Section 12.0 Crowns: Measurements and Sampling

12.1 OVERVIEW

Crown indicators are designed to be used together. Each indicator comprises a piece of information that can be used individually or as a factor in combination with other indicators. Each variable, alone or in combination with others, adds to the overall rating given each tree. It is important to realize that models are designed to rate trees on how they look, from thriving to almost dead and to help predict future conditions of trees and forest ecosystems.

VIGOR CLASS, UNCOMPACTED LIVE CROWN RATIO, CROWN LIGHT EXPOSURE and CROWN POSITION are determined for each sapling. Foliage below the point used for UNCOMPACTED LIVE CROWN RATIO is not considered in VIGOR CLASS determination. All sapling measurements are done during plot establishment and whenever plot remeasurement occurs.

Crown evaluations, including UNCOMPACTED LIVE CROWN RATIO, LIGHT EXPOSURE, POSITION, DENSITY, DIEBACK, and TRANSPARENCY are made on all trees with DBH/DRC (DRC in the West) 5.0 in or larger. Trees with high scores for UNCOMPACTED LIVE CROWN RATIO and DENSITY, and low scores for DIEBACK and FOLIAGE TRANSPARENCY have increased potential for carbon fixation, nutrient storage and increased potential for survival and reproduction. Crown evaluations allow for the quantitative assessment of current tree conditions and provide an integrated measure of site conditions, stand density and influence of external stresses. All crown measurements are taken during plot establishment and whenever plot remeasurement occurs.

Two persons make all crown measurements. Individuals should be ½ to 1 tree length from the base of the tree to obtain a good view of the crown. Move away from each other at least 10 feet to take these measurements. A position of 90 degrees to each other from the tree base is ideal. When estimates made by two individuals disagree, they should discuss the reasons for their ratings until an agreement is reached, or use the methods below to resolve the situation.

If the numbers for a crown measurement estimated by two crew members do not match, arrive at the final value by:

- Averaging the two estimates for those trees that actually have different ratings from the two viewing areas (ratings of 30 and 70 would be recorded as 50).
- Taking an average, if the numbers differ by 10% (2 classes) or less.
- Changing positions, if the numbers differ by 15 % or more and attempt to narrow the range to 10% or less.

12.2 CROWN DEFINITIONS

Crown Shape
Crown shape is the silhouette of a tree, drawn from branch tip to branch tip, which contains all of a tree's foliage as it grows in a stand. Exclude abnormally long branches beyond the edge of the crown for this silhouette.

Normally, silhouettes are derived from vigorous, open grown trees and tend to be species-specific. For Phase 3 purposes, silhouettes vary with age and spacing. Tree crowns tend to flatten out with age and be more slender when growing in crowded conditions. Crown shape is important when measuring CROWN DENSITY and is used to estimate crown biomass. Crown shape is used as an outline for the sides of the tree.

Crown Top
The crown top is the highest point of a standing tree. Young trees usually have more conical-shaped crowns and the main terminal is the top. Older trees and many hardwoods have globose and flat-topped crowns, where a lateral branch is the highest point. For some measurements the highest live foliage is considered the live crown top. Other measurements include a dead top. Some crown measurements assess how much of the expected crown is present and include broken or missing tops.

Dieback
This is recent mortality of branches with fine twigs, which begins at the terminal portion of a branch and proceeds toward the trunk. Dieback is only considered when it occurs in the upper and outer portions of the tree. When whole branches are dead in the upper crown, without obvious signs of damage such as breaks or animal injury, assume that the branches died from the terminal portion of the branch. Dead branches in the lower portion of the live crown are assumed to have died from competition and shading. Dead branches in the lower live crown are not considered as part of crown dieback, unless there is continuous dieback from the upper and outer crown down to those branches**.**

Epicormic
Shoot growth, from latent or suppressed buds, that arises from old branches, from the trunk or near large branch wounds or breaks.

Live Branch
A live branch is any woody lateral growth supporting foliage, and is 1.0 in or larger in diameter at the base above the swelling where it joins a main stem or larger branch. Small trees or certain tree species greater than 5.0 in DBH/DRC may have only live twigs which have not yet reached 1.0 in or larger at the point of attachment. If the death of larger branches is not the cause of these twigs, the twigs are considered branches until the tree reaches a point where twigs have attained live branch size.

