EC 1124
Revised January 1997
$1.50

The Woodland Workbook

Logging

Felling and Bucking Techniques for Woodland Owners

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Contents

Skills in felling and bucking timber are useful for many woodland owners. Safe and effective use of chain saws promotes efficiency in thinnings, salvage operations, hardwood removals, firewood gathering, and full-scale harvesting operations. However, chain saws are dangerous! Do not use them without adequate skills and preparation, including physical conditioning and experience in chain saw use and maintenance.

This publication is not an in-depth felling and bucking skills manual. Rather, it's a guide to basic principles and procedures for inexperienced timber cutters. Its intent is to help you improve your basic skills in manual timber felling and bucking techniques. This publication does not cover all state or federal rules that may apply to felling and bucking.

Proper felling and bucking also can affect timber values and revenue received from timber sales. These topics are covered only briefly in this publication, and are discussed in greater detail in other publications (see "For Further Reading," page 16).

A good approach to skills development involves first understanding basic principles. Many are outlined in this publication, in chain saw operator manuals, and in other references.

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You can develop skills for effective chain saw operation by cutting timber that is already on the ground. This practice also will help improve bucking skills.

Consider arranging practice sessions with experienced timber cutters to learn felling techniques for standing timber. Start with live, small, straight trees of sound, green wood. Ordinarily, if problems occur, small trees will not require the use of mechanized equipment.

Never work alone with a chain saw! Always have someone nearby to provide immediate assistance should an accident occur.

Clothing and Equipment

You must have the tools and supplies necessary for your job. Protective clothing and equipment for safe and productive timber felling and bucking include the following:

- Hardhat (protective helmet)
- Eye protection (screens, glasses, or goggles)
- Hearing protection (ear muffs or plugs)
- Safety chaps or special pants containing protective inserts
- Gloves
- Boots (caulked boots provide more secure footing and are preferred by professionals)
- Comfortable clothing (loose fitting, cuffless pants)
- First aid kit
- Fire extinguisher
- 3–5 lb axe (for pounding wedges and cleaning out the undercut)
- Saw gas, bar oil, and lubrication (for the tip of the bar)
- Wedges (soft plastic)
- Chain file with handle and proper filing guide, plus gauges to check filing results
- Plumb line (string with a weight at the end to provide a vertical line for determining lean of a tree)
- Peavey or chain (to free hangups)

Chain saws

The chain saw should be modern and in good repair. Do not attempt a task as dangerous as felling trees with a poorly functioning saw. Check your chain saw for the following:

- The chain saw should be equipped with a chain brake that functions as the manufacturer intended.
- The length of the bar should not be excessively long (i.e., not much greater than the diameter of the trees you expect to cut).
- The chain should be sharpened correctly. Correct sharpening will ensure straight cuts and removal of wood "chips" rather than sawdust.

You may find a saw equipped with saw dogs (sharp, pointed teeth attached to the saw housing near the base of the bar) easier to control.

Timber Felling Plans

The way you fell timber influences skidding or yarding activities. Make felling and skidding plans before cutting begins (Figure 1). A planned system of skid trails, combined with proper felling-to-lead, can greatly help skidding timber to an access road. Use colored flagging to mark skid trails before skidding operations begin. "Designated skid trails" will help protect your residual stand and soil by limiting machine travel to specific areas.

"Lead" refers to planned, directional cutting of timber. For either ground-based skidding or cable yarding, trees "felled-to-lead" are angled approximately 30 to 45 degrees to either side of the skid trail or skyline cableway. Timber felled using this procedure resembles a herring-bone pattern. This pattern reduces timber breakage and damage to the remaining stand. This felling pattern is useful particularly for thinning operations or partial cuts. In small timber, either tops or butts of trees may face the skid trail.

Trees felled out-of-lead typically are angled 90 degrees or more away from the skidding direction. During skidding, felled timber must be pulled toward the desired direction of travel. If you must swing timber into a skid trail, it can badly scar standing trees or crush young regeneration. Safety also can be jeopardized when timber is pivoted toward the direction of travel.

In a clearcut operation, arrange the cutting pattern so trees are felled into the open area rather than into standing timber. When standing timber is brushed by falling trees, limbs or tops may be broken and propelled backward toward the cutter. They also may hang dangerously overhead and fall unexpectedly.

In thinning operations, fell trees into openings. 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.

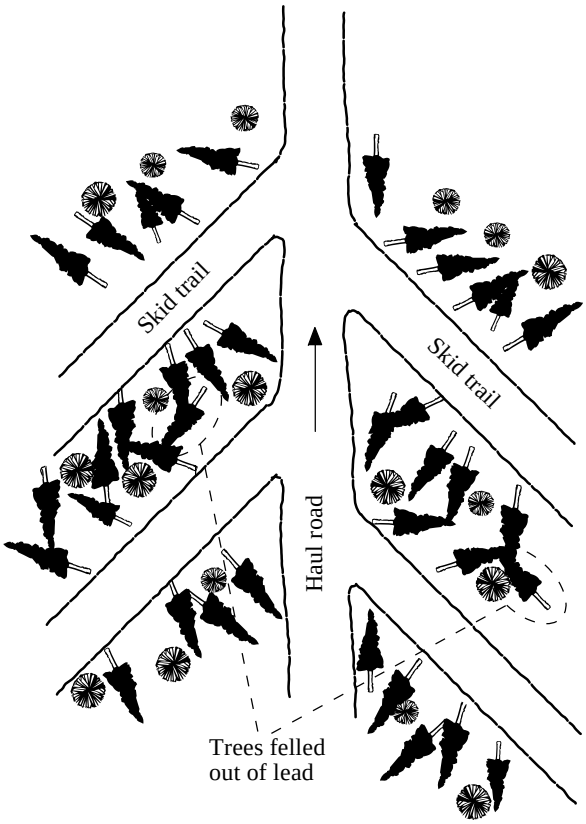


Figure 1.—*A planned felling pattern (not to scale).*

Evaluating Tree Felling Conditions

Hazardous conditions

Under some conditions, timber felling should be considered unsafe. Such conditions involve weather, terrain, and operator skill. When unsafe conditions exist, inexperienced cutters should either seek assistance from a professional or postpone activities. Under these conditions, professionals can minimize risks that may create life-threatening conditions for beginners.

Unsafe conditions include the following:

- *Light, intermittent wind* may be sufficient to tip a tree in the wrong direction or cause other problems at the stump. If tree tops are moving, do not attempt to fell timber.
- *Fog* hampers vision upward into the tree crown. Detached limbs and tree lean can be obscured. If the direction-of-fall is not visible, someone could enter a danger area without being seen.
- *Snow and ice* may cause limbs, heavy bark, or tree tops to fall suddenly.

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. Some kinds of danger trees include the following:

- *Standing dead or rotten trees* constitute a serious hazard to your safety. Such trees are referred to as snags. Snags are beneficial for various bird and mammal species. After they fall, snags decompose, further enriching soil nutrients.

  However, snags often have problems with rot, heavy bark, and loose limbs. Wind can cause snags to topple without warning. Snags can react unpredictably when standard cutting techniques are used. Due to their deteriorated condition, snags should be felled only by an experienced cutter.
- *Trees with "pistol butts"* are found on slumps and slides. Their distinct shape results from not achieving normal vertical growth, and they often require specific cutting techniques.
- *Trees with brittle or rotten heartwood* may require the attention of an experienced cutter. Alder, maple, and madrone often have these characteristics.
- *Utility lines, buildings, steep slopes, or trees whose length will allow them to cross roads* can cause special problems. Professionals use cutting techniques, wedges, hydraulic rams, cables attached to machinery, and their expertise to solve problems.

As an inexperienced cutter, exercise caution when attempting to fell or buck timber unfamiliar to you. If you are unsuccessful, your attempt may cause additional danger to the professional ultimately responsible for felling the danger tree.

In preparation for all felling operations, you must determine a clear direction-of-fall. If you cannot make this determination, leave the tree standing until you obtain assistance.

Mark any potentially hazardous tree with highly visible, colored flagging (special "danger tree" flagging is available). This warning will alert others to the presence of a danger tree.

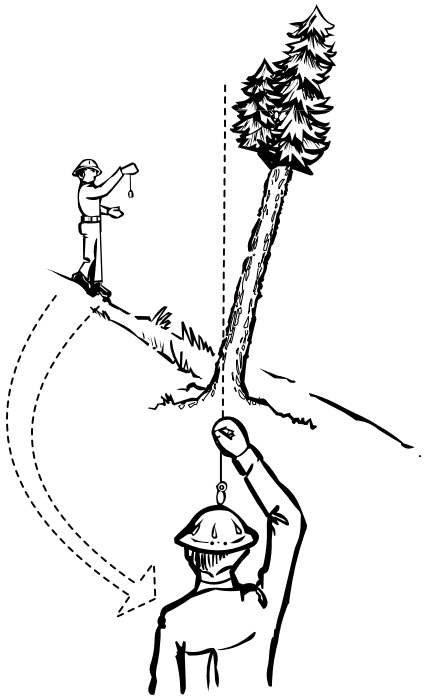


Figure 2.—*Determining the lean with a plumb line.*

Assessing the Tree

A careful evaluation of felling conditions will guide you in making felling cuts. Assess potential hazards to determine whether or not assistance is needed. For each tree to be felled, beginning cutters should go through a mental checklist containing items similar to those listed at the close of this publication (see "Summary Checklist," page 15). Failure to recognize a key piece of information could threaten your safety.

