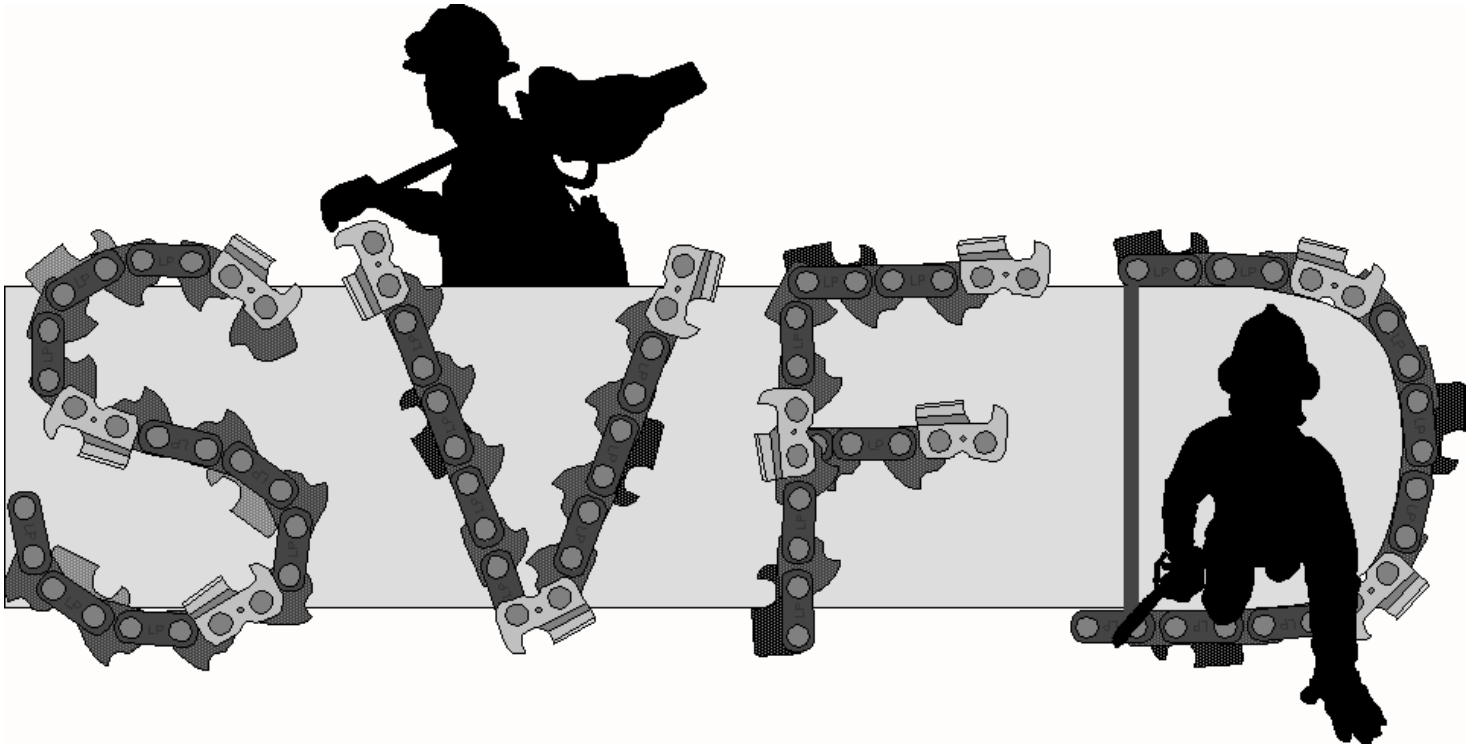


CHAINSAW TRAINING PROGRAM

Revision 1.0

PART 2

SWANNANOA VOLUNTEER FIRE DEPARTMENT

www.svfd.net

Trees:

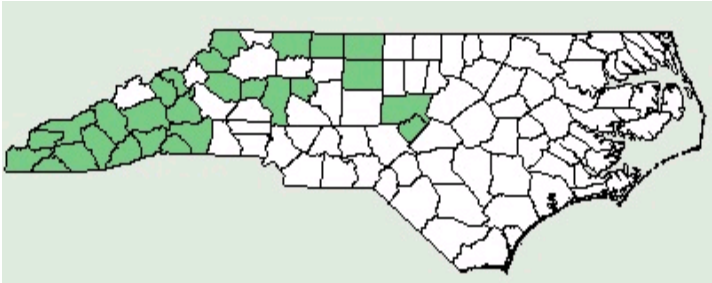
This module will discuss a few species specific to North Carolina. The second section will discuss hazard and hung trees. The third section will discuss the actual process of cutting a tree down and finally all of these things will be put together and the student will be able to evaluate a tree and its hazards (using a Job Hazard Analysis).

This part of the state is labeled a *Temperate Broadleaf and Mixed Forest* area. This essentially means that there are multiple layers of tree canopy and undergrowth.

More specifically we are near what is called the "*Appalachian & Mixed Mesophytic Forest*". This describes the specific ecological area that is unique in the world to the surrounding areas. It is unique in that there are a number of tree species that overlap here as well as some that are endemic only to this region in the world. While sawyers in other parts of the country will only cut only a handful of species of trees, sawyers here will be required to have a basic knowledge of many types of trees. This is important for sawyers to know because such things as drought, insect invasion, fire, and wind will interact with each species differently. For example a poplar tree will generally be easier to cut than a large oak tree. Another example would be a Juniper tree – which as it grows oftentimes, will absorb some of the organic material that it's growing in into its bark. This causes the chain on the saw to dull rather quickly.