Live Crown Base
The live crown base is an imaginary horizontal line drawn across the trunk from the bottom of the lowest live foliage of the "obvious live crown" for trees and from the lowest live foliage of the lowest twig for saplings. The "obvious live crown" is described as the point on the tree where most live branches/twigs above that point are continuous and typical for a tree species (and/or tree size) on a particular site. Include most crown branches/twigs, but exclude epicormic twigs/sprigs and straggler branches that usually do not contribute much to the tree's growth. The base of the live branch/twig bearing the lowest foliage may be above or below this line.

For trees 5.0 in DBH/DRC or greater, if any live branch is within 5 ft below this "obvious live crown" line, a new horizontal line is established. Create

the new line at the base of live foliage on that branch. Continue this evaluation process until no live branches are found within 5 ft of the foliage of the lowest qualifying branch (Figure 12-1).

Occasionally, all original major crown branches/twigs are dead or broken and many new twigs/sprigs develop. These situations are likely to occur in areas of heavy thinning, commercial clearcuts and severe weather damage:

- Trees that had an "obvious live crown" with live branches now have no crown to measure until the new live twigs become live branches. When these new live branches appear, draw the new live crown base to the live foliage of the lowest live branch that now meets the 5 ft rule.

- Saplings and small trees that had only live twigs should establish the crown base at the base of the live foliage on the new lowest live twig. If no live twigs are present, there is no crown to measure.

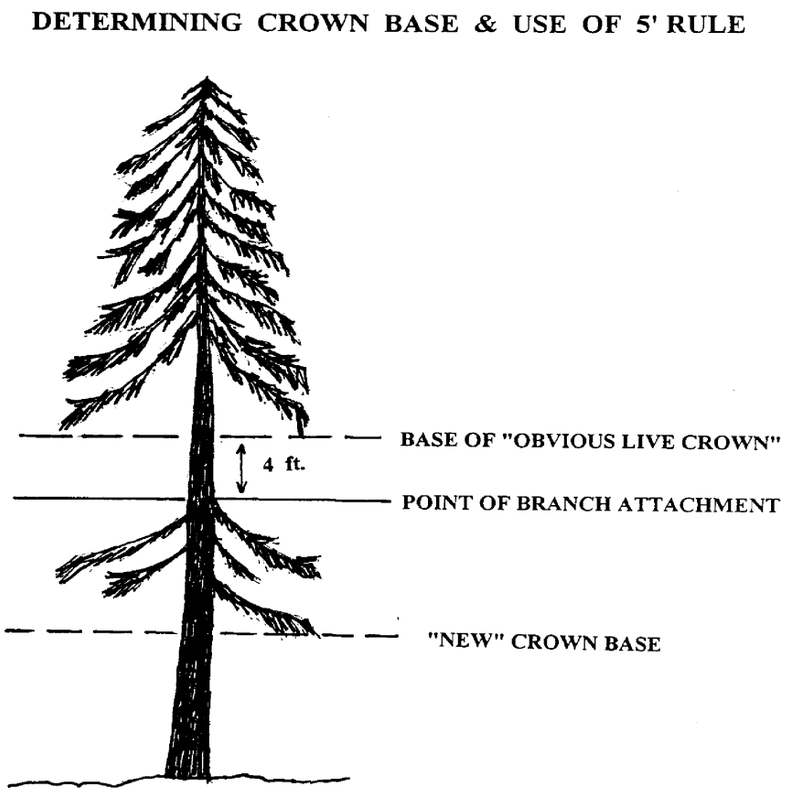


Figure 12-1. Determining the base of the live crown.

Overstory Canopy Zone
The area delineated by the average live crown height is used to determine UNCOMPACTED LIVE CROWN RATIO for overstory trees. The bottom of the overstory canopy zone is the average height of the live crown bases. The top of the zone is the average height for the live crown tops.