Always begin the felling process by determining tree lean. You are inviting disaster by cutting a tree without evaluating its lean. The lean of each tree is unique. Do not assume you can assess the direction a tree naturally will fall simply by looking at it. For example, trees growing on slopes often lean downhill. Even trees that appear to lean uphill may be straight or lean slightly downhill.

You can estimate the amount of lean using a plumb line made from a small weight and a piece of string (Figure 2). By looking at the tree's lean from at least two sides at right angles, you can determine the direction of natural fall.

First, stand uphill and to the side of the tree. Then, assess the tree's lean from right angles to that position. If the natural lean is toward the chosen direction-of-fall, use standard cutting techniques. If the natural lean is away from the desired direction-of-fall, special cutting techniques will be needed.

Another factor that influences direction-of-fall is the pattern of limbs. Limb loading can result from a large limb growing on one side of the tree. This condition will cause a tree to be pulled out-of-lead as it falls. Limbs from adjacent trees may interlock, making it difficult to start a tree's fall in the desired direction. Specific cutting techniques can overcome problems related to limbs as well as to lean.

As you examine a tree for lean and limb loading, look for loose limbs hanging overhead. Loose bark also can be a hazard. Snags and trees with overhead hazards are particularly dangerous. Saw vibration or tree movement can release the objects, causing them to crash downward. If you plan to cut such trees, arrange for an additional person to watch

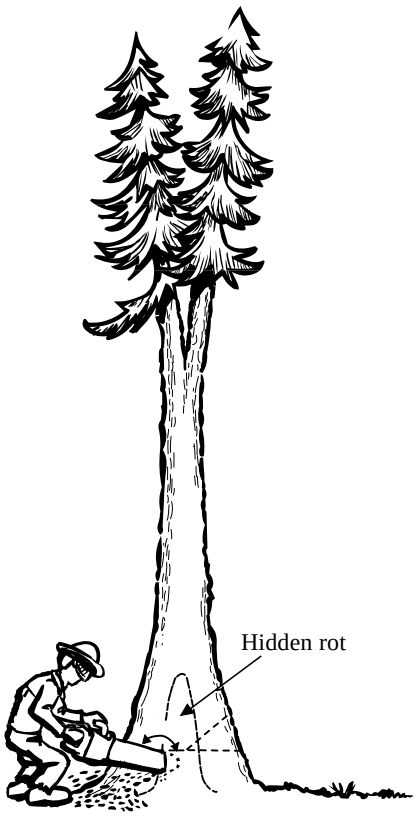


Figure 3.—*Boring the stump to detect the presence of rot.*

overhead and warn of hazards while you attend to responsibilities at the stump.

Always determine if rot is present where your felling cuts will be made. Controlling a tree during felling requires that cuts be made in sound wood. Felling cuts made in areas containing rot can cause a tree to split or shatter, with serious results for the timber faller.

Expect to find rot in standing dead trees. Fungal fruiting bodies known as conks also indicate rot. Tree species such as hemlock, true firs, cedar, and some hardwoods are known to contain stump rot.

If rotten wood is present, compensate for it by leaving extra sound wood. As another alternative, you may want to consider changing the direction-of-fall.

Trees suspected of containing rot may be bored using the saw bar to determine if rot is present. While maintaining the saw bar in a vertical plane, make a boring cut by pushing the saw bar directly into the tree stump within the area suspected of containing rot (Figure 3). These cuts will not weaken the tree if they are made below the point where felling cuts are planned. When boring, maintain firm saw control to prevent chain saw kickback.

Make your cuts parallel with the direction-of-fall, and assess the chips or sawdust produced. Sawdust from rotten wood is quite different from chips produced from sound wood. As an exercise, cut into logs known to contain rotten wood and examine their sawdust.

Figure 4 indicates additional factors you should consider when evaluating a tree to be felled. For trees that have butt swell, make felling cuts far enough into the tree to penetrate beyond the swelled area. This distance will equal a projection of the upper bole downward into the butt swell. Snow break, prior damage, double trunks, or physical differences among various tree species can weaken trees, affecting your cutting procedures.

Figure 4.—*Evaluate tree to be felled.*

Escape Path

Clear at least one escape path for each tree you plan to fell (Figure 5). A clear, unobstructed path will enable you to move quickly to a safe position after dropping the saw at the tree stump. Your path should be angled 45 degrees backward and away from the direction-of-fall. Because many felling accidents occur to cutters who remain within 15 feet of the stump, clear an escape path greater than this distance. The path should be free of brush and other obstacles.

Sometimes, obstacles located 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 obstacles jeopardize your safety, you may need to cut higher stumps. This practice will allow you to maintain a standing position necessary for escaping quickly.

Beginning cutters should seek professional assistance if rocks, multiple stems growing from one stump, steep slopes, difficult terrain, or other obstacles hinder a quick escape. An escape route can be critical if a tree does not fall as planned.

Tree Felling

Sighting direction-of-fall

Chain saw handles are designed to be used as a sighting mechanism. Saws with curved handles have “sight marks” imprinted on the saw housing. When making your undercut, sighting down the handle of the saw or 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 of your saw.

Matching saw cuts

Before making any undercut, it’s vital to understand the importance of matching saw cuts. In order to control a tree’s intended direction-of-fall, you must make felling cuts that do not overlap. Ideally, your cuts will match perfectly. As a tree tips toward its desired direction-of-fall, cuts matched properly will close uniformly along their line of intersection.

If your cuts do not match, the differential rate at which an undercut closes dramatically alters a tree's direction-of-fall (Figure 6). You may lose directional control. The tree could split vertically, creating extreme danger for the cutter. Figure 7 indicates how forces from a falling tree are redirected when an undercut does not close uniformly, creating a "barber chair."

To ensure matching cuts, use a heavy crayon to sketch the shape and location of your undercut. Mark your intentions with your axe (Figure 8). Beginning cutters always should have another person on the opposite side of the tree to alert the cutter if corrections are needed.

Undercuts

Once you understand matching cuts, the first step in felling any tree is to make an undercut near the tree's base. An undercut allows a tree to be guided toward a preferred direction-of-fall. To make an undercut, follow the instructions below to remove a wedge of wood whose width and volume are compatible with the tree's size and your cutting technique.

In order to effectively complete an undercut, your saw should be equipped with saw dogs to help grip and hold the saw's position. Using saw dogs, you can maintain constant contact between the saw bar and the wood being cut. Saw slippage will be reduced, and your personal safety will be improved. As an undercut is made, the saw is rotated around the base of a tree. With each new saw position, the saw is pivoted, allowing the dogs to bite deeply into the tree bark.

Three types of undercuts commonly are used for felling timber—the conventional, the Humboldt, and the open-face undercuts (Figure 9a,b,c).

Conventional undercuts. The conventional undercut is accepted worldwide and is the easiest method for beginners to learn. Select a direction-of-fall and make a horizontal cut at right angles to your intended direction-of-fall, sighting with your handle or saw's sight marks. The depth of this cut should be one-fourth to one-third of the tree's diameter (Figure 9d).

Angle the next cut so it meets the deepest point of the horizontal cut exactly at both corners. In so doing, a wedge of wood will be cut free. When