Trees likely to be cut by Swannanoa sawyers:

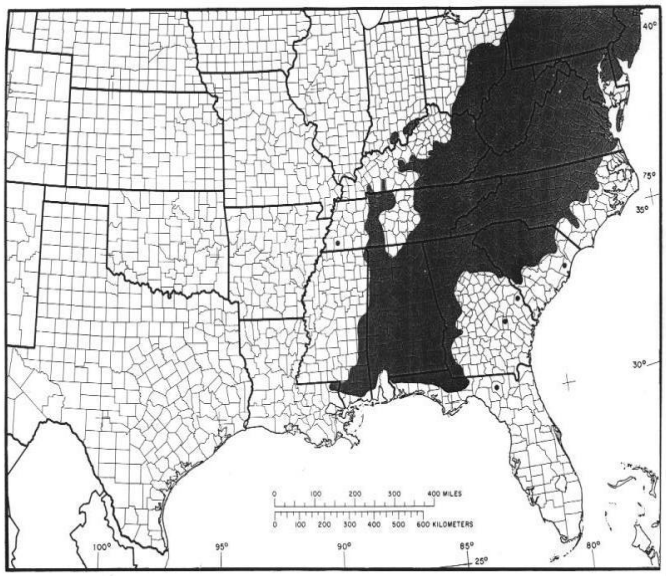
Pine (i.e. Eastern White, Pitch, Virginia, and Table Mountain) – This is a common tree throughout the country. The map to the right shows only the White Pine species in NC. This tree is a competitive tree, which means it competes with other trees that surround it for sunlight (the pine is shade intolerant), water, and nutrients. Natural process favors the pines within a stand that grow the tallest and fastest. The smaller trees that do not receive the necessary amount of light/water/ or nutrients will die off and would normally be burned in low intensity surface fires, creating nutrients for the survivors. However this does not happen and pine trees become too numerous to support the volume of pines in one area. The whole stand then becomes stress weakened and is more prone to succumbing to beetle invasion, drought and fire. Remember – large stands of pine trees close together may be very weak and prone to "widow-making".



Pine in Fire Situations

Eastern white pine is moderately fire resistant. Mature trees survive most surface fires because they have thick bark, branch-free boles, and a moderately deep rooting habit. Younger trees are not as fire resistant. The needles have relatively low resin content so are not highly flammable. Deep-burning ground fires may cause root injuries that are more serious than crown injury. Where 75 percent or more of the major surface roots had been killed or severely damaged by fire.

- **Laurel –** Latin Name **Kalmia Latifolia** and called Mountain Laurel by the people of the Southern Appalachian Mountains where it is very dominate (see growth map) as it grows in almost every part of North Carolina. Laurel grows in the forest edge, edges of water and wherever light filters through the forest canopy.
- Mountain-laurel wood is heavy (green weight: 63 lbs/ft^3), hard (1,790 lbf), and strong, but rather brittle, with a close straight grain. Mountain-laurel sapwood is yellow, while the heart wood is yellow-brown with red spots.
  - generally has a rounded shape
  - can be dense-compact or loose-open depending on how much light the plant receives
  - mature size is typically 5 to 12' tall, with a similar spread
  - **can be significantly larger, especially in the Southern Appalachian Mountains**
  - branching is irregular
  - a broadleaf evergreen
  - leaves arranged alternately
  - leaves clustered toward the shoot tip
  - leaves are elliptical, 2" to 5" long, 0.75" to 1.5" wide
  - leaf tip is pointed
  - margins are entire and smooth
  - color is dark green and glossy above
  - in full sun foliage can be yellow-green



Map 75-SE. *Kalmia latifolia* L., mountain-laurel.

Laurel in Fire Situations - Fire effects to mountain-laurel vary with season, severity, and intensity and range from partial consumption to complete consumption of the aboveground plant. Leaves of mountain-laurel are reported to burn at high intensity; burning shrubs can produce flame lengths of 100 feet (30 m). The combustible nature of mountain-laurel is suspected to be due to the oil or wax content of the leaves. Also, fire behavior characteristics are thought to be highly associated with live fuel moisture. In the southern Appalachians, leaf moisture content of mountain-laurel is highest (70%) in new growth and declines as leaves mature.

Live fuel moisture of leaves, twigs, and stems greater than 1-year-old average 50% to 60% moisture content. **For these reasons constructing fire line through laurel is dangerous and is not recommended!**

Mountain-laurel's leaves, buds, flowers and fruits are poisonous and may be lethal to livestock and humans. However, white-tailed deer, eastern cotton tails, black bear, and ruffed grouse are known to utilize this species especially as winter forage or during years of food shortages.

American Sycamore – Sycamore is a native, deciduous tree. Although not the tallest, it is among the tallest trees of eastern deciduous forests. Mature heights range from 60 to 120 feet (18-37 m). Reported diameters range from 2 to 6.6 feet (0.6-2 m). The bark of young trunks has small scales. Bark at the base of large trunks is deeply furrowed and up to 3 inches thick (7.6 cm) ; on the upper portions of the trunk the bark exfoliates in patches, leaving areas of inner bark exposed.

Sycamore in Fire Situations

Surface fires in the bottomland forests in which sycamore occurs readily kill saplings and seedlings of all species. Larger trees are wounded by fire; fire wounds act as vectors of disease, increasing rot and decreasing plant vigor.

Sycamore is one of the hardwoods that are under attack from anthracnose fungi. This causes the leaves to lose their chlorophyll (1) and die. The branches become infected with cankers (2) and the tree becomes weakened after a few cycles of this and will become more intolerant to fire and wind.

1. Sycamore leaf with Anthracnose Fungi

2. Cankers on branches

Oak – There are 39 different species of oak that can grow in NC alone. 38 of the species are native to NC and only one (the saw tooth oak) was introduced. This is a hardwood that grows to be very tall and is very dense (0.75 g/cm³). This poses a few watch outs for sawyers. First is the height – be careful when felling a large oak as its size must be accounted for when determining safety zones and escape routes for both the sawyer and the swamper. Hanging the tree up is also a factor that comes into play with such a large tree, as a heavier tree will be harder to wedge over. Two things to keep in mind with oaks in and around Swannanoa include drought stress and tree rot. Many of the oaks are dying due to drought - these are recognizable by the changing colors of the leaves on the tree. The second hazard is that oak trees oftentimes rot from the inside out. This is important to remember when determining how much holding wood must be left.