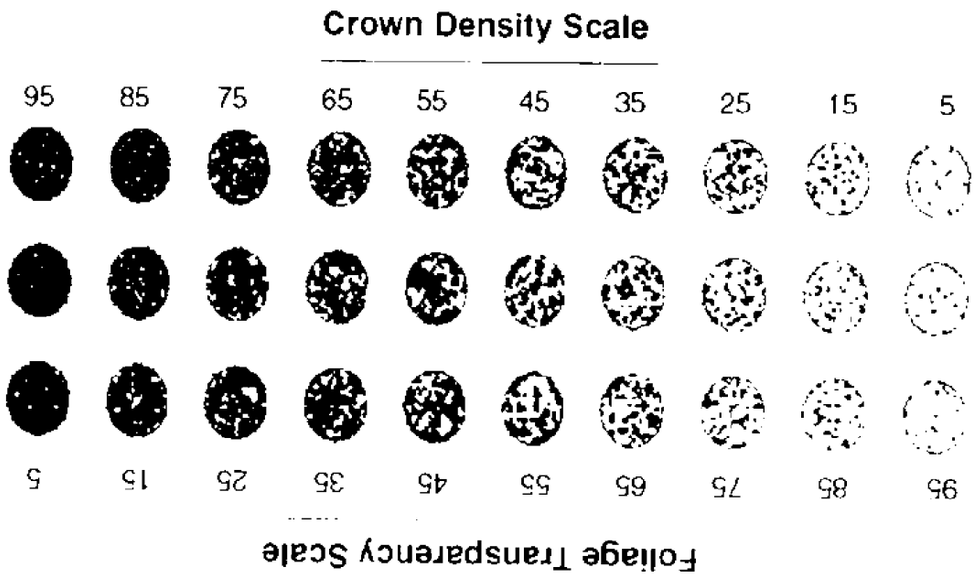
Snag Branch
A dead upper crown branch without twigs or sprigs attached to it.

Sprig
Any woody or non-woody lateral growth, without secondary branching, less than 1.0 inch in diameter at the base above the swelling at the point of attachment to a branch or crown stem.

Twig
Any woody lateral growth, with secondary branching, less than 1.0 inch in diameter at the base above the swelling at the point of attachment to a branch or crown stem.

12.3 CROWN DENSITY-FOLIAGE TRANSPARENCY CARD

Front



Back

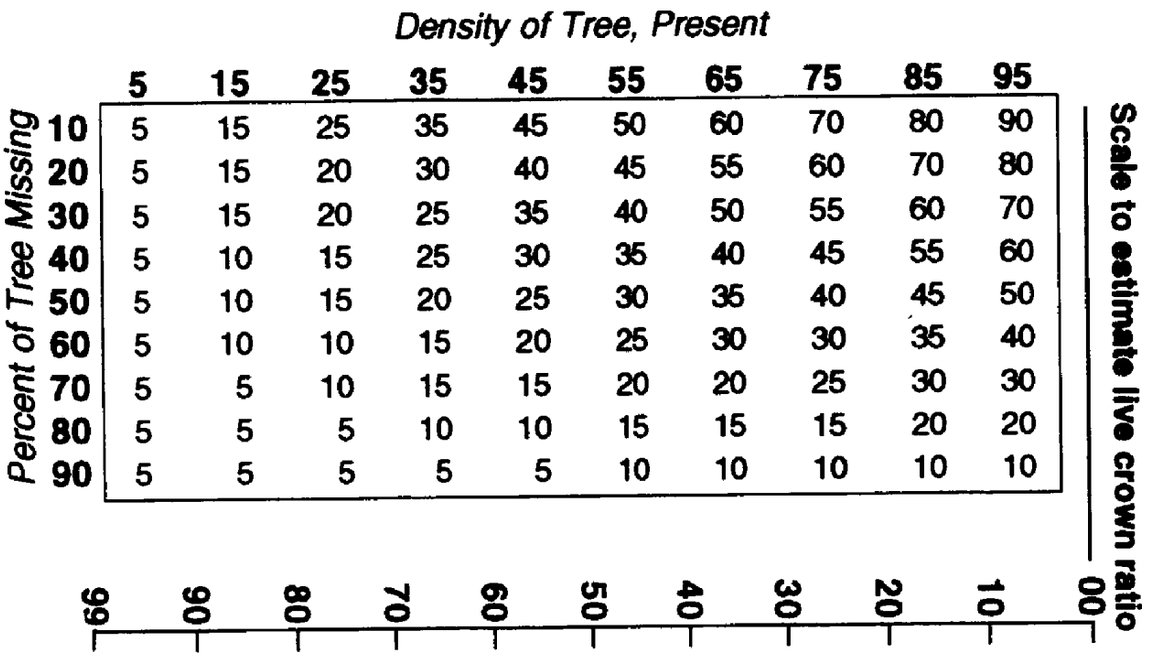


Figure 12-2. Density-Transparency card

The Crown Density - Foliage Transparency card (Figure 12-2) should be used as a training aid until crew personnel are comfortable with all ratings. White areas of the card represent skylight visible through the crown area and black areas represent a portion of the tree that is blocking skylight. After training, use the card to calibrate your eyes at the start of each day and rate those trees that do not fit into an obvious class. For CROWN DENSITY, hold the card so that "Crown Density" is right-side up ("Foliage Transparency" should be upside down). Use the numbers that are right-side up. Conversely, for FOLIAGE TRANSPARENCY, make sure that "Foliage Transparency" is right-side up. Crews should refer to specific CROWN DENSITY or FOLIAGE TRANSPARENCY sections for a definition of aspects that are included in the crown rating.

