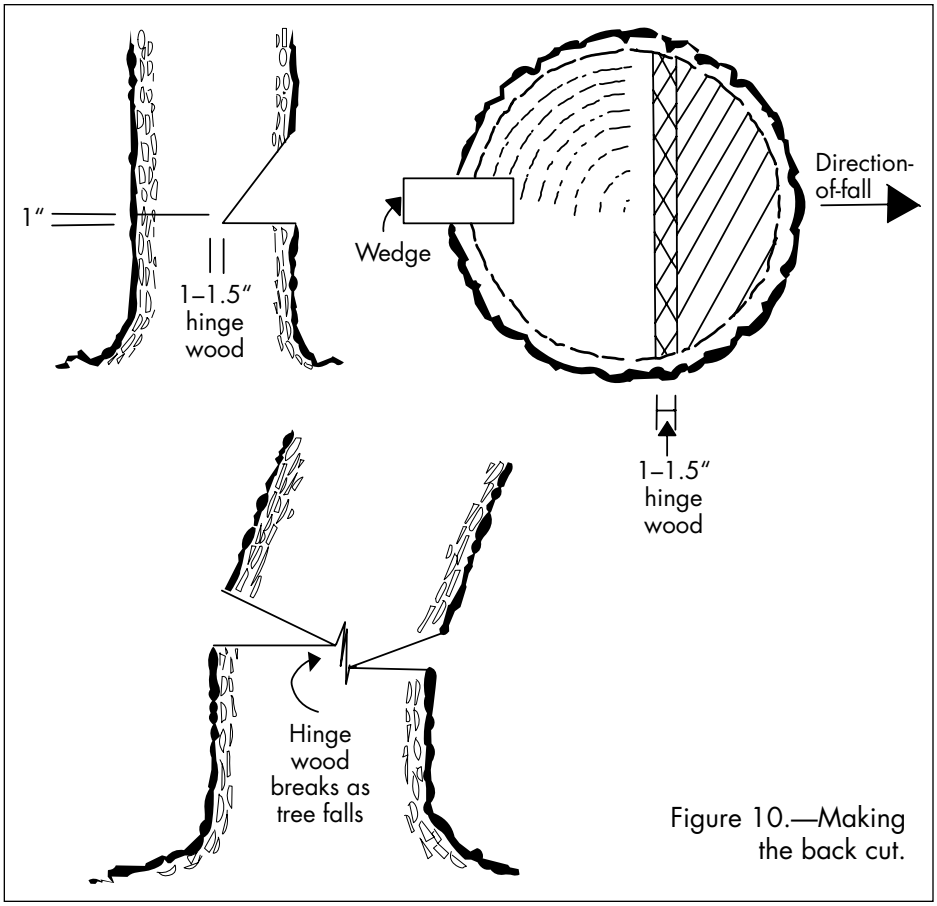


Figure 10.—Making the back cut.

fibers are pushed together. Tension wood (also called "release") is along the outside of a curved piece of wood. Tension wood fibers are pulled apart.

Many times it is difficult to evaluate correctly the exact location of compression wood and tension wood. Always keep an axe and wedges available for releasing a pinched saw bar.

Normally, two cuts will be enough to buck smaller logs or any logs that do not appear to have a large amount of tension and compression wood. The first bucking cut will be shallow and is intended to sever only a small amount of compression wood without binding the saw. A second cut will release the tension wood.

Use caution—to protect both your safety and the value of the cut timber—when bucking large timber or logs with a large amount of tension and compression wood. Sometimes you must make a number of cuts in compression wood and tension wood. Be sure to contact a professional if in doubt about the internal forces of a tree that was felled in a precarious location or is in a position where these forces are difficult to determine accurately.