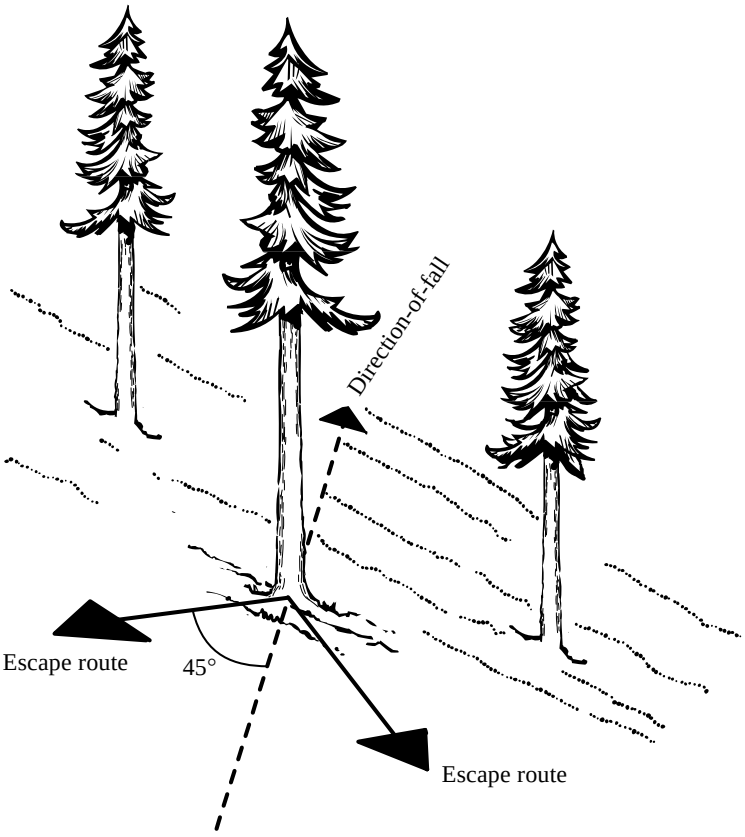


Figure 5.—*Clear, unobstructed escape paths needed.*

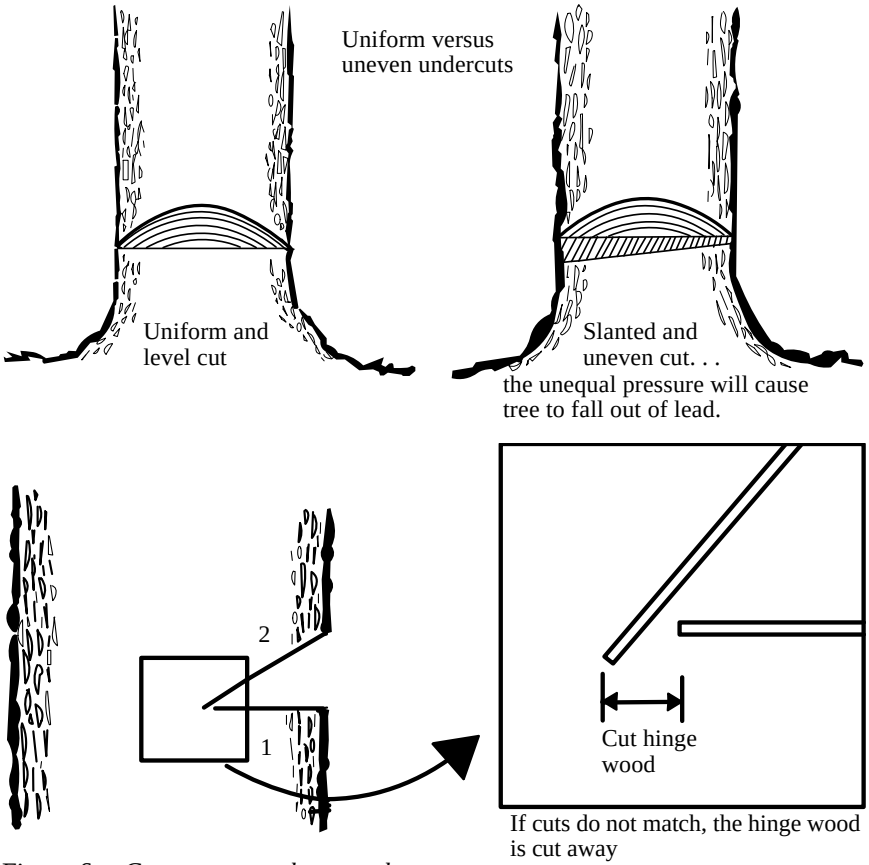
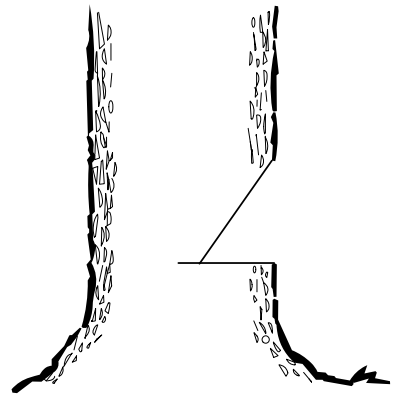


Figure 6.—*Cuts must match properly.*



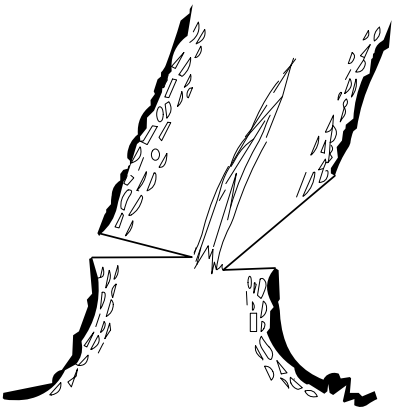


Figure 7.—*Barber chair from mismatched cuts.*

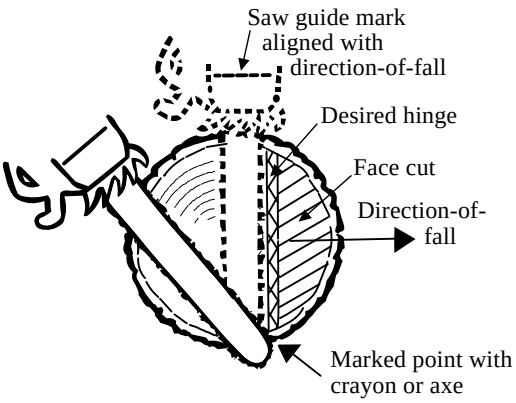


Figure 8.—*Mark intentions to be sure cuts match.*

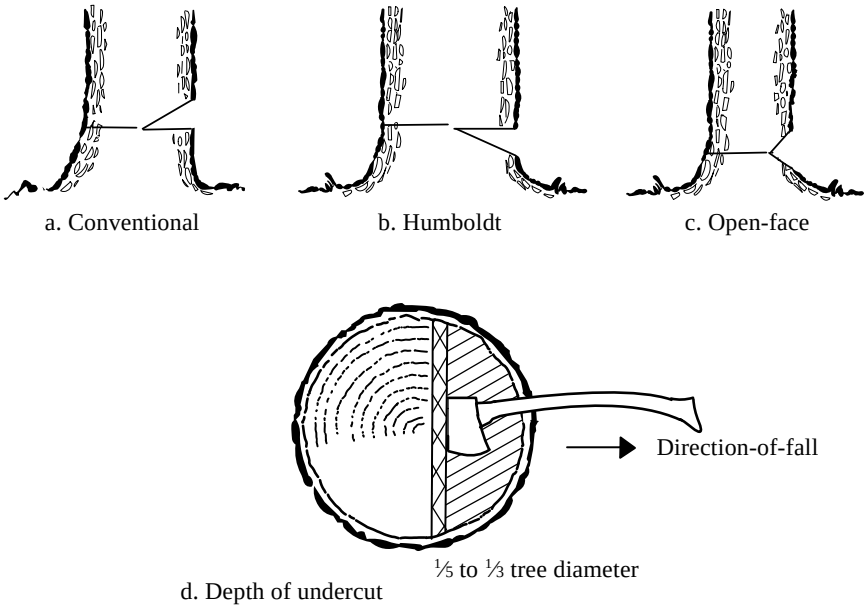


Figure 9—*(a, b, and c) Types of undercuts; (d) Depth of undercut, and using an axe to check direction-of-fall.*

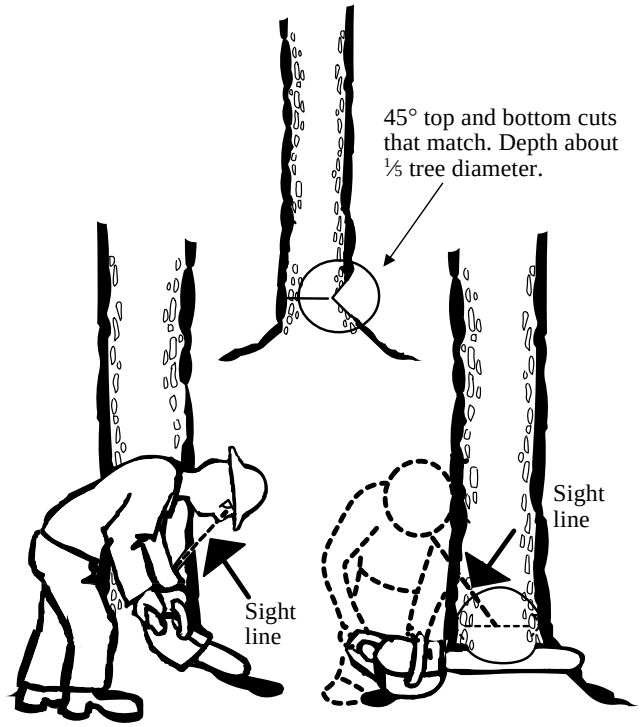


Figure 10.—*Sight down open cut to help match lower cut.*

making your undercut, try to create a vertical opening approximately one-fourth the tree's diameter. After some practice, you may be able to anchor the saw at the near point and match your cuts with greater accuracy.

Once the cuts match, chop out the wedge with your axe. After removing the wedge of wood, place your saw in the undercut, and use it as a device to sight the desired direction-of-fall. Since the tree won't fall in the desired direction if it isn't aligned to do so, make corrections to the cuts as needed.

Humboldt undercuts. An undercut popular in the west is the Humboldt undercut. It generally is used when felling medium to large timber. The horizontal cut of the Humboldt undercut is made similar to 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 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. The open-face cut originated in the Nordic countries and is used for felling small, straight trees. Do not use saw dogs when making the open-face undercut or back cut.

Make an open-face undercut as follows. After sighting the tree's intended direction-of-fall, start with the top cut first. Keep the saw horizontal while the angled cut is made. To make the top cut, cut downward at a 45-degree angle. Then sight down the top cut to make sure the bottom cut will exactly meet at the intended angle (Figure 10). To make the bottom cut, cut upward at a 45-degree angle. When cuts at the bottom and top intersect, they will form a 90-degree angle.