The back of the crown density - foliage transparency card has two uses: for CROWN DENSITY when a portion of the crown is missing and a general scale for estimating UNCOMPACTED LIVE CROWN RATIO. Crews should refer to the CROWN DENSITY and UNCOMPACTED LIVE CROWN RATIO sections for the use of this side of the card.

12.4 CROWN RATING PRECAUTIONS

Crews must be especially careful when making evaluations, and pay special attention to certain factors that may affect measurements in the field. These factors include:

- Distance and slope from the tree
- View of the crown
- Climatic conditions
- Heavy defoliation
- Leaning trees
- Trees with no “crown” by definition

Distance and slope from the tree -
Crews must attempt to stay at least 1/2 to 1 tree length from the tree being evaluated. Some ratings change with proximity to the tree. In some situations, it is impossible to satisfy this step, but the crew should do the best it can in each case. All evaluations are made at grade (same elevation as base of the tree) or up slope from the tree. This may not be possible in all cases but never get in the habit of evaluating trees from the down slope side.

View of the crown -
Crew members should evaluate trees when standing at an angle to each other, striving to obtain the best view of the crown. The ideal positions are at 90 degrees to each other on flat terrain (Figure 12-3). If possible, never evaluate the tree from the same position or at 180 degrees. In a thick canopy forest, getting a good perspective of the crown becomes difficult. Overlapping branches, background trees and lack of a good viewing area can cause problems when rating some trees. Crews need to move laterally to search for a good view. Take special care when rating such trees.

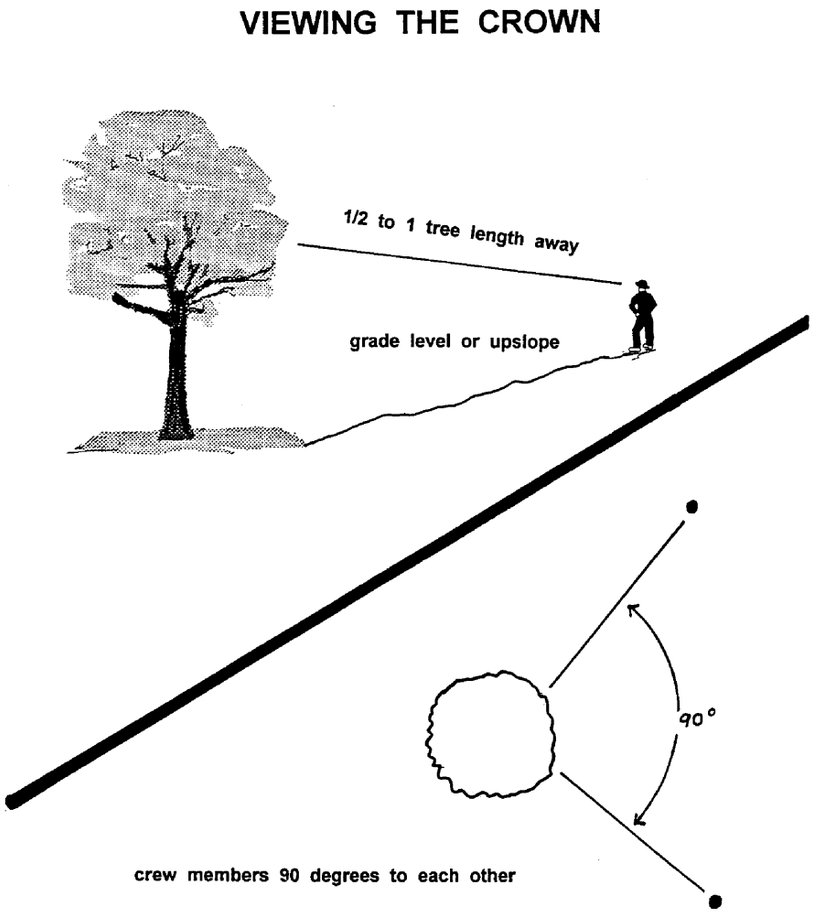


Figure 12-3. Crew positions for viewing crowns.