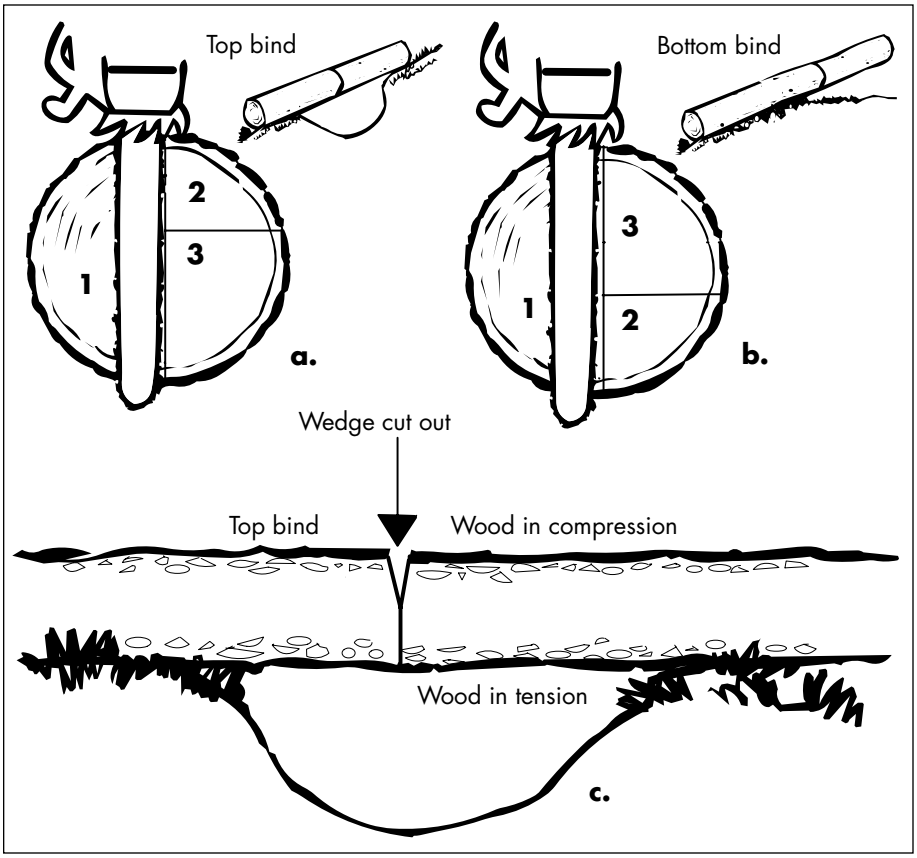
open and your saw free. If the logs will not separate, mark them with brightly colored flagging to warn those doing the skidding or yarding.

Figure 11.—When bucking, maintain a safe working position on the uphill side of the tree or bucked log. Note that the just-bucked log segment at right is rolling swiftly downhill.

Hazards during bucking

You may encounter several dangerous situations during log bucking. On sloping terrain, remember to make your bucking cut from the uphill side (Figure 11). This will prevent bucked logs from rolling downhill toward you.

A felled tree may be subject to "end pressure" when it lies perpendicularly along a slope and is supported along its entire length (Figure 13, page 10). After you make the first cut, you could be in danger if the upper log slides downhill. If you're not sure what internal forces are on the wood fiber, safely buck the log by making the first cut on the log's lower half. When making your cut in the log's upper half, insert a wedge to help you keep the upper cut



Figures 12a–c.—Cut compression wood first.

Rootwads

Windfalls can cause dangerous bucking problems and are difficult to evaluate. It is difficult to predict how rootwads will react when cut away from the stem. Roots that are bent underground will apply pressure, causing a rootwad to possibly upright itself, or roll toward the log or perpendicular to the log being bucked. Windfalls with the tree stem pointing downhill and perpendicular to the slope of the ground are extremely dangerous! When cut away from the stem, gravity may cause the rootwad to roll downhill. Rootwads moving downhill also may roll to the side unexpectedly, creating an extreme hazard for the bucker.

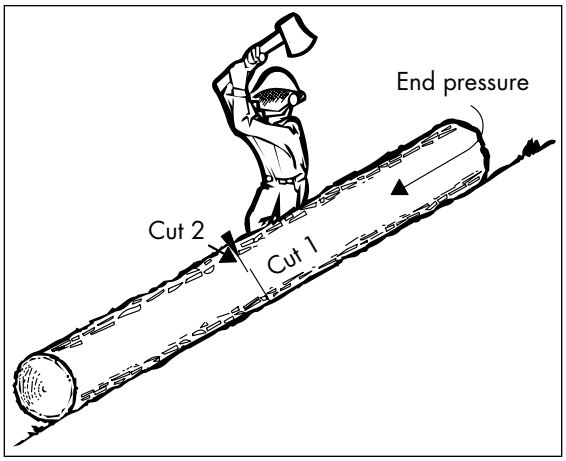


Figure 13.—Felled trees and logs that lie on a slope may be subject to end pressure.