Oaks in Fire Situations

Oak is moderately resistant to fire. Aerial portions may be killed by fire, but underground regenerative structures protected by overlying soil usually survive. The rough, scaly bark of oak is more fire-resistant than the solid bark of many other oaks. Oaks typically become more fire resistant as the bark thickens with age.

Hemlock (Eastern, Carolina) –The map at the right shows the counties in NC with both species of Eastern and Carolina Hemlocks thrive.

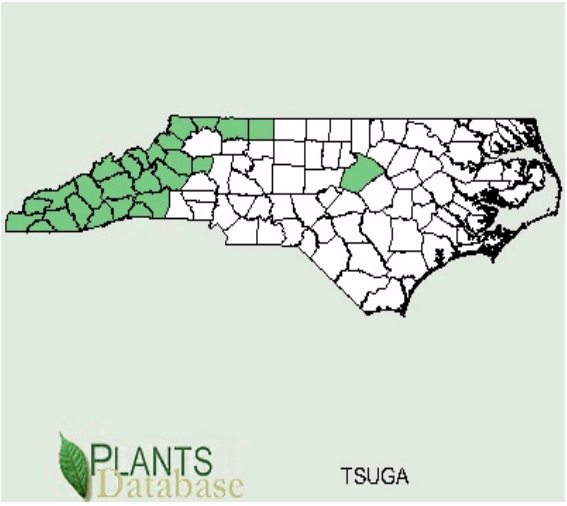


Figure 3 Carolina Hemlock

Some of the largest Hemlocks in the eastern US are growing in NC. Several have been recorded in the forests of Biltmore Estate, and in the Carolina Hemlocks Recreation area in Yancey County.

Figure 4 Eastern Hemlock

The two species in North Carolina have been severely impacted by the Wooly Adelgid. The Hemlock Woolly Adelgid is an aphid-like insect that is a serious pest of Eastern hemlock and Carolina hemlock. Although originally introduced into the United States (Oregon) from Asia, it has since spread throughout the East from Virginia (1950s), Pennsylvania (1960s), Connecticut, and Massachusetts (1980s), killing forests and landscapes from New England to North Carolina. Trees of all sizes and ages are attacked. Mature trees in native settings or landscapes that are large and tightly packed together may be severely attacked.

Damage Symptoms: The Hemlock Woolly Adelgid prefers the new twig growth of hemlocks, feeding on sap and, theoretically, injecting toxic saliva. Feeding damage first appears as needle discoloration (from deep green to grayish green to yellowing), followed by premature needle drop/defoliation, branch desiccation, and loss of vigor. Gradual limb dieback, beginning at the

bottom of the tree, occurs within 2 years. Eventual death of the tree occurs after 4 to 8 years, depending on size, environmental stress level, and site of the tree.

Monitoring and life cycle: The Hemlock Woolly Adelgid reaches maturity between late winter and early spring.

They can be observed at the base of individual needles, covering themselves with fluffy white, cottony wax. Hemlock Woolly Adelgids covered with wax resemble the tips of cotton swabs. This wax often remains firmly attached to hemlock branches long after the insect dies.

All Hemlock Woolly Adelgid are female. Brownish orange eggs are laid under the cottony wax and hatch during an extended period from February through June. Eggs are dispersed from tree to tree throughout the spring, via wind, birds, and other animals. Newly hatched woolly adelgids (immature crawlers) are black, oval, and flat. They emerge from the cottony egg mass as the new hemlock growth expands in May and June. The tiny immature crawlers can only be seen with a hand lens because they are barely visible to the naked eye. Crawlers migrate to new growth, molt, lose their legs, and settle down at the base of a needle and begin to feed. These immature nymphs remain at this site (where needles attach to twigs) until maturity.

Figure 5 Hemlock Wooly Adelgid

The Adelgid cause Hemlocks to start dyeing off in 2 years if going untreated. This has a great impact on the effects of fire on Hemlocks. The trees will be in a weekend state and prone to wind and fire. This will leave large areas of dead and dyeing trees with large 100 to 1000 hour fuels for a fire to consume.