Climatic conditions -
Cloudy or overcast skies, fog, rain and poor sun angles may affect estimates. UNCOMPACTED LIVE CROWN RATIO may be affected but to a lesser degree than other crown indicators. CROWN DENSITY tends to be overestimated or underestimated because light does not project well through the foliage or, in some cases, the light may be too bright for a good estimate. CROWN DIEBACK may be underestimated, because it is difficult to see dead twigs and/or to differentiate defoliated twigs from dead twigs. FOLIAGE TRANSPARENCY estimates could be affected in either direction, because it is hard to separate foliage from branches. The data quality expectation standard helps, because crews can normally be within +/-10 percent, even in poor weather. However, crews need to be especially careful during poor lighting conditions. Crews should move around a tree to get another view, even if the view appears adequate at a specific location.

Heavy defoliation -
During heavy defoliation, CROWN DIEBACK may be overestimated and FOLIAGE TRANSPARENCY may be underestimated due to the difficulty in differentiating dead twigs from defoliated twigs. The use of binoculars may help in separating dead twigs from defoliated twigs.

Leaning trees -
Leaning trees cause a major problem in estimating crown variables. Record crown variables as accurately as possible for the **tree as it actually occurs** rather than as it might appear if standing upright and also record in the PDR tree note field that it is leaning (Figure 12-5). This will allow for better data interpretation.

Trees with no "crown" by definition (epicormics or sprigs only) - After a sudden release or damage, a tree may have very dense foliage, but no crown. These situations are coded as follows: UNCOMPACTED LIVE CROWN RATIO - 00, CROWN LIGHT EXPOSURE - 0, CROWN POSITION - 3, CROWN DENSITY - 00, CROWN DIEBACK - 99, FOLIAGE TRANSPARENCY - 99.

Epicormics remain epicormics until they regain the size of previous branches for trees with no branches 1.0 in or larger in diameter at the base above the swelling. For trees that had 1.0 in or larger branches when the epicormics formed, epicormics become branches once they reach 1.0 inch in diameter.

12.5 UNCOMPACTED LIVE CROWN RATIO

UNCOMPACTED LIVE CROWN RATIO is a percentage determined by dividing the live crown height by the total live tree height (Figure 12-5).

When collected: All live trees $\geq$1.0 in DBH/DRC
Field width: 2 digits
Tolerance: +/- 10% (2 classes)
MQO: 90% agreement
Values:

Code	Definition	Code	Definition	Code	Definition
00	0%	35	31-35%	70	66-70%
05	1-5%	40	36-40%	75	71-75%
10	6-10%	45	41-45%	80	76-80%
15	11-15%	50	46-50%	85	81-85%
20	16-20%	55	51-55%	90	86-90%
25	21-25%	60	56-60%	95	91-95%
30	26-30%	65	61-65%	99	96-100%

Note: Class code is the percentage of the upper limits of the class, i.e., Code 10 is 6% to 10%, etc. Estimates are recorded to the nearest 5 percent to be consistent throughout this guide with other procedures and to allow estimator flexibility.

Saplings

Determine sapling UNCOMPACTED LIVE CROWN RATIO by dividing the live crown height by total tree height to the live crown top, then enter the appropriate code into the PDR. Live crown height is the distance between the top live foliage (dieback and dead branches are not included) and the lowest live foliage on the lowest live twig for saplings. Be sure to eliminate vine foliage as best you can when determining the live crown. The live crown base for saplings is different from trees 5.0 in DBH/DRC and larger. The 5 ft/1 in rule does not apply in this case. Do not include sprigs or leaves on the main stem below the lowest live twig (Figure 12-4).

When the two estimates do not agree, follow the guidelines listed at the end of section 12.1 Overview. The estimate is placed into one of 21 percentage classes.