Analyze each bucking situation for its unique circumstances. Assess its compression and tension wood, potential for movement, and safe positions from which to make bucking cuts. When in doubt, contact a professional.

Springpoles

Springpoles are small trees or stems of large bushes bent under by larger trees you have already cut (Figure 14). They are under extreme tension and can react unpredictably when cut. Attempt to cut a springpole only if you can position yourself at a right angle to the stress of the bent stem; then position yourself as far away as possible and still make the cut.

Note the extreme tension in the outer fibers of the tree at this point. Stand as far away as possible to the side of the springpole and check where the ends of the springpole will move when you make the cut. Then, make a series of shallow cuts in the compression wood opposite the point of maximum tension.

Alternatively, you can shave the compression wood along the same area with the side of the saw. This releases some of the tension, and successive cuts can release more.

If the springpole is large, or if you cannot stand at a safe distance while cutting, mark it with colored flagging and remove it using lines from a machine.

Chain Saw Reaction Forces

Chain saw reaction forces transfer the power of the rotating chain away from the action of cutting wood and back to the saw and the operator, causing kickback, pushback, or pull-in. Reactive forces may make your saw move rapidly and unpredictably, or cause you to lose control of your saw or to lose your balance.

Kickback is the most serious reaction force. Movement is unpredictable, extremely fast and may cause serious injury or death.

Kickback can be due to many circumstances, such as inaccurately low depth gauges or dull cutting teeth, or it can occur when you shift from cutting soft, live wood to hard, dead wood. Saw teeth that fail to cut wood can cause the saw to react violently backward, which is most likely when

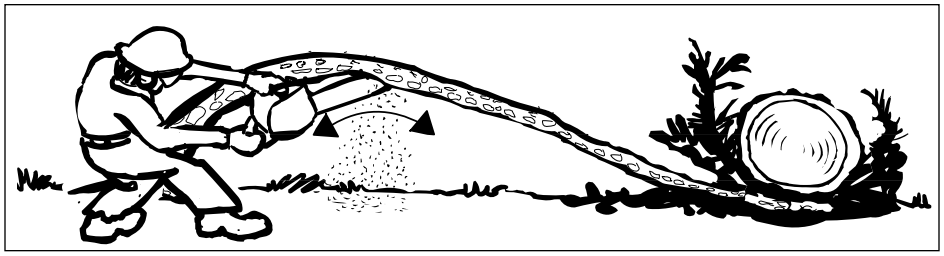


Figure 14.—Cutting springpoles requires special precautions.

cutting with the top quadrant of the tip of the saw bar (Figure 15). If the nose of the bar strikes an obstacle without cutting it, the saw will kick up and back toward the operator.

Many kickback-related injuries can be prevented by:

- Operating the saw using a solid, two-handed grip with your thumbs wrapped around the saw handles
- Maintaining good footing and positions for preventing kickback; do not stand in line with potential bar movement
- Knowing where the tip of the bar is at all times
- Anticipating kickback when you are making a boring cut. Bore approximately 12 inches at an angle upward or downward rather than straight into the log, and begin boring cuts using the bottom of the saw bar tip.
- Keeping track of the kind of wood you are cutting (live versus dead)
- Maintaining the saw's chain brake. However, do not depend on its chain-stopping feature alone.
- Sharpening your chain according to the manufacturer's instructions. You can use the available guides and gauges to help sharpen your chain, but it is preferable to have a saw shop do it for you.
- Using low-kickback bar designs and an anti-kickback chain

If the saw chain becomes pinched, the saw may move in the direction opposite the chain's movement. If the top of the bar is pinched, the saw will "push back," pushing you and the saw backward. If the bottom of the bar is pinched, the saw will "pull in," pulling itself and you forward.

To reduce the likelihood of a pinched chain, watch for compression wood that may cause the chain to bind. Consider using a wedge to help keep the saw cut open.