Figure 6 Nymph Wooly Adelgid

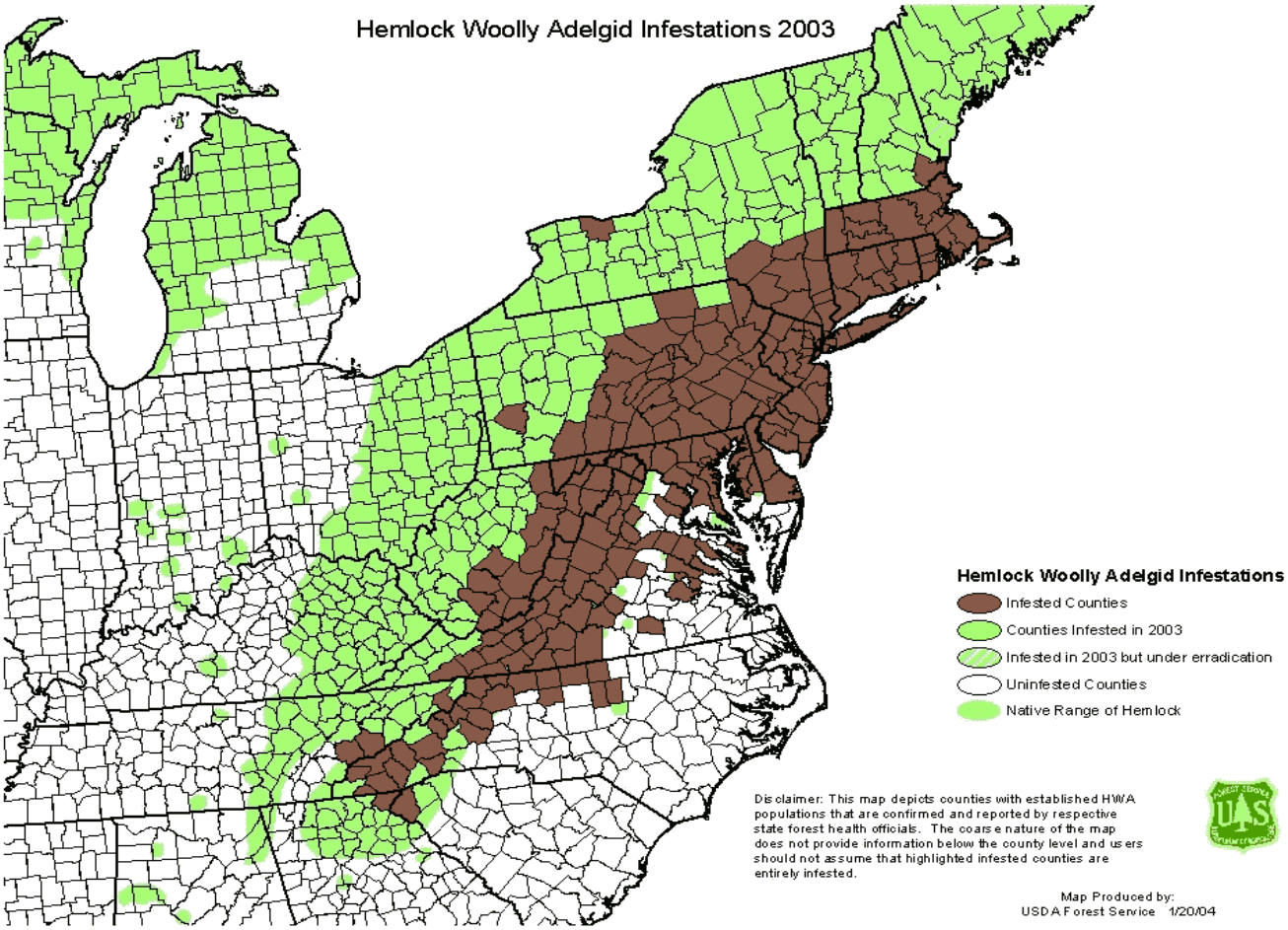


Figure 7 Infection of Wooly Adelgid in 2003

Fire effects on Hemlocks

Low-severity fire readily kills seedlings and saplings of eastern and Carolina hemlock, and may also kill larger trees. A low-severity ground fire in a northern hardwoods community in south-central New York killed 93 percent of the eastern hemlock saplings. Sixty percent of the mature eastern hemlock died or were badly injured as a result of the fire.

The presence of fire scars indicates that larger trees have thick enough bark to survive low-severity surface fires.

Eastern hemlock appears to invade burned sites over time. In the Pisgah Forest 80 percent of old-growth hemlock germinated within the first 37 years after a major fire in 1665

Though there will be many tree species you will see and cut in our area the ones mentioned above have been or are becoming more of a problem in fire and weather situations.

Hazard Trees

Safety is the number one consideration at all times. It should be noted that there is always risk in cutting trees down. We strive to be as safe as possible, but the only way to mitigate all hazards is to not engage in the task in the first place. This is not always feasible so we must use a way to assess how hazardous the task is. An equation was developed to facilitate in your decision making.

The Equation: Risk = Hazard x Exposure

Examples:

H (Burning widow maker) x E (working ¼ mile away constructing fireline away from the tree) = 0 risk

H(Storm damaged tree next to a elementary school with roots exposed, loose top and 30% lean) x E (will take 30 min to cut down) = Very High risk

Apply this "formula" to every tree that is cut. There will be some trees which present a hazard so high and require such a long exposure to the tree that the risk far outweighs the benefit of cutting it down.

Hazard Trees: The Canadian Forest Service has devised a hazard tree program which will be referenced throughout this manual. The entire program is available at: http://www.nwcg.gov/teams/shwt/httf/training_education/trng-resources/assessor_course.pdf

A hazard tree is any tree (regardless of its size) that is hazardous to people or property because of:

- ***Location or lean*** *– Is the location presenting a problem? Is the tree likely to fall and cause injury or property damage (trees along roadways, near buildings such as schools, near power lines, etc)*
- ***Physical damage*** *– using the Generalized Tree Defect Indicator listed below evaluate the tree.*
- ***Overhead hazards*** *– Are there power lines or other trees that will cause hang-ups.*
- ***Deterioration of limbs, stem or root system*** *– These are all factors that will influence the direction of fall as well as the likelihood of being hit by a piece of the tree as it falls.*
- ***A combination of the above***