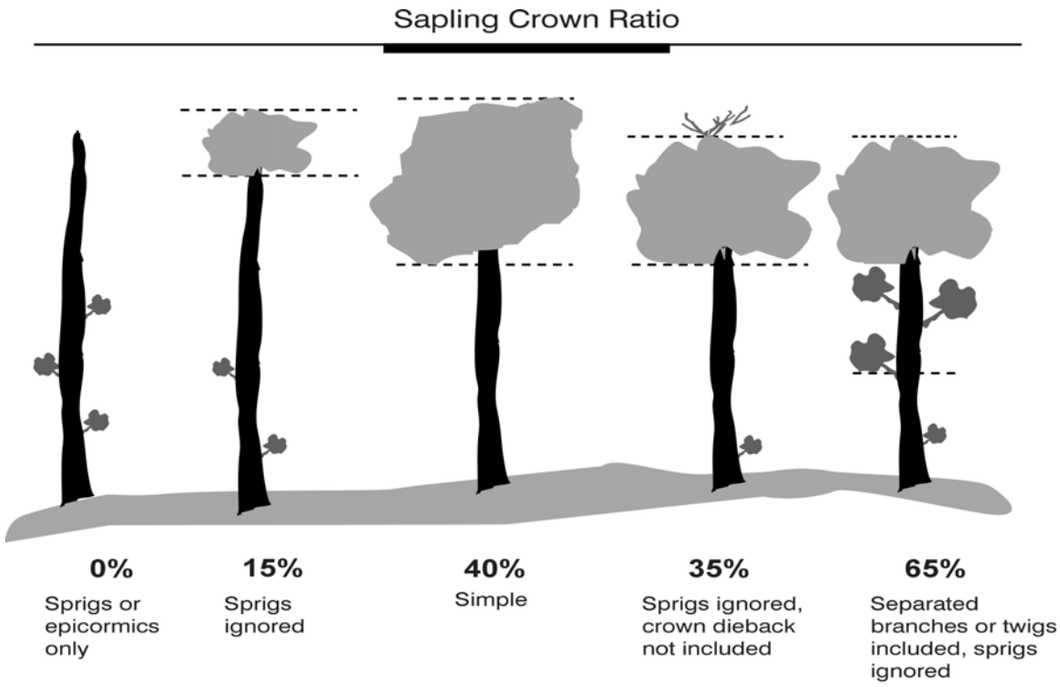


Figure12-4. Sapling UNCOMPACTED LIVE CROWN RATIO determination examples.

Measure leaning saplings as they are (Figure 12-5).

After a sudden release or damage, a sapling may have very dense foliage, but no crown as it only has sprigs. These situations are coded as follows: UNCOMPACTED LIVE CROWN RATIO – 00, CROWN LIGHT EXPOSURE – 0, CROWN POSITION – 3, sapling VIGOR – 3.

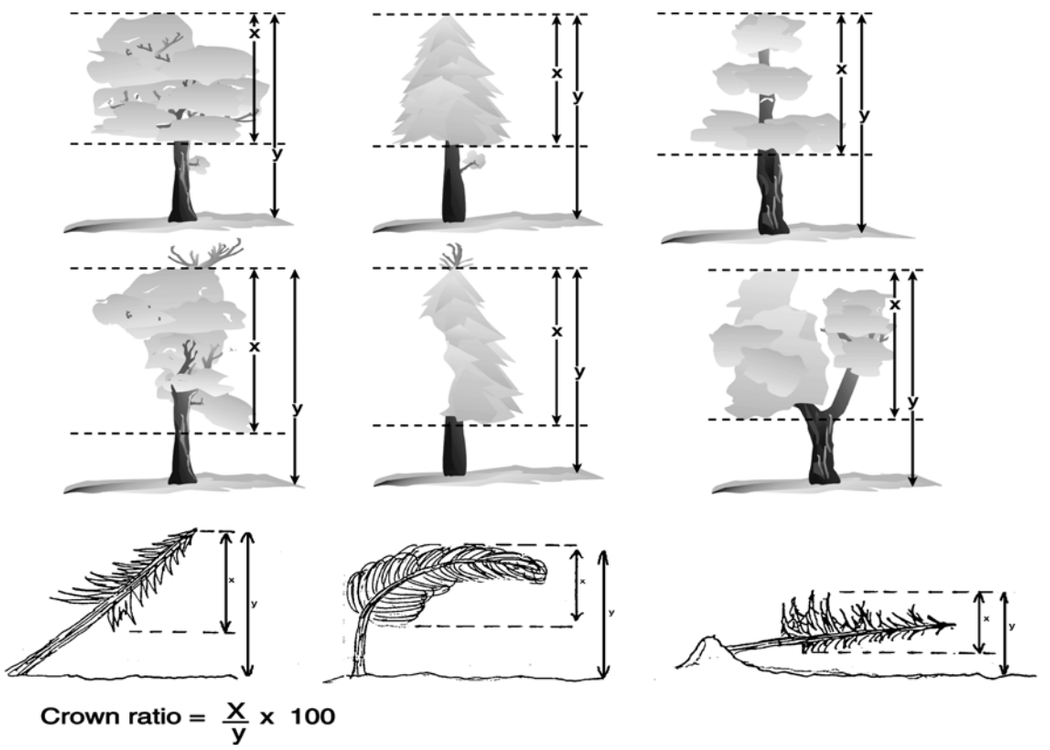


Figure 12-5. UNCOMPACTED LIVE CROWN RATIO examples.