The depth of your cuts should equal about one-fifth the tree's diameter. It's important that the top and bottom cuts match and are not overcut at their corners.

Back cut

A back cut is made horizontally. It is the final cut that causes the tree to fall. The back cut is approximately 1 inch higher than the undercut. When making your back cut on sloping ground, always work from the uphill side of the tree.

Before you begin to make 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 definite communication, indicating a safe position, has been established.

As the back cut is made, do not allow it to intersect the undercut. Instead, you should leave an unbroken hinge of uncut wood between the undercut and back cut. This uncut wood allows you to control the tree's speed and direction-of-fall. A horizontal back cut whose hinge width is 1 to 1.5 inches should be adequate for controlling trees whose stump diameter is less than 24 inches (Figure 11).

If the tree's diameter is sufficient, insert a falling wedge in the back cut as soon as possible to prevent the tree from sitting back on your saw bar. Wedges also can be very useful for correcting tree lean.

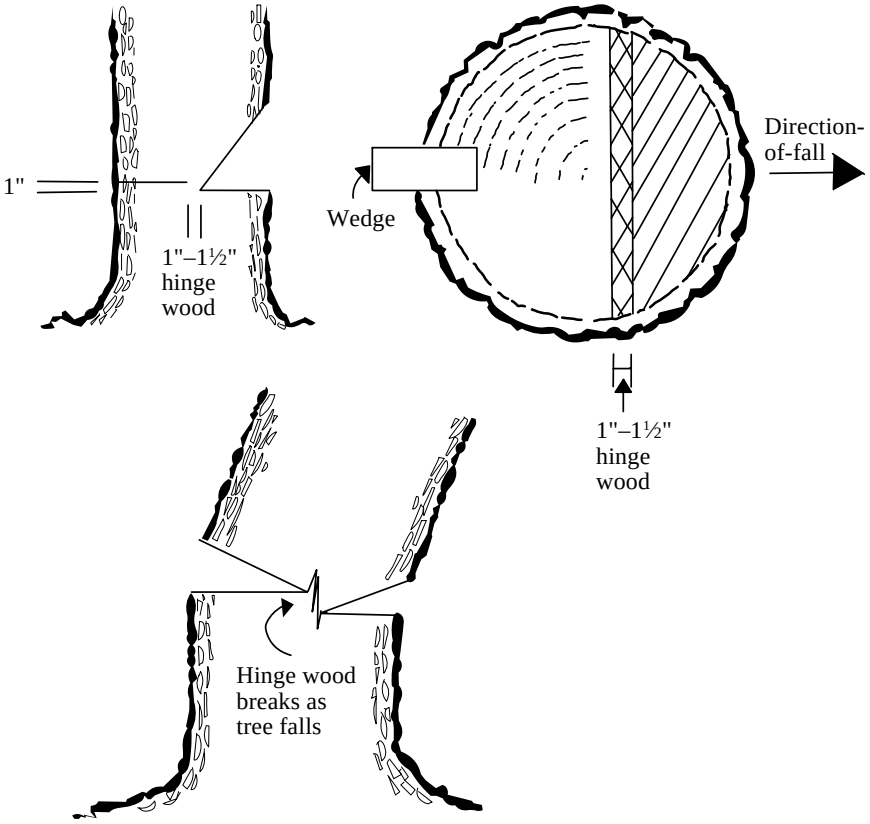


Figure 11.—*Making the back cut.*

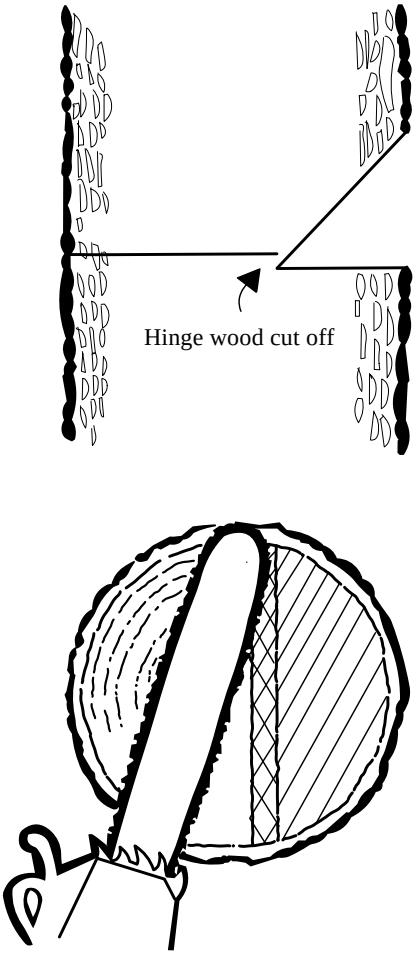


Figure 12.—*Overcutting the back cut.*

Make your back cut moderately fast 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. Check frequently to make sure your back cut is progressing satisfactorily. Take care to avoid cutting off the corners of your hinge wood. Overcutting the back cut can alter a tree's direction-of-fall (Figure 12). Glance frequently into the tree crown to check for hazards overhead.

As the tree begins to fall, remove the saw from the cut and immediately drop it behind the stump. Proceed quickly along your predetermined escape path. Retrieve your saw after the tree is on the ground.

Small trees may require that the back cut be made before the undercut. This will enable you to better accomplish directional felling by first placing a wedge in the tree. Practice

this technique with an experienced cutter before attempting it on your own.

Occasionally, you may wish to fell a tree whose diameter is greater than the length of your saw bar. Under such circumstances, the back cut must be made utilizing a series of cuts (Figure 13). Utilizing a series of cuts preserves the strength of the hinge wood until the final cut is made. As you make the series of cuts, wedges may be needed to maintain control of the tree.

Bucking Procedures

Bucking involves cutting trees into log segments whose lengths are specified by mill requirements, including trim. Buckers should make cuts square to the logs, correctly measure log length, and maintain log value. You must carefully evaluate each bucking situation. When bucking, maintain a safe working position on the uphill side of bucked logs.

The first consideration in safe log bucking is to determine the direction log segments will move after the cut is completed. You can make this determination by following one basic principle: "cut the compression wood first."

The position of the tree creates internal forces in wood fibers. Figure 14 illustrates the difference between compression wood and tension wood. Compression wood is located along the inside of a curved or bent piece of wood. In compression wood, wood fibers are pushed together. Tension wood is located along the outside of a piece of wood. In tension wood, wood fibers are pulled apart.

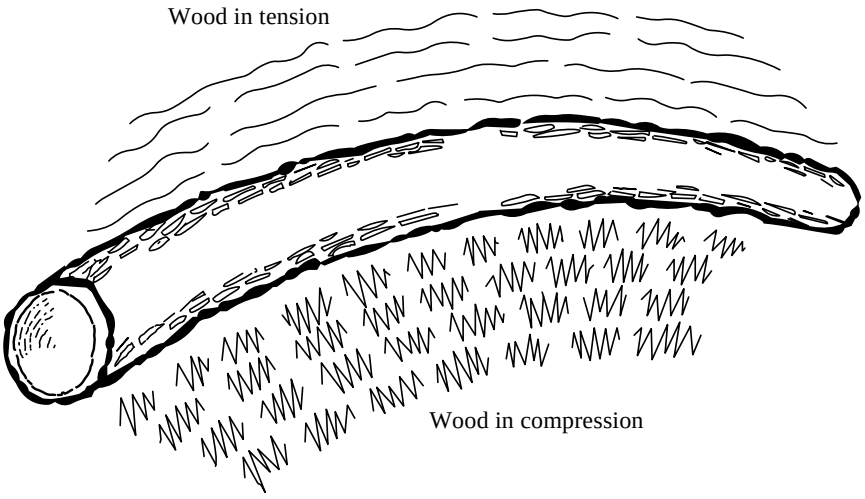


Figure 14.—*Wood in tension and compression.*

The concept of cutting compression wood is illustrated in Figure 15a,b,c. Generally, cutting compression wood first allows a log to move in the direction of tension. Gravity also will act on trees during bucking, causing them to roll, slide, or fall.

It may be difficult to evaluate correctly the exact location of compression wood and tension wood. Therefore, always keep an axe and wedges available for releasing a pinched saw bar.

The term "bind" is used to indicate the location of compression wood. Bucking principles and procedures described previously also apply to trees lying in a horizontal bind.

When bucking large timber, you sometimes must make a number of cuts in order to release the tension wood. As tension wood is cut, it is not uncommon for wood beneath the cut to break away.