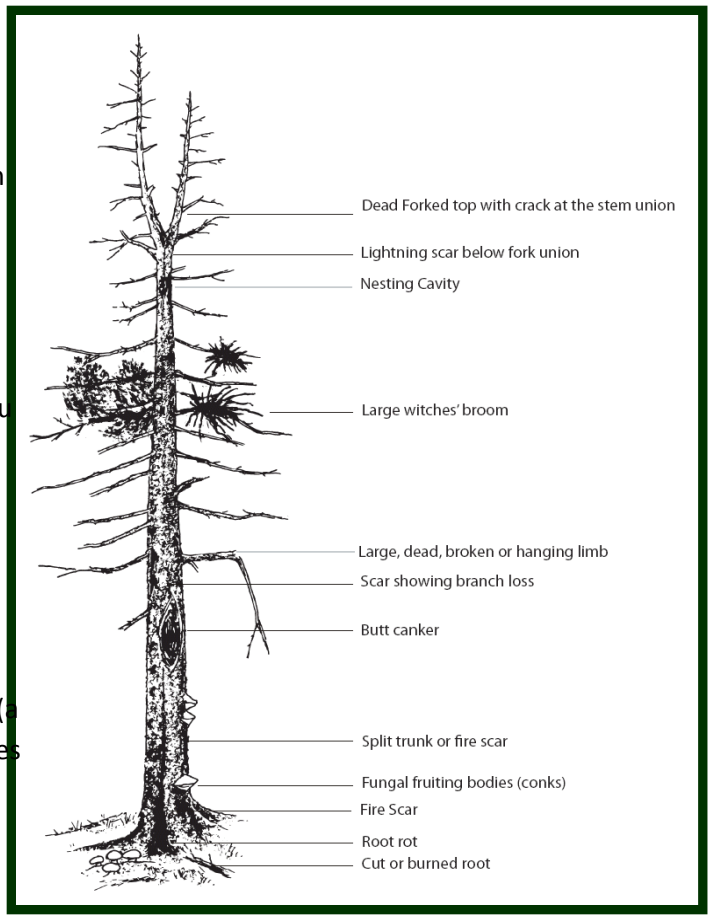
8. A Leaning Tree

This must be determined by a visual inspection of the tree. This presents a problem for those new to felling – which is why having an experienced sawyer present is important during the initial learning stages.

When the saw team first approaches a tree you should immediately begin to evaluate the tree for safety.

Observe the tree for lean, fire, or any of the items listed on the picture.

Starting from the top the sawyer needs to be cognizant of any weakened limbs or branches (a group of branches is sometimes called a witches broom) that may fall due to the process of cutting (or simply a gust of wind).



Next look for marks such as lightning scars, nesting holes, or cankers that will possibly impact the tree during its fall. These can cause the tree to split during the fall, oftentimes going the opposite direction as the majority of the tree.

If these are present evaluate your escape routes and safety zones and ensure that lookouts are posted. If you have determined the tree is safe to approach you will be able to observe the roots.

9. A Cat Face

Be watchful of burning roots, exposed roots and such things as **"cat's faces"** – a name for openings in the tree caused by fire. These will impact your placement of the cuts, and may be a determining factor for a tree to flag and leave.

While the condition of the tree is being evaluated the sawyer also needs to be determining the lean. The lean of the entire tree will generally be anywhere from 10% (5 degrees) to 30% (16 degrees), any less than that is hardly visible and any more and the tree will generally be hanging in another tree. The two types of lean are defined as *recent lean* and *prior lean*. Recent lean often poses a greater hazard because the tree is weakened and will have loose roots. Prior lean will often allow for the tree to re-root itself. This is also a hazard because the surrounding trees will be supporting the tree and as they are removed the unseen leaner will fall.

Trees can also grow in odd directions. As discussed previously trees compete for sunshine and nutrients. There are occasions where a tree will grow on the side of a hill and due to changing environmental conditions will change direction. This is called sweep and oftentimes the tree looks like the letter "L" as it grows. While these trees are awkward to cut they are not always "leaner's"; however, the hazard list still applies to them.

As each tree is evaluated the sawyer needs to determine if it is a "GO/NO GO" situation. A "GO" situation is one that the sawyer can cut the tree with no hesitation. A "NO GO" situation is one that sawyer finds him/herself questioning the safety of the process.

Unfortunately such factors as overconfidence and peer pressure are prevalent in determining if a tree can be cut. The mark of an experienced sawyer and firefighter is the ability to not fall victim to these factors.

10 **Does this area need to be cut?**

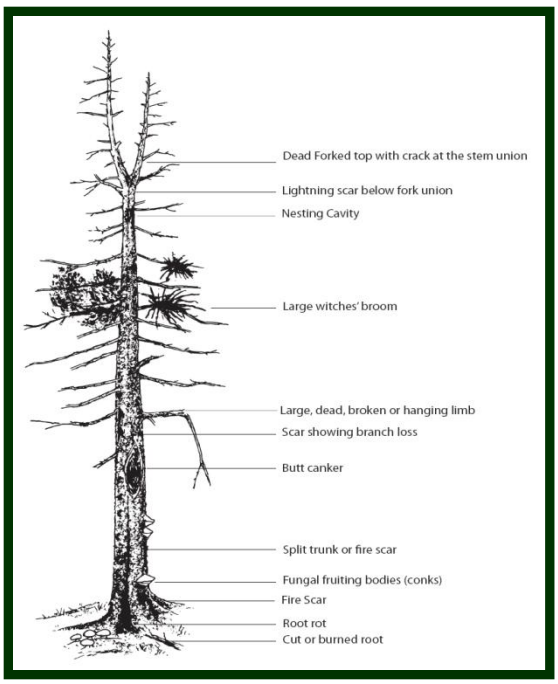
Cutting Preparation

The next step is to prepare for your cut. This portion is important because you must have a safe work area with escape routes and safety zones cleared out. You must also thoroughly inspect the tree you are potentially going to cut. Do not rush during these steps as inadequate preparation will compromise your safety during later steps.