Trees

Live crown height is the distance from the live crown top (dieback in the upper portion of the crown is not part of the live crown) to the "obvious live crown" base. Many times there are additional live branches below the "obvious live crown". These branches are only included if they have a basal diameter greater than 1.0 in and are within 5.0 ft of the base of the obvious live crown (Figure 12-1). The live crown base becomes that point on the main bole perpendicular to the lowest live foliage on the last branch that is included in the live crown. The live crown base is determined by the live foliage and not by the point where a branch intersects with the main bole. Occasionally, small trees or certain species may not have 1.0 in diameter branches. If this occurs, use the 5.0 ft rule, and apply it to branches that you feel contribute significantly to tree growth. Two people measure UNCOMPACTED LIVE CROWN RATIO.

An individual can use the UNCOMPACTED LIVE CROWN RATIO scale on the back of the crown density - foliage transparency card to help estimate ratios (Figure 12-2). **Hold the card in one hand, parallel to the trunk of the tree** being evaluated and move the card closer or farther from your eye until the 0 is at the live crown top and the 99 is at the base of the tree where it meets the ground. Then place your finger at the live crown base. The number on the scale provides the UNCOMPACTED LIVE CROWN RATIO. Interpolate to the nearest 5 percent if the point is between two values on the scale. A clinometer can also be used to verify the UNCOMPACTED LIVE CROWN RATIO by determining the values of both heights and determining the ratio of the two values.

When estimates between crew members do not agree, follow the guidelines listed at the end of section 12.1 *Overview*. The estimate is placed into one of 21 percentage classes.

After a sudden release or damage, a tree may have very dense foliage, but no crown. These situations are coded as follows: UNCOMPACTED LIVE CROWN RATIO - 00, CROWN LIGHT EXPOSURE - 0, CROWN POSITION - 3, CROWN DENSITY - 00, CROWN DIEBACK - 99 and FOLIAGE TRANSPARENCY - 99.

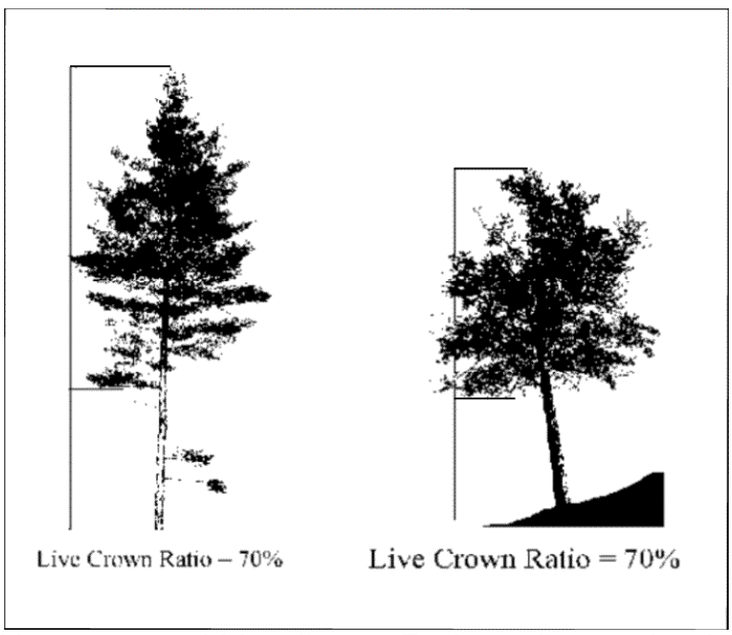


Figure 12-6. Uncompacted Live Crown Ratio outline and rating examples

12.6 CROWN LIGHT EXPOSURE

When collected: All live trees ≥ 1.0 in DBH/DRC
Field width: 1 digit
Tolerance: within 1 if > 0
MQO: 85% agreement
Values:

Code	Definition
0	The tree receives no full light because it is shaded by trees, vines, or other vegetation.
1	The tree receives full light from the top or 1 side.
2	The tree receives full light from the top and 1 side (or 2 sides without the top).
3	The tree receives full light from the top and 2 sides (or 3 sides without the top).
4	The tree receives full light from the top and 3 sides.
5	The tree receives full light from the top and 4 sides.