When bucking smaller logs, two cuts normally will be adequate. The

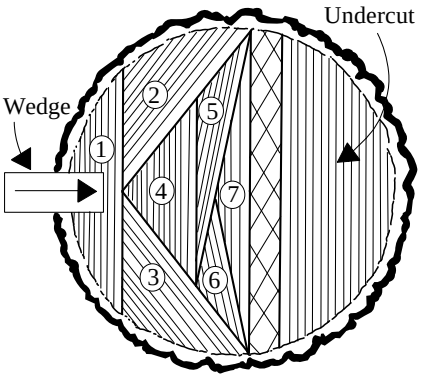


Figure 13.—*Using a series of cuts.*

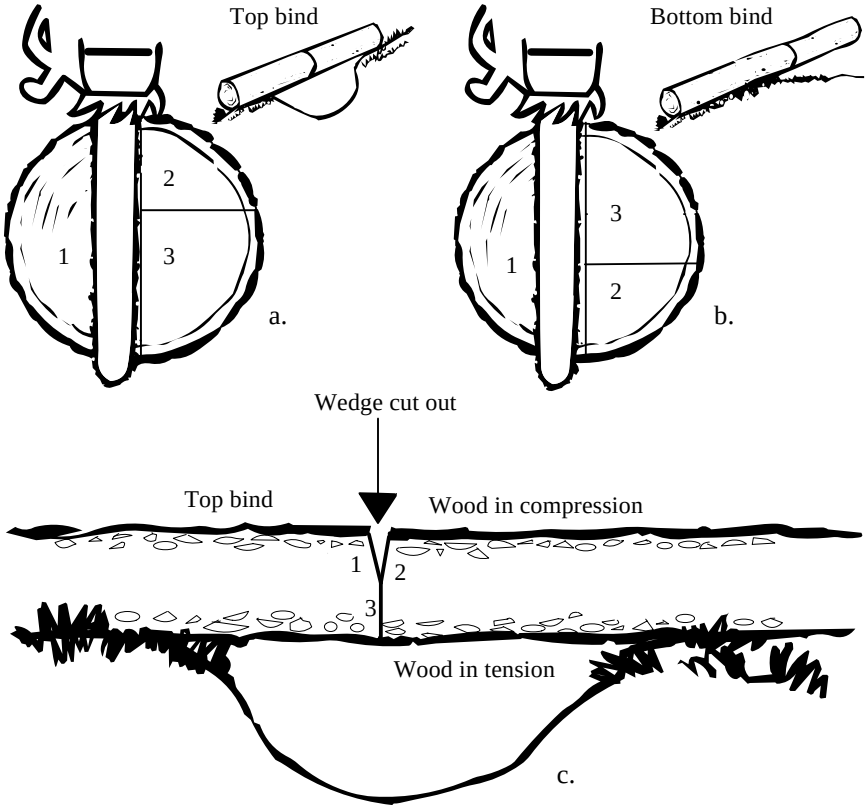


Figure 15.—*Cutting compression wood first.*

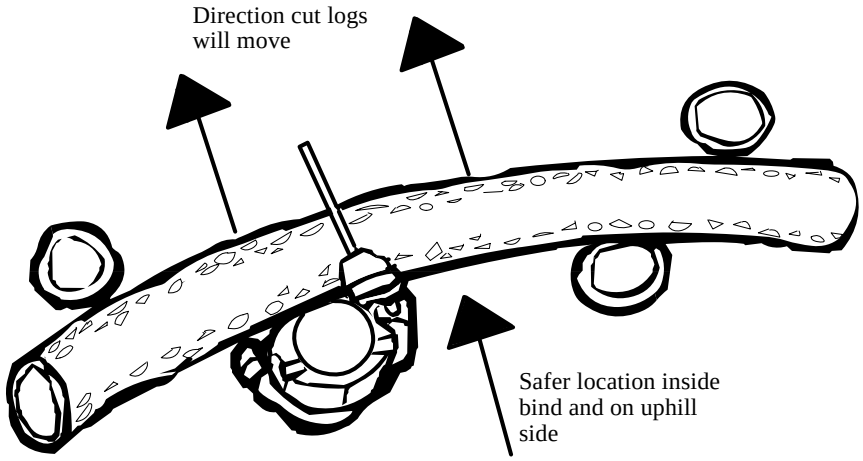


Figure 16—*Make final bucking cuts from a safe position.*

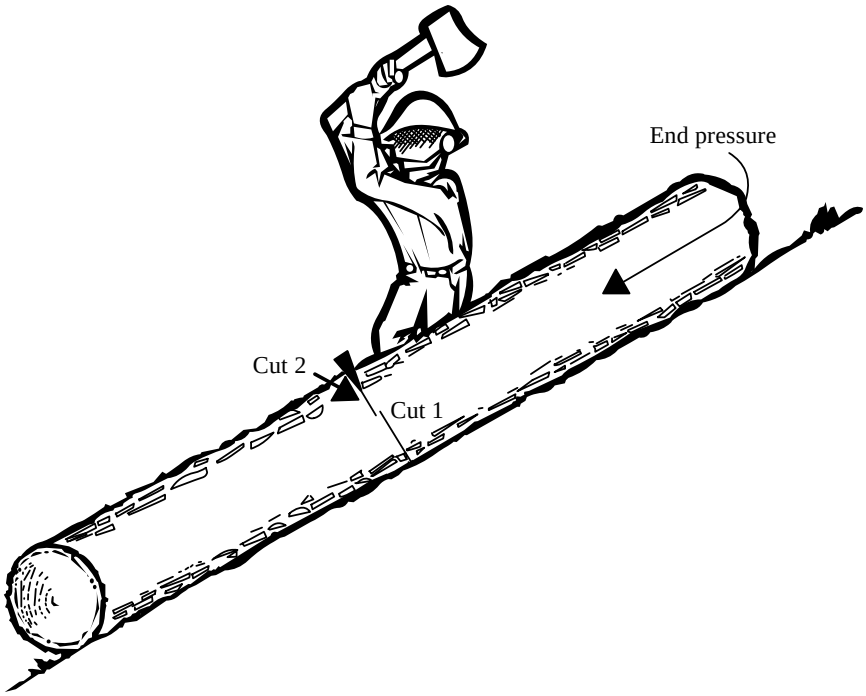


Figure 17—*Trees/logs subjected to end pressure.*

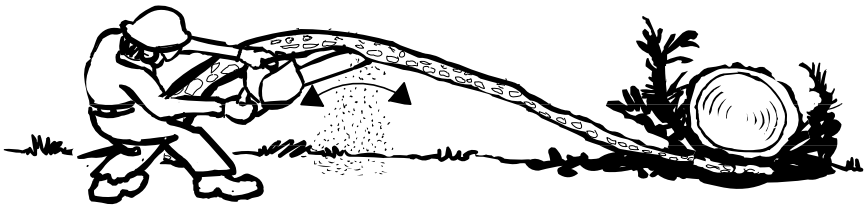


Figure 18—*Cutting springpoles.*

first bucking cut will be shallow. It's intended to sever only a small amount of compression wood without binding the saw. A second cut will release the tension wood.

Hazards during Bucking

You may encounter several dangerous situations during log bucking. On sloping terrain, remember to make your final bucking cut from the uphill side. This will prevent bucked logs from rolling downhill toward the bucker (Figure 16).

Trees sometimes are subject to end pressure. This occurs when trees lie along a slope and are supported along their entire length (Figure 17). After the first cut is made, you could become endangered by the upper log sliding downhill. In order to safely buck such logs, you must make two cuts.

The first cut, on the log's lower half, should be offset and uphill. The second cut, on the log's upper half, should be downhill. Inserting a wedge will help you keep the upper cut open. If the logs will not separate, mark them with brightly colored flagging to serve as a warning to those doing the skidding or yarding.

Windfalls cause dangerous bucking problems and are difficult to evaluate. Rootwads may act unpredictably when cut away from the stem. Roots bent underground can apply pressure, causing a rootwad to upright itself when cut. An uprighted rootwad may either roll onto the bucker or cause the bucked log to react unpredictably.

Analyze each bucking situation for its unique circumstances. Assess its compression/tension wood, potential for movement, and safe positions from which to make bucking cuts.

Springpoles

Springpoles are small trees bent under by larger trees you have already cut (Figure 18). They are under extreme tension and can react unpredictably when improper cutting methods are used. Attempt to cut a springpole only if you can reach a point where a right angle is formed by the lines of the bent tree.

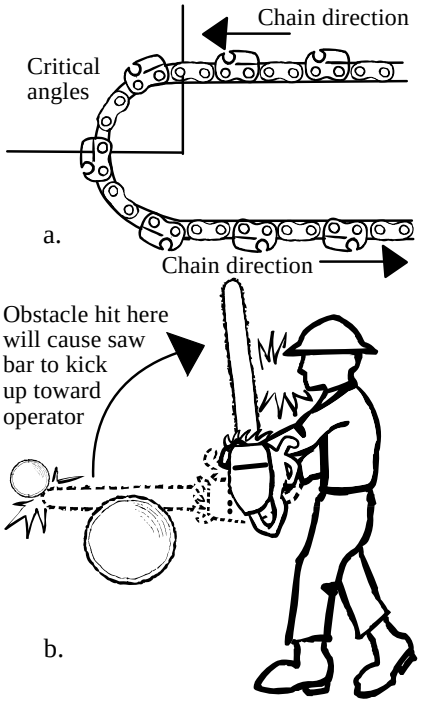


Figure 19—*Avoid chain saw kickback.*

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

Alternately, you can shave the compression wood along the same area with the side of the saw. Experience shows this releases some of the tension, and successive cuts can continue to release additional tension by cutting the compression wood.

For larger springpoles, or if there is no place to stand while cutting, mark them with colored flagging and pull the trees off with lines from a machine.