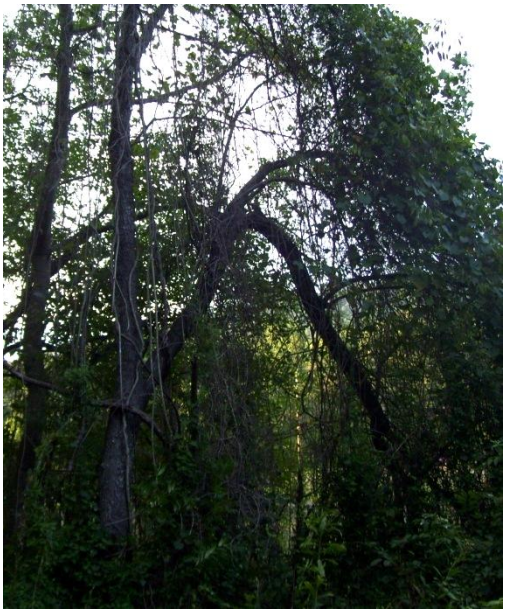
1 .Determine if the tree needs to be cut. As mentioned many times before not all trees need to be removed. Sometimes it is faster and safer to “just go around”.

2. Approach the tree – **look up** for hazards such as power lines, leaning trees, widow makers surrounding the tree and loose tops. Observe the wind direction(s) and speed.

3. Visually evaluate the tree – does it have any of the items on the hazard tree picture? Walk a ***FULL 360*** around. Look at the top all the way down to the roots. Communicate to your swamper what you see.



4. Sound the tree – use a falling axe to hit the tree. When you do this make sure you are looking up as debris will fall out of the tree. Does the tree sound hollow? Remember that some trees rot from the inside out. **HIT THE TREE HARD**, do not merely tap it.



5. Determine the lean – this can be done with a plum bob or a falling axe.

6. Determine if the tree can be cut (GO/NO GO) – with all factors taken into account ask yourself the following questions: Do I need to cut it? Can I safely cut it – is this within my skill level? If the answer is NO GO then stop! If you determine that the tree poses such a hazard notify your supervisor and flag the tree or a safe area around the tree.

7. Clear around the tree – make a safe working area for yourself. Make sure you have safe footing and will not be tripping over ANYTHING. IF there are rocks in the way move them, if there are bushes in the way, cut them. Build at least two escape routes from the tree. Make sure you can run them without running into anything. Take the time to be safe.

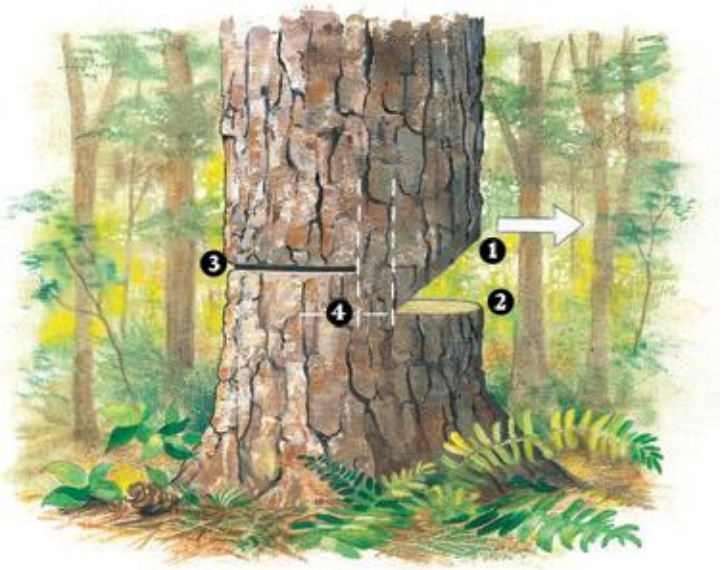
8. Secure the environment around you – clear your swamper. Make sure that there are at least 1.5 tree lengths of space between the tree and any other personnel/equipment. Make sure your tree won't roll away and hit someone one downhill. Watch for helicopters and air tankers, they can cause downdrafts. Evaluate your winds and wind speed. Can you still cut the tree?

If you still answer "***yes***" to this question you are ready to cut. An answer of **NO** to any step above, or an inability to complete any step above makes this a NO GO situation. Do not proceed. Remember that EVERYONE GOES HOME after each assignment. DO NOT take unnecessary risks.

Felling

The process of actually cutting a tree down only takes *three* cuts. There are two cuts for the face cut, which will partly determine the direction the tree falls, and the back cut, which removes enough wood holding the tree to allow for it to fall over. It is never that simple in real life, however; and this manual should only be seen as an introduction – there is no substitute for experience. The first part of this chapter will discuss felling the rarest and unusual tree you will encounter: a perfectly upright, healthy tree. The second segment will discuss wedging and finally dropping leaning trees.

The 3 cuts for cutting down a perfectly upright tree with no lean:



The first cut is called a **<u>gunning cut</u>.**

1. Remove any bark around where you will be cutting.
2. Hold the saw at waist height and aim your gunning sights to determine where the tree will fall. Cut into the tree approximately 1/3 of the way.

The Gunning Cut.

The second cut is called the **<u>slope cut.</u>**

1. Place the dogs at the bottom corner of your gunning cut and cut at a *45* degree angle. These two cuts (gunning and slope cuts) MUST line up. If they do not line up you create what is called a *Dutchmen*. This will cause the tree to either barber chair or swing in an unpredictable direction as it begins to fall.

The Slope Cut

2. Ensure that you remove any *Dutchmen* in your face cut.

After the face cut is removed make sure that the face cut is entirely clean. Place your bar into the face cut and verify that the direction is still correct- if it is not you need to fix it.

A Dutchman

A Barber-Chair

The third and final cut is the **back cut.**

Look Up!

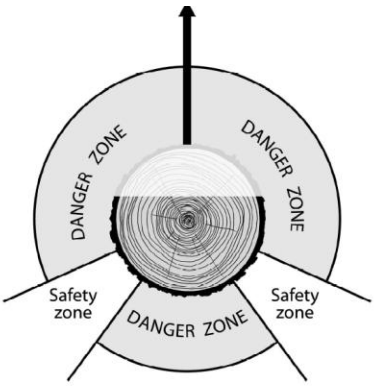
While you are cutting you should be **looking up** most of the time. This serves two purposes: the first is to see if there are witches brooms/nests/tree tops/etc. falling on you, and additionally it is easier to see the tree begin to fall when you are looking up at it.