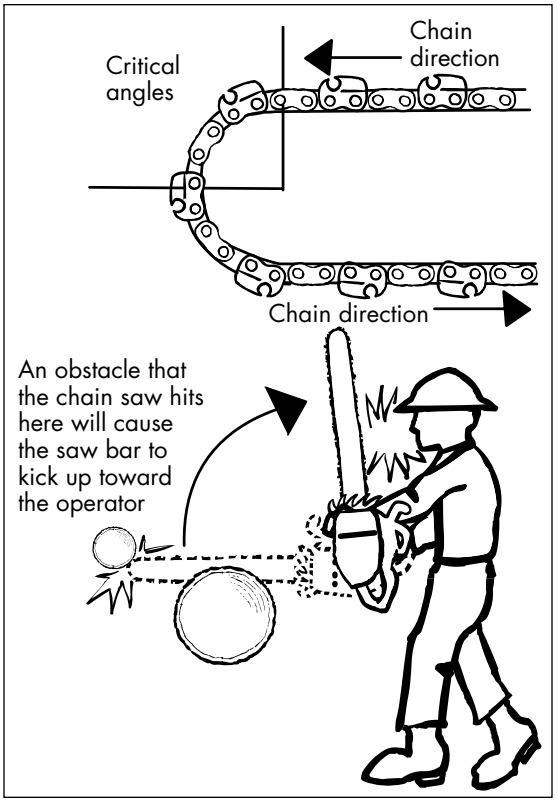


Figure 15.—Avoid chain saw kickback.

Limbing

Cutting limbs may appear to be relatively simple, but predicting the limbs' movement after they're cut can be difficult as well as time-consuming, tiring, and dangerous. To safely and effectively cut limbs, you must evaluate their pressure points to determine the location of compression and tension wood. There is no pattern in the tension and compression wood of individual limbs, so when you begin to cut a limb, pay close attention to its movement. Getting your saw pinched (hangups) by a limb will happen frequently without close attention to detail.

Awkward cutting positions are common during limbing operations. Unsure footing may jeopardize your safety when moving between limbing positions. As limbing proceeds, it is best to keep the log between you and the saw bar. Protect your legs with safety pants or chaps. Work from the side of the tree stem, and do not attempt to stand on the tree while limbing.

The following steps contribute to safer and more effective limbing.

1. Start limbing at the butt of the tree and work toward the top. If on a slope, remain on the uphill side. Stand parallel and alongside the tree and cut the limbs in front of you on the side nearer you. Keep the saw to the side of your body and cut only those limbs you can reach comfortably with the saw tucked closely to your side.
2. Support the weight of the saw by placing the bar flat, on top of the tree stem. Slide along the stem and use the top of the bar to cut the limbs on top of the stem, carefully evaluating them based on their compression and tension wood.
3. Using the stem as a leverage point and to support the weight of the saw, cut the limbs on the side away from you. Cut what you can reach without overextending yourself.
4. With the saw resting on the tree, position yourself to face the stem. Bend your knees, keeping a straight back, and cut the limbs on the bottom of the stem in a sweeping motion. Keep the bar parallel to the bottom of the tree and pressed against the stem during the movement.
5. Move forward and repeat the process.

With practice, these steps will form a pattern that has several benefits. The lower back stays straight, and the large muscles of the legs do most of the work. The weight of the saw is off-loaded to the tree stem for much of the time, rather than being carried by your arms. Your legs are better protected, especially when moving to a new position with the saw on the opposite side of the tree stem. And always be aware that you must constantly evaluate compression and tension wood when limbing.

Problem Trees

Multiple stems

Multiple stems growing from one base can be unusually difficult for inexperienced cutters. You may find yourself in awkward cutting positions and have difficulty determining the direction-of-fall. Normally, it's best to treat each stem as if it were a single tree.

In felling multiple stems, begin with the outermost stem. Fell the stem in its natural direction-of-fall. As you cut each stem, be aware of overhead hazards.

If the split from single stem to double stems is higher than you can reach comfortably and safely with a saw, enough wood may hold the two stems together to let you fell the tree as if it had a single stem (Figure 16). Regardless of fork height, examine the trunk cautiously for a well-defined vertical seam or scar indicating separation between the stems, then proceed with the perpendicular direction-of-fall as described above.

If you can reach the split with a saw, fell the stems separately. Select the direction-of-fall on one of the stems, make the undercut, and fell the tree. Beware of kickback as you bore the stem for your back cut. Fell the remaining stem in the direction of its natural lean.