Chainsaw Reaction Forces

Chainsaw reaction forces result when the power of the rotating chain is transferred from the action of cutting wood to the saw and the operator. The common reactive forces are kickback, pushback, and pull-in. Reactive forces may cause the saw to move rapidly and unpredictably, or cause operators to lose control of the saw or to lose their balance.

Kickback is one of the major issues in maintaining safe bucking and limbing practices. It is the sudden transferral to the operator of uncontrolled chain saw cutting power. Movement is unpredictable and may cause serious injury or death.

Kickback can occur due to many circumstances. Inaccurately high or low depth gauges, or dull cutting teeth result in a poorly maintained saw chain. Saw teeth that fail to cut wood can cause the saw to kick back. Kickback also can occur when your cutting moves from soft, live wood to hard, dead wood. Kickback is more likely when cutting with the top quadrant of the saw bar nose.

Figures 19a,b illustrate critical angles on a saw bar nose where kickback during cutting might be more likely. 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 could be prevented by the following:

- Control the saw using a solid, two-handed grip with thumbs wrapped around the saw handles.
- Maintain good footing and positions for preventing kickback by not standing in line with potential bar movement.
- Know where the tip of the bar is at all times.
- Anticipate kickback situations when you are making a boring cut. Bore at an angle upward or downward rather than straight into the log, and begin boring cuts using the bottom of the saw bar nose.
- Keep track of the kind of wood you are cutting (live versus dead).
- Maintain the saw's chain brake. However, do not depend on its chain-stopping feature alone.
- Sharpen the saw chain according to the chain manufacturer's directions. Use the available guides and gauges to help sharpen your chain, or have a saw shop do it for you.
- Use low-kickback bar designs and anti-kickback chain.

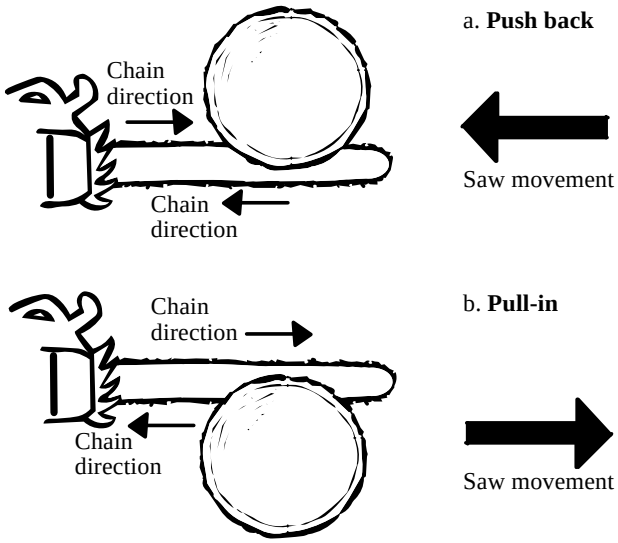


Figure 20—*Pinched chain forces.*

If the saw chain becomes pinched, the saw may move in the opposite direction to chain movement. If the top of the bar is pinched, the saw will *pushback* into the operator. If the bottom of the bar is pinched, the saw will *pull-in*, pulling itself and the operator forward (Figure 20a,b).

To reduce the potential for pinched chain, always start the cut with the saw chain running at full speed. Watch for compression wood that would cause the chain to bind. Consider using a wedge to help keep the saw cut open.

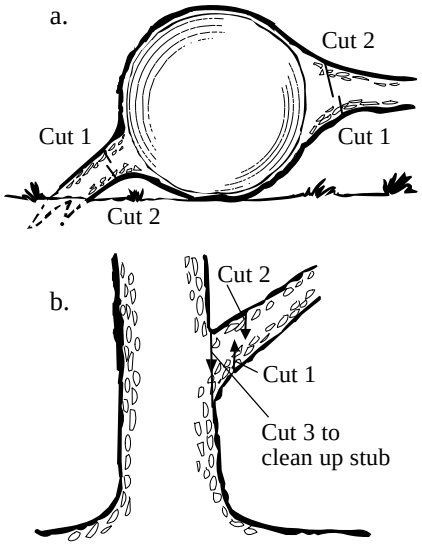


Figure 21—*Cutting limbs.*

Limbing

Limb removal may appear to be relatively simple; however, it is time-consuming, and accidents often occur. You may encounter problems when limbs supporting the stem cannot be removed safely. Predicting the movement of cut limbs can be particularly difficult. You must evaluate limbs under pressure to determine the location of compression and tension wood (Figure 21a,b).

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

You may benefit from using a delimbing technique developed in the Nordic countries for coniferous trees. It also may be modified for use with hardwood trees. Figure 22 shows appropriate positioning for this method. Think of this method's movements and positioning as if they were a practiced athletic drill, or even dance movements. The following delimbing steps are suggested for a right-hand saw user:

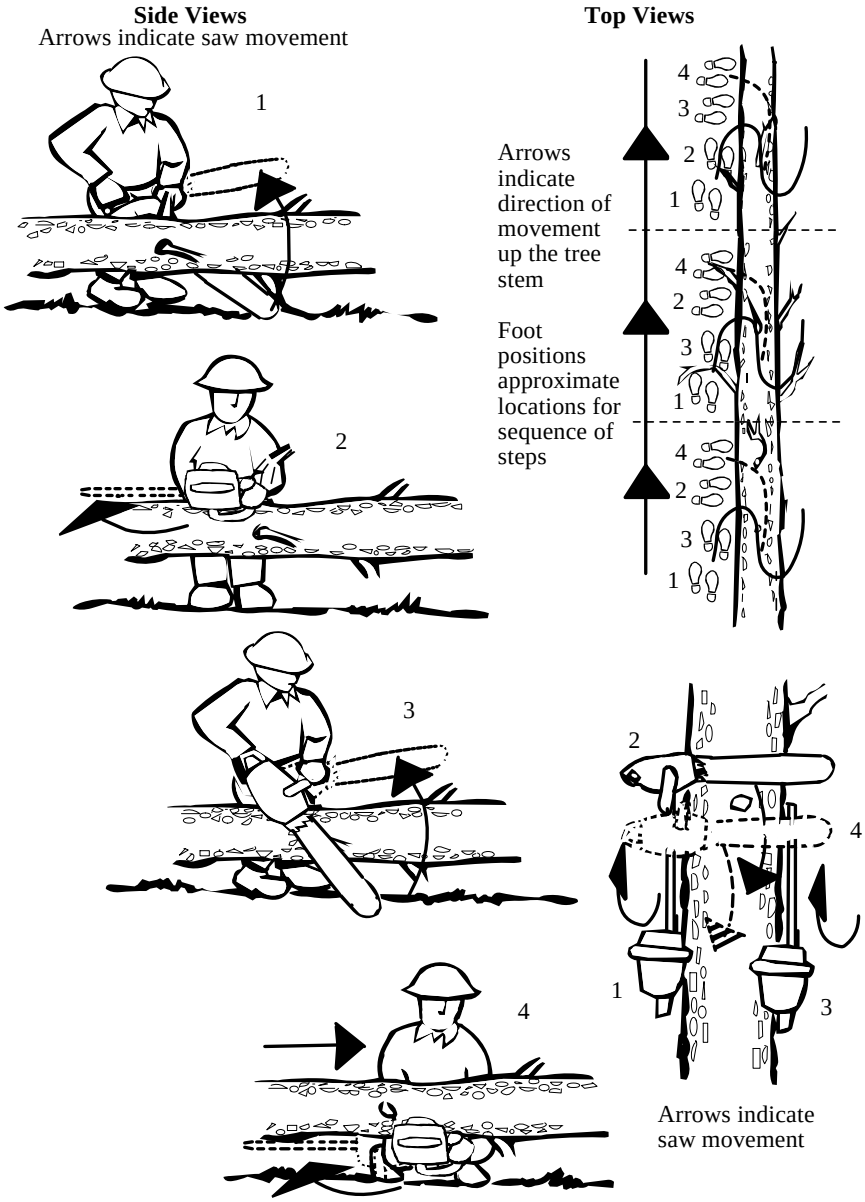


Figure 22—*Nordic delimbing technique. Arrows indicate saw movement or direction up the tree stem.*

1. Usually start at the butt of a tree and cut the limbs in front of you, keeping the saw to the right side of your body. Cut only those limbs that can be reached comfortably with the saw tucked close to your right side.
2. At the end of the sweeping, cutting motion, change your grip on the saw handle to the left side of the saw, reposition your feet, and turn the bar parallel to the stem. Use the top of the bar to slide along the stem. Cut the limbs on top of the stem toward the butt of the tree where you started.
3. Reposition your grip to the top of the saw handles and turn the saw so it rests on top of the stem. The front of the saw will be on top of the stem, and the bar will be in a vertical position on the opposite side of the stem. Use the stem as leverage point and slide the saw forward, cutting the limbs on the opposite side of the tree. The stem supports the weight of the saw and is used to lever the saw into position for cutting the limbs. Cut what you can reach without overextending yourself.
4. With the saw resting on the stem, and the bar on the opposite side, step forward to a new position and face the stem. Grip the saw on the left part of the handle, bend your knees keeping a straight back, and cut the limbs on the bottom of the stem in a sweeping motion toward the butt of the tree. Use the top of the bar, keeping the bar parallel to the bottom of the tree and pressed against the stem during the movement.
5. At the end of the sweeping movement, reposition the left hand to the top of the handle and begin Step 1 again.