The back cut should be at least two inches above – but not more than five inches above the gunning cut on the opposite side. You can cut on either side of the back of the tree – whichever is safer.

1. Yell **"BACKCUT!"** Set your dogs into the tree so that you leave 1-2 inches of holding wood between your back cut and face cut.
2. Cut straight and level until you can place a wedge in.
3. At this point the tree will either fall over, or ideally you can wedge it over.

The Backcut

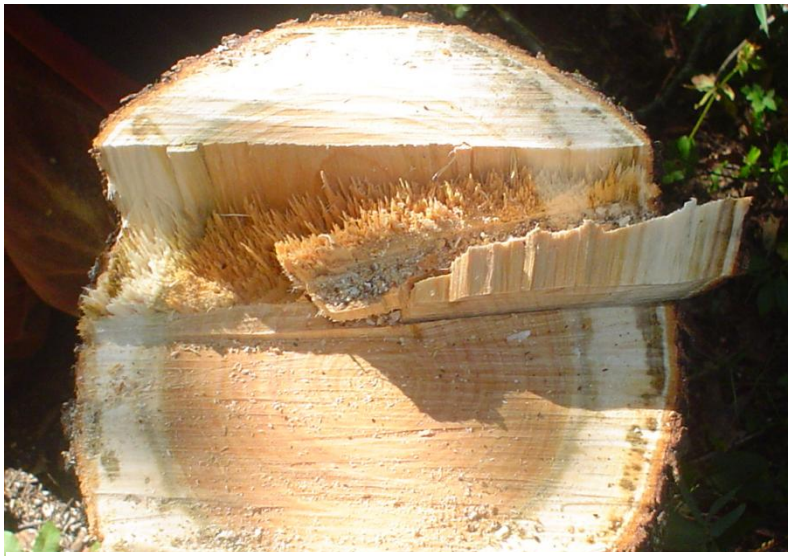
Lastly you must **escape** the tree. As you are looking up you will see it begin to fall and hear it crack as it snaps. If you are holding ANYTHING (axe, wedge, saw) drop it and use your escape route. Remember your escape route is 45 degrees back from either direction you are dropping the tree. Make sure it is at least 20+ feet away from the stump.



Assuming that the lean was read correctly and it was cut correctly the tree will fall in the exact direction of the face cut. The face will close and the tree will be controlled down to the ground by the holding wood (also called HINGE wood). Since you cut the back cut 2 – 5 inches above the gunning cut you know have a “stump shot” that will prevent the tree from coming back at you (assuming no winds are interfering).

This stump indicates that not enough holding wood was left towards the top of the picture. There is also a slope and not enough stump shot.

After the tree is safely down you can evaluate your stump. Look to see if you left the right amount of holding wood, the height of the stump shot, if the gunning cut and back cut were level, and finally ultimately if the tree went where you intended for it to go.



This tree has the proper amount of holding wood and stump shot. There is no slope and the cuts are in proportion to the size of the tree.

Things to remember: Once the back cut is started you cannot change its location – you are committed. Be ready to run at any time – trees may become unstable and fall at any time. Keep an axe and wedges with you at all times. Watch the wind – having to remove the power head from the bar because the tree sat on your bar is never pleasurable. Look up and live!

A saw stuck in a tree.

Hung up tree removal

Inevitably trees will become entangled in other trees. There are times when this is unavoidable and it is therefore imperative to be able to be able to bring the tree to the ground when this occurs. *<u>Safety note:</u> If you are uncomfortable with a hung tree ask for help!*

When the tree becomes hung up it essentially becomes similar to bucking – as the same procedures are used.

The first step is to remove any branches that will prevent the tree from falling to the ground.

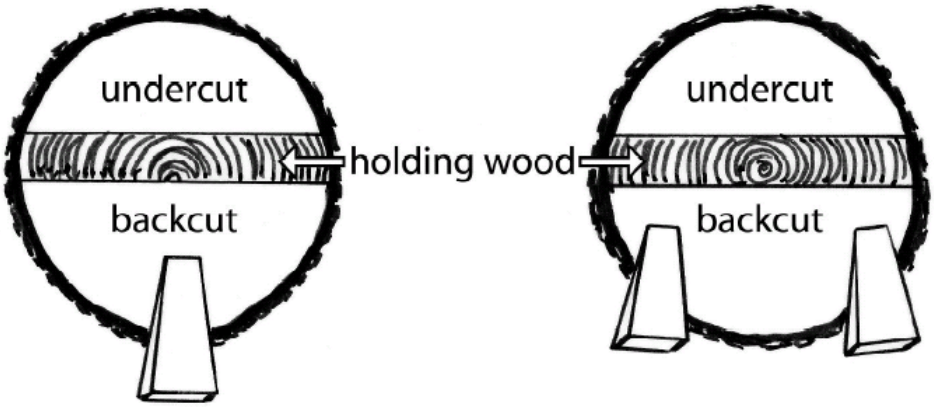
Next cut a wedge into the top of the tree to overcome compression (and avoid having your bar pinched).

Once this is done you can cut on the other side of the face and drop the tree down.

This may have to be repeated a number of times until the tree is down.

Wedges

It is recommends that all trees be wedged – but there are times this is not always possible in the field. The wedge is an excellent tool that increases the safety of the saw team as well as allows us to sometimes “defy” gravity. The best practice is to use two wedges.



As you cut your back cut into the tree place two wedges as soon as possible. Continue to cut and as soon as the wedges begin to drop push them back in. Once you have reached the appropriate amount of holding wood pull your saw out and strike the wedges until the tree falls over. Do not hit the wedges too hard or you will damage the holding wood.