Leaning trees

Trees that lean heavily are problems for even the most experienced cutter. As a beginner, do not attempt to fell trees that lean heavily until you feel comfortable

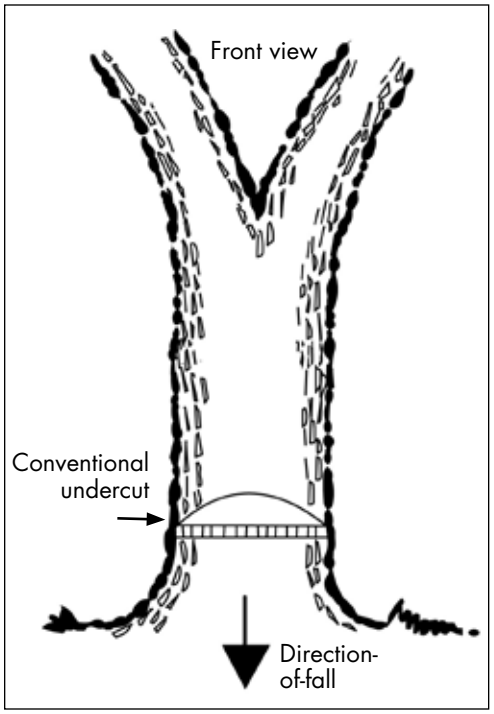


Figure 16.—Felling a "problem" tree that has multiple stems.

operating a chain saw and have gained skills and experience. Basic skills will allow you to fell trees having moderate lean, but do not attempt any situations where you compromise safety or doubt your technical skill to perform a particular task.

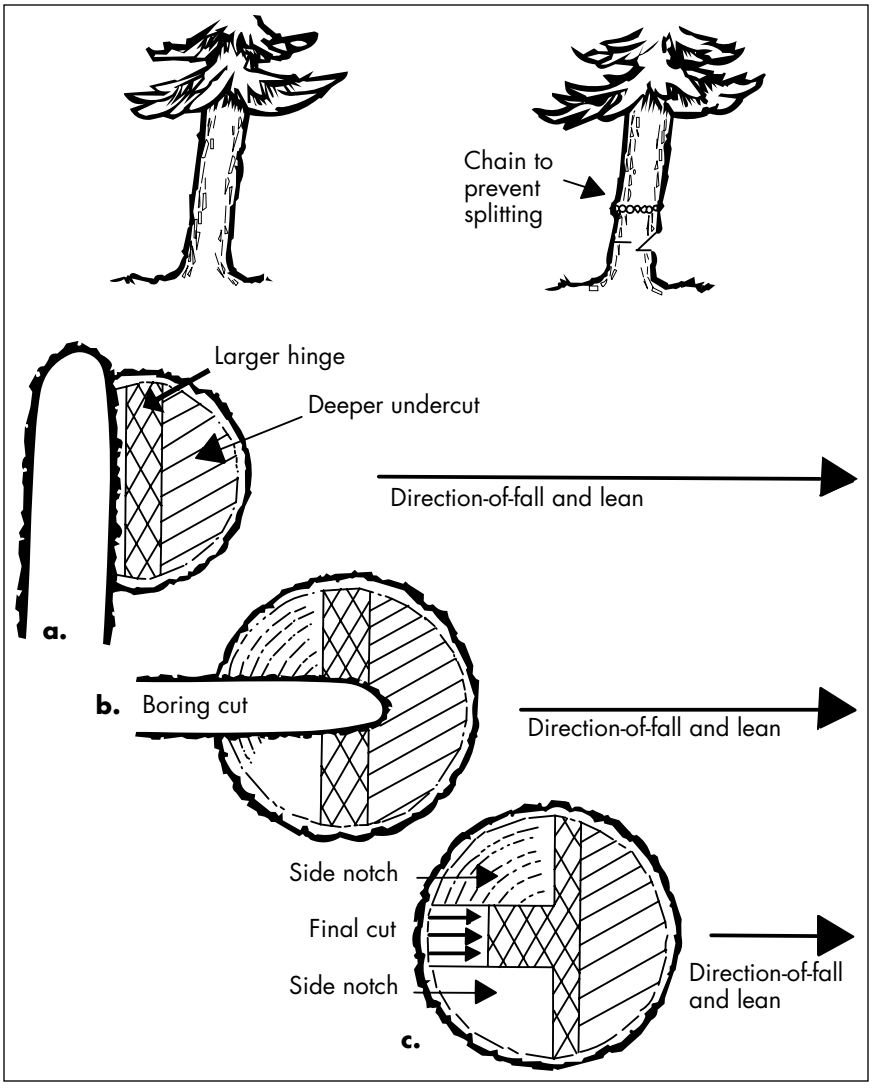
Begin by selecting an appropriate undercut. Depth of the undercut will be approximately one-third the tree's diameter. Pay careful attention to matching your saw cuts (see page 6). Depending on the tree's size and degree of lean, you might use one of the following types of back cut.