With practice, these steps will form a pattern that has several benefits. The lower back is kept 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 carried by the arms. Legs are better protected, especially when moving to a new position with the saw on the opposite side of the tree stem. Nothing in the pattern restricts handling unusual circumstances when they arise.

Problem Trees

Multiple stems

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

Felling multiple stems requires that you begin with the outermost stem. Fell the stem in its natural direction-of-fall. As you cut each stem, be aware of overhead hazards. Several escape paths may be required.

Occasionally, conifers will have double stems originating from a single stump. If the split occurs at a height greater than you can reach with a saw, there may be sufficient wood holding the two stems together to enable you to fell the tree as if it had a single stem. Its direction-of-fall should be perpendicular to the horizontal long axis of the two stems (Figure 23). Regardless of fork height, examine the trunk cautiously. Locate a well-defined vertical seam or scar indicating separation between the two stems.

If the split occurs at a height you can reach with a saw, fell the stems separately. Cut vertically down the seam with your saw. Select the direction-of-fall on one of the stems and make an undercut. Make your back cut, leave an adequate amount of hinge wood, and fell the tree. You can fell the remaining stem either with or against the lean (Figure 24).

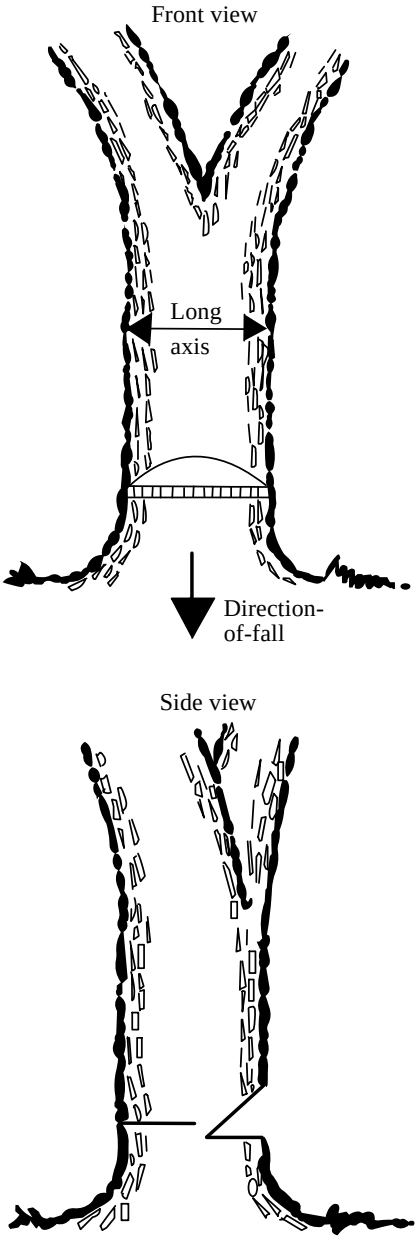


Figure 23—*Felling two stems together.*

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 gain skills from an experienced cutter. Basic skills will allow you to fell trees having moderate lean. Obviously, trees can be felled with the least amount of difficulty toward the direction in which they lean naturally.

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. Depending upon the tree's size and its degree of lean, you might use one of the following types of back cuts.

1. For trees whose diameter-at-breast-height (dbh) 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 desired hinge wood thickness is achieved (Figure 25a).
2. For larger trees with more lean, you may choose to bore the center of the back cut. This will reduce the likelihood of producing a barber chair (Figure 25b). After the tree has been bored, make a quick back cut using the remaining wood on either side of the center cut as a hinge.
3. Large leaning trees may require two side cuts. Wood that remains in the tree's center portion will hold the tree. Make a back cut quickly in order to release the remaining wood. However, a substantial amount of wood will break away as the tree falls (Figure 25c).

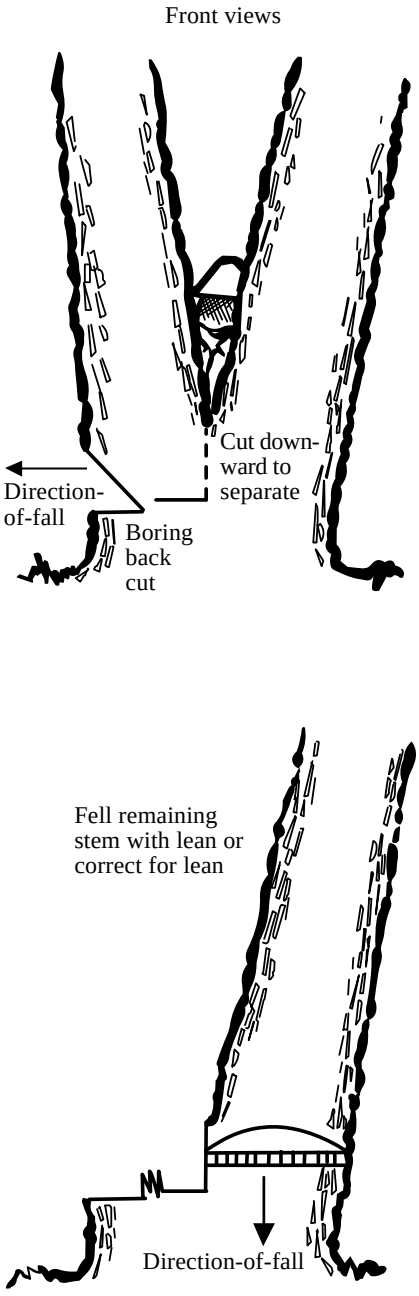


Figure 24—*Felling stems separately.*

Correcting for moderate lean. "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 26). Usually, hinge wood should not be cut because it helps control a tree's direction and rate of fall.

Felling against the lean

Trees that lean heavily can be felled against their lean. However, you often need considerable judgment gained from years of cutting experience. Felling against the direction of natural lean is accomplished using hand tools and special felling techniques.

You will need two or more soft plastic wedges to lift the leaning tree. Make a shallow undercut approximately one-fourth the tree's diameter to achieve a longer lever arm for the wedges to lift. Clear away the bark where you will insert the wedges under the point of the tree's lean. Start the back cut there, insert both wedges as soon as there is ample room, and keep them tight in the cut.

Proper wedging can lift a tree into an upright position. Ideally, wedges will provide approximately 1 inch of tree lift. Alternately cutting the back cut and wedging will shift a tree away from its natural lean, through a vertical position, and toward a more desirable direction-of-fall.

If additional lift is required, you can place one wedge on top of another. This practice will almost double the lifting capability of your wedges. Continue the process until the tree is relieved of its lean and straightens (Figure 27).

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

The following guidelines indicate the maximum amount of lean that wedging can correct. Values are approximate and apply to trees whose stump diameter varies between 12 and 24 inches.

Amount of lean (ft)	Tree height (ft)
4	50
7	100
10	150

Using wedges, it may be possible for experts to fell trees with even greater lean. Hydraulic rams can be used to lift leaning trees. Cables attached to heavy machinery also may be used to pull a heavily leaning tree into an upright position for directional felling.