Practice wedging every opportunity you get. This skill becomes very useful during high winds, when snagging and when pushing a tree against its lean.

Leaning Trees

Since most trees have some lean to them it is vital to understand how to read, and fall leaning trees.

There are a few methods to determine the lean of a tree. The first is to carry a plumb bob around and to do a full 360 degree evaluation of the tree. This seems excessive during normal firefighting operations but when evaluating extreme hazard trees this level of thoroughness is more than necessary.


A Plumb Bob

The second option is to use the handle of a falling axe. This method is not perfect but it is adequate during standard fireground operations.

Regardless of which technique you employ make sure that you are looking at the entire tree.

Points to consider that will impact the overall lean of a tree.

1. The direction of growth
2. Tops that are growing in other directions
3. A side with large branches
4. Cat faces and hollow points that will impact the direction of fall.
   With all of this is mind you can get some trees to go so far as 45 degrees away from the primary lean direction.

   Once you determine the lean and the extent of the lean you must make the decision as to weather you can safely drop the tree. Sometimes there is no safe escape route; you cannot drop the tree unless you push it dramatically against its lean, etc.

Which way are these trees leaning?

Can this tree fall to the right side of the photo?

Which way will this tree fall?

JOB HAZARD ANAYLSIS

The final portion of this is to develop a **J**ob **H**azard **A**nalysis (or **JHA**). This is an OSHA requirement that requires everyone involved in a hazardous assignment to:

1. **Identify the task**
2. **Identify the training, qualifications and experience required to complete it**
3. **Identify the steps that will be used to complete the task (but do not go overboard)**
4. **Identify potential hazards that may arise from these tasks**
5. **Identify steps that can be taken to mitigate these hazards**

A simple "JHA" for chainsaw training might list the following:

TASK – Cut down a single tree for training

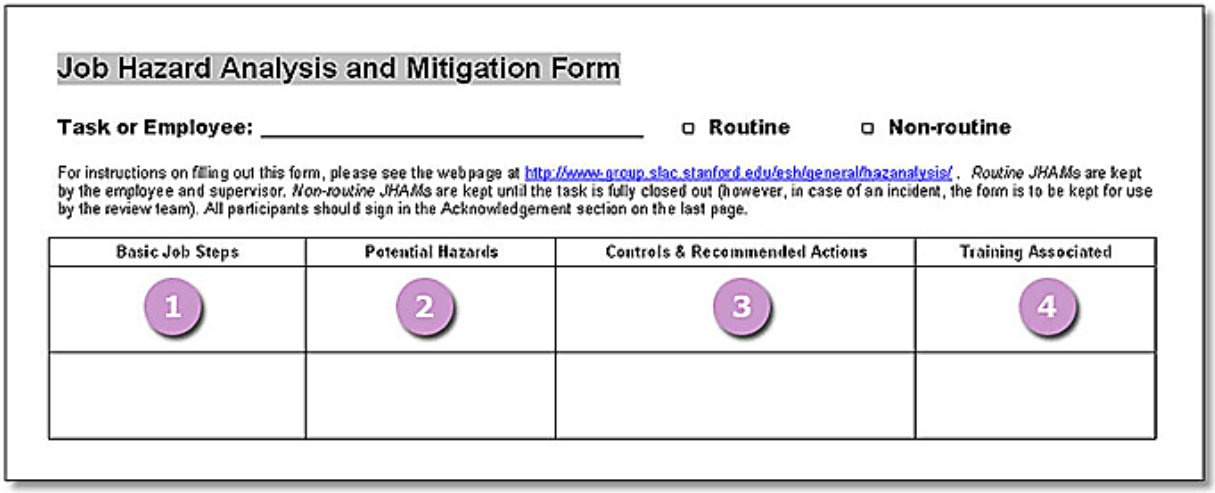
TRAINING/QUALS/ETC – Student – must have completed Swan-212

Instructor – Must be a department authorized instructor.

STEPS – Will follow Swan-212 falling procedures

HAZARDS – Little experience of faller, possibility of hang ups, stress weakened trees, wind

MITIGATION – Will be assisted by instructor, must properly identify lean, must sound tree properly, have full PPE and Escape Routes/Safety Zones indentified/cleared prior to cutting. Wind trigger point of 5 MPH.



Job Hazard Analysis and Mitigation Form

Task or Employee: _____ ☐ **Routine** ☐ **Non-routine**

For instructions on filling out this form, please see the webpage at http://www-group.slac.stanford.edu/esh/general/hazanalysis/ . *Routine JHAMs* are kept by the employee and supervisor. *Non-routine JHAMs* are kept until the task is fully closed out (however, in case of an incident, the form is to be kept for use by the review team). All participants should sign in the Acknowledgement section on the last page.

Basic Job Steps	Potential Hazards	Controls & Recommended Actions	Training Associated
1	2	3	4

What other items might be applicable to this list?

The **J**ob **H**azard **A**nalysis is important for a few reasons. The first is liability – JHAs are integral to OSHA requirements. The second and more important aspect of the JHA is that it forces us to evaluate what we are doing and how we are doing it. While it will not be practical to sit in a group and fill this form out it the basic aspects need to be touched upon during briefings and as conditions change.

Make sure that as a sawyer on a fire/storm/misc. you are properly informed of your hazards. Be asking about power lines, snags, high winds, etc. and anything else that you see during your task.

Conclusion – Cutting takes practice and experience in order to become proficient. During this process remember that safety is paramount. Do not become complacent as you become more confident and capable – there have been many experienced sawyers that have failed to perceive warning signs about the tree they were cutting as well as their own condition (fatigue, peer pressure, overconfidence).

Despite all the dangers and unavoidable hazards this is a **fun** and challenging piece of firefighting operations. Do not hesitate to get as much “trigger time” as possible and learn as much as possible.

Keep Cutting!