For trees whose dbh (diameter at breast height, or about 4.5 feet above the ground) is less than 12 inches, use a standard back cut. Make the back cut rapidly, because a substantial amount of hinge wood will break away quickly. As the tree begins to fall, continue cutting until you reach the desired thickness of hinge wood (Figure 17a).

For larger trees with more lean, you may choose to bore the center of the back cut (Figure 17b). This reduces the likelihood of producing a "barber chair"). After the tree has been bored, make a quick back cut on the remaining wood on both sides of the boring cut.

Large leaning trees may require two side cuts. Begin your back cut by cutting about one-fourth the diameter of the tree from each side, leaving the center half of the tree to hold the tree. Make your back cut quickly in order to release the remaining wood. It is possible a substantial amount of wood will break away as the tree falls. However, you will have prevented a "barber chair" by previously making the side cuts up to the desired hinge wood (Figure 17c)

"Holding wood" may be used to directionally fell trees with moderate lean. Holding wood is additional wood left on the hinge to provide a holding force opposite the direction of natural lean (Figure 18, page 14). Usually, hinge wood should not be cut because it helps control a tree's direction and rate of fall.



Figures 17a–c.—Three options for back cuts in order to fell a leaning tree in the direction of the lean.

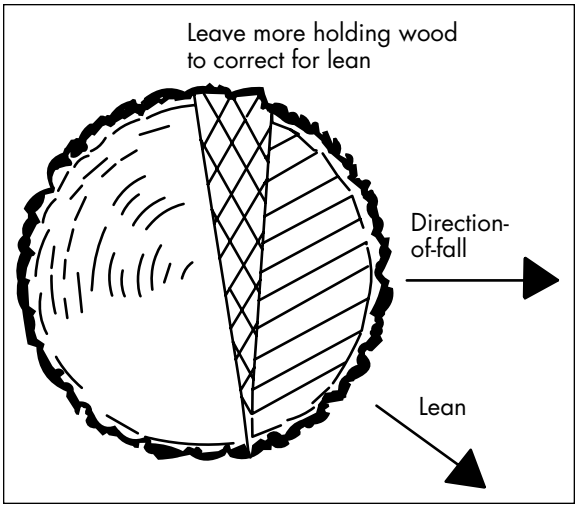


Figure 18.—Use "holding wood" to correct for moderate lean.

Felling against the lean

Trees with moderate lean can be felled against their direction of natural lean. However, to do that successfully you often need considerable judgment gained from years of cutting experience. Felling against the lean requires hand tools and special felling techniques.

You will need two to four soft plastic wedges to "lift" the leaning tree (Figure 19). Make a shallow undercut approximately one-fourth to one-third the tree's diameter, to achieve a longer lever arm for the wedges. Clear away the bark where you will insert wedges under the point of the tree's lean. Start the back cut there and insert both wedges as soon as there is ample room. As you proceed with the back cut, keep wedges tight by frequently stopping the saw and pounding the wedges tightly into the cut.

Alternately cutting the back cut and then wedging will shift a tree away from its natural lean, through a vertical position, and toward the desired direction-of-fall. To get additional lift, tighten only one of the wedges in the cut, thus relieving pressure on the remaining wedge. Pull the loosened wedge far enough out of the cut so you can put an additional wedge on top of it. Pound the two stacked wedges alternately until they become tight in the cut. You can then stack an additional wedge on the remaining, single wedge and pound these wedges until they become tight. This will almost double the lifting capability of your wedges.

A hinge of wood is always needed to maintain tree control. By monitoring the amount of force needed to drive the wedges, an experienced timber cutter can determine whether to increase the depth of the back cut. Removing the bark will allow you to monitor the effectiveness of your wedge. Once you have achieved the desired thickness of hinge wood from the back cut, remove the saw and continue wedging until the tree falls.