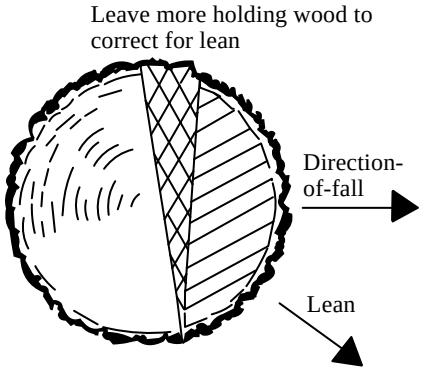


Figure 26—*Correcting for moderate lean using holding wood.*

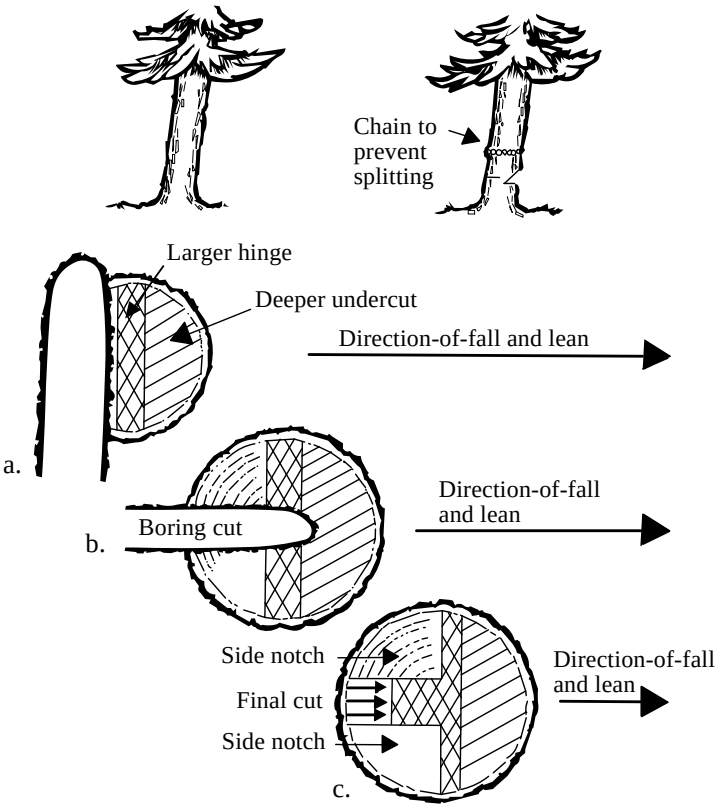


Figure 25—*Felling trees with the lean.*

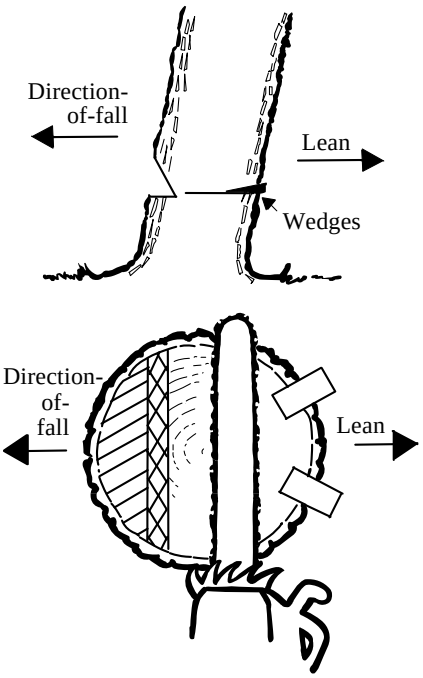


Figure 27—*Felling against the lean using wedges.*

Hangups

Eventually, every timber cutter will create a hangup. Hangups occur when a felled tree becomes lodged in a standing tree. Once a hangup occurs, find a safe location where you can carefully evaluate the situation. Lodged trees often are held only by their limbs, which can break and release the hangup to fall 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 are unable to free the hangup safely, seek advice from an experienced cutter. Two techniques commonly are used to safely get the hung tree on the ground (Figure 28). The first is most effective for trees whose diameter is less than 18 inches.

1. *Cutting away the butt.* Making a cut part way up the butt of the tree may clear the hangup. First, make a shallow V-shaped cut on the top of the tree (see "Bucking"), then make a cut from the bottom. Severing the stem may cause the tree to dislodge itself from the hangup.

   Two or more of these sequences may be required to get the tree clear. If possible, between each of these sequences, try to roll the tree clear using a peavey or similar tool. Watch the top of the hangup carefully, and be prepared to make an escape.

2. *Felling another tree into the hangup*. Sometimes a hangup can be cleared by felling an adjacent tree into the hangup. The tree should strike the hangup with sufficient force to break either the tree or the obstacle.

If the original hangup causes another tree to become lodged, use lines from machines or seek assistance from an experienced cutter. Do not compound a safety problem by building a tepee of hung trees. Mark the hangups with colored "danger" ribbon and get help.

Specific skills are required to cut problem trees. Evaluate each tree carefully and do not attempt to fell a tree if you have any doubts about what will happen. Seek assistance from a more experienced professional.

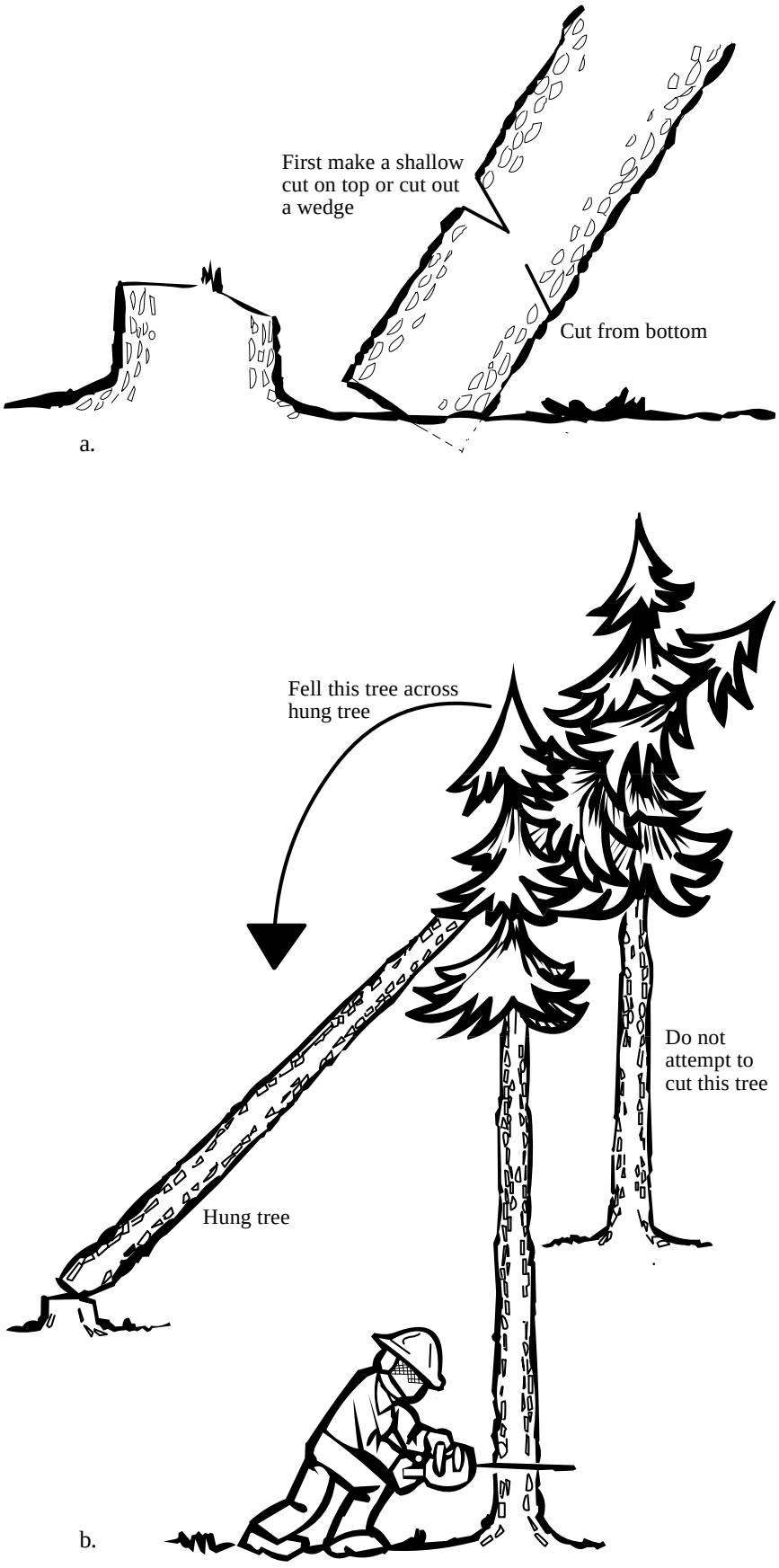


Figure 28—*Cutting down hangups by (a) cutting away the butt, and (b) felling another tree into the hangup.*

Summary Checklist

Timber cutters must recall and utilize a vast assortment of information. The following checklist will assist you in this exercise. Ideally, the checklist will become a set of mental habits, but explicit reminders will be needed. Consider making a pocket card checklist for your use.

Felling and bucking timber can be extremely dangerous. However, you can make the process safer through proper use of safety equipment and cutting techniques.

1. *Prepare to perform the job safely.*
   - Personal protective equipment (hardhat, ear and eye protection, safety pants or chaps, first-aid kit, etc.)
   - Tools and supplies (axe, wedges, peavey, etc.)
   - Saw and chain maintained
2. *Evaluate cutting conditions.*
   - Weather
   - Escape routes
   - Cutting positions
   - Timber felling pattern
3. *Evaluate the tree and its direction-of-fall.*
   - Did you use a plumb bob?
   - Were lean and limb loading determined?
   - Is rot present?
   - Is this a danger tree?
4. *Make the undercut.*
   - Are the cuts level? Do the cuts match up? Is the face cleaned out?
   - Does the undercut face the direction-of-fall?
   - Is there proper depth?
5. *Make the back cut.*
   - Shout a warning and listen for replies.
   - Use wedges as needed.
   - Make the back cut approximately 1 inch higher than the undercut.
   - Don't cut off the holding wood.
   - Leave a hinge to control the fall.
6. *Move to safety and watch for overhead hazards.*
   - Is help needed to clear a hangup?
   - Are hazardous, broken limbs left in adjacent trees?
7. *Evaluate the limbs before limbing.*
   - Look for limbs under tension.
   - Look for springpoles.
8. *Determine if the bucking cut can be made safely.*
   - Determine the location of compression wood, tension wood, and the way the bucked pieces will move.
   - Buck from the uphill side.
9. ***Never work alone!***
10. ***Never work fatigued!***

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Garland, J.J., *Increasing Values Through Improved Bucking Practices: Manufacturing Logs*, EC 1184 (Oregon State University, Corvallis, reprinted 1993). $2.50

Other publications

Chain Saw Manual, 2nd edition (American Pulpwood Association, Danville, IL, 1988).

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