Using wedges and special cutting techniques, experts may be able to fell trees with a substantial amount of lean. When wedges cannot lift a tree to vertical position, hydraulic rams can do the job. Cables attached to heavy machinery also may be able to pull a heavily leaning tree into an upright position for directional felling. These techniques are only for professionals; they are beyond the capacity of the average woodland owner.

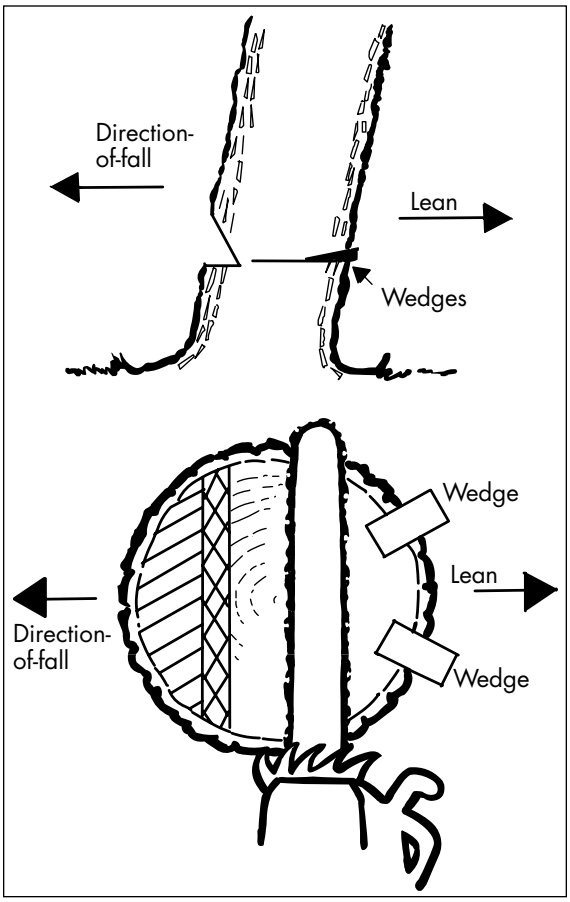


Figure 19.—Felling against the lean, using wedges.

Hangups

Whether a professional or a beginner, eventually every timber cutter will create a hangup. A hangup is a felled tree that becomes lodged in a standing tree. Once a hangup occurs, find a safe location from which you can carefully evaluate the situation. Lodged trees often are held only by their limbs, which can break and release the hangup suddenly and unexpectedly. **Never attempt to fell the tree in which a hangup is lodged!**

Always keep the tree in which the hangup is lodged between you and the hangup itself. If you can't free the hangup safely, seek advice from an experienced cutter. Two techniques commonly are used to safely get the desired tree on the ground. The first is more effective for trees whose dbh is less than 18 inches.

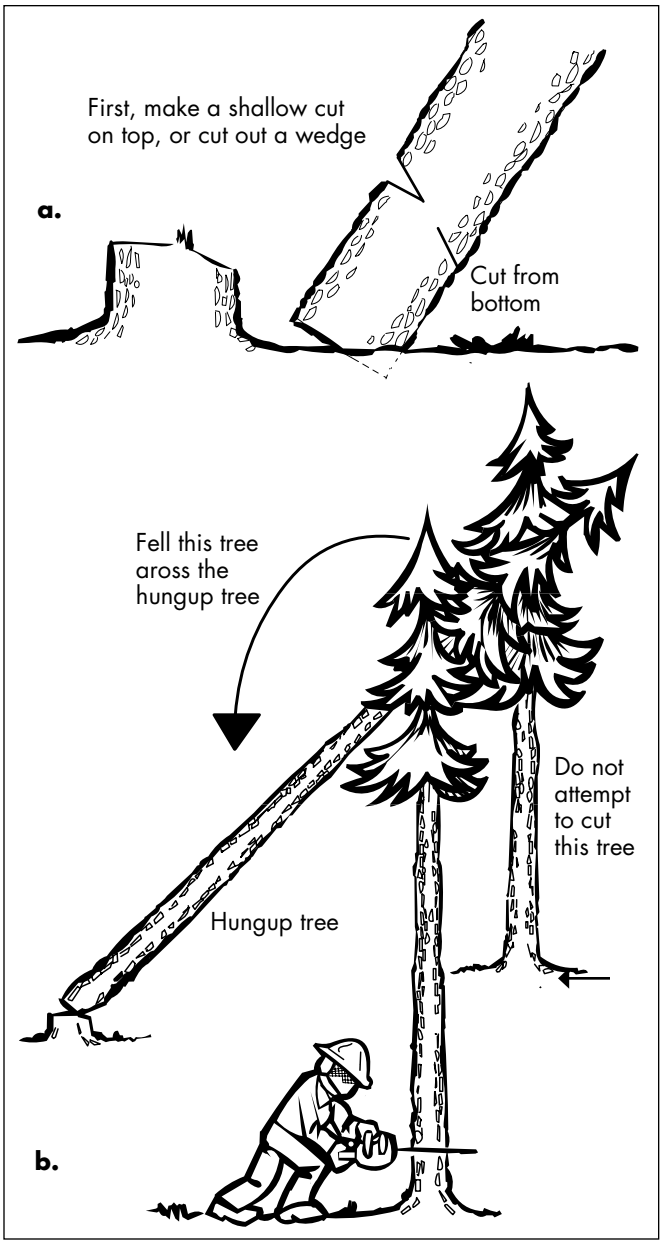
1. *Cutting away the butt*. Make a cut 2 to 3 feet up the butt of the tree. First, make a shallow V-shape cut on the top of the tree. Then make a cut from the bottom until the stem is severed. (Figure 20a). Severing the stem may cause the tree to dislodge itself from the hangup.

   You might have to do this sequence two or more times to get the tree clear. If possible, between each sequence try to roll the tree clear using a peavey or similar tool. Watch the top of the hangup carefully, and be prepared to make a rapid escape. The angle of the hangup tree increases (i.e., the tree approaches vertical) with each cutting sequence, and it becomes more difficult to determine how the tree will react to the next one. Use extreme caution when making additional cuts to free the tree!

2. *Felling another tree into the hangup*. This is the preferred method if a suitable, adjacent tree is available (Figure 20b). The tree should strike the hangup with enough force to break either the tree or the obstacle.

If another tree becomes lodged in the original hangup, use lines from machines or get help from an experienced cutter. Do not compound a safety problem by building a "tepee" or "jackpot" of trees. Mark the area around the hangups with colored "danger" or "killer tree" ribbon and get help.

Specific skills are required to cut problem trees. Evaluate each situation carefully and do not attempt to fell or buck a tree if you have any doubts about what will happen. Seek the assistance of an experienced professional. Safety always comes first! Always remember that operating a chain saw is extremely dangerous work under the best of conditions.



Figures 20a–b.—Cut down hangups by (a) cutting away the butt, or (b) felling another tree into the hangup.

Summary Checklist

To operate a chain saw safely, you must recall a lot of information. The following checklist will help. Consider making a pocket-size checklist for use in the field.

1. Prepare to do the job safely and efficiently.

- Personal protective equipment (hardhat, ear and eye protection, safety pants/chaps, first-aid kit, etc.)
- Tools and supplies (axe, wedges, peavey, etc.)
- Well-maintained saw and chain

2. Evaluate cutting conditions.

- Weather
- Terrain
- Escape routes
- Cutting positions

3. Evaluate the tree and its direction-of-fall.

- Use a plumb line and bob.
- Determine lean and/or limb loading.
- Check for rot.
- Decide whether this is a "danger tree"

4. Make the undercut.

- Are the cuts level?
- Do the cuts match up?
- Does the undercut face the direction-of fall?
- Is the undercut a proper depth?

5. Make the back cut.

- Shout a warning and listen for replies.
- Ensure a clear escape path.
- Use wedges as needed.
- Make the back cut *at least* as high as the undercut.
- Leave adequate hinge wood to control the fall.

6. Fell the tree.

- Move to safety along the escape path.
- Watch for overhead hazards.
- Is help needed to clear a hangup?
- Are broken limbs or tops left in adjacent trees?

7. Limb the tree.

- Continue to watch overhead for possible hazards.
- Look for limbs under tension.
- Look for springpoles and other hazards.

8. Buck the tree.

- Determine whether you can cut safely.
- Look for compression and tension wood.
- Evaluate how bucked pieces will move.
- Ensure an adequate escape path.
- Buck from the uphill side.

9. Never work alone!

10. Never work when you are fatigued!

For More Information

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Revised December 1996; revised June 2009.

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