Rate the UNCOMPACTED LIVE CROWN RATIO for each side of the tree separately using the criteria for estimating total UNCOMPACTED LIVE CROWN RATIO. Visually divide the crown vertically into four equal sides. In order for a side to qualify for tally, the side must have an uncompacted live crown ratio of at least 35 percent. Additionally for a side to qualify, a continuous portion of live crown 35 percent or more in length must be completely exposed to direct light. For this measurement, a tree cannot shade itself (e.g., leaning trees or umbrella shaped trees). Try to divide the crown in such a way that as many sides as possible receive full light. Count the number of sides that would receive direct light if the sun were directly above the tree. Add one if the tree receives direct light from the top (Figure 12-7).

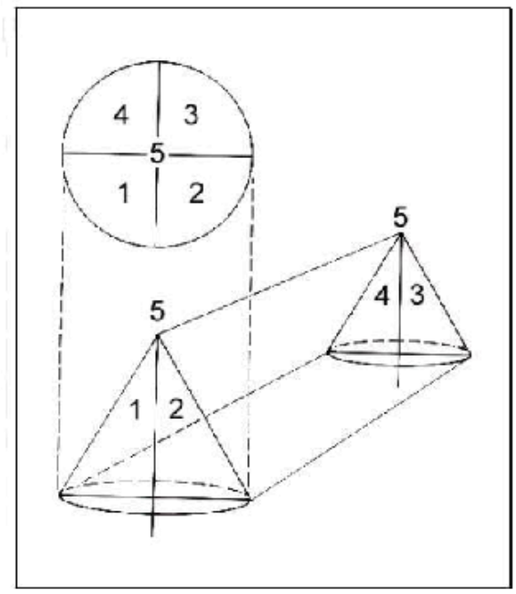


Figure 12-7. Dividing the

Note: The entire side (25% of the crown circumference) must be receiving full light to qualify. A sliver of a side receiving light does not qualify.

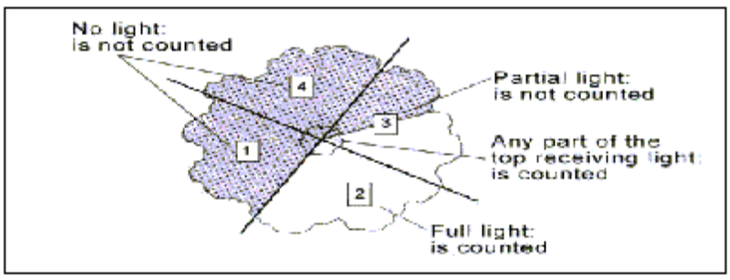


Figure 12-8. CROWN LIGHT EXPOSURE.

Trees with all sides having less than a 35% UNCOMPACTED LIVE CROWN RATIO can have a maximum crown exposure of one. Individual sides with less than 35% UNCOMPACTED LIVE CROWN RATIO should not be counted (Figure 12-8).

12.7 CROWN POSITION

When collected: All live trees ≥ 1.0 in DBH/DRC
Field width: 1 digit
Tolerance: No errors
MQO: 85% agreement
Values:

Code	Definition
1	Superstory. The live crown top must be two times the height of the top of the overstory canopy zone. The tree is open grown because most of the crown is above the overstory canopy zone (pioneers, seed trees, whips, remnants from previous stands, etc.). NOT USED FOR SAPLINGS.
2	Overstory. The live crown top is above the middle of the overstory canopy zone.
3	Understory. The live crown top is at or below the middle of the overstory canopy zone.
4	Open Canopy. An overstory canopy zone is not evident because the tree crowns in this condition are not fully closed (<50% cover). Most of the trees in this stand are not competing with each other for light.

Determine the relative position of each tree in relation to the overstory canopy zone (Figure 12-9).

Saplings

Saplings can never be coded as 1. Codes 2 or 3 should be used in stands where the tree crown cover is closed (>50 percent cover). If the tree crowns are not closed (<50 percent cover) and the area is greater than 1 ac in size, then assign code 4. When code 4 is used, it is always assigned to all trees in the stand. Code 4 is typically used in the following cases:

- Saplings in stands, over 1 ac in size, where crown cover is less than 50%.
- Saplings in clumps less than 1 ac in size (i.e., not a condition class), when the overall forest (the condition class), over 1 ac in size, is a patchwork of open areas and clumps of trees.

Trees

Codes 1-3 should be used in stands where the tree crown cover is closed (>50 percent cover). If the tree crowns are not closed (<50 percent cover) and the area is greater than 1 ac in size, then assign code 4. When code 4 is used, it is always assigned to all trees in the stand. Code 4 is typically used in the following cases:

- Trees in stands, over 1 ac in size, where crown cover is less than 50%.
- Trees in clumps less than 1 ac in size (i.e., not a condition class) when the overall forest (the condition class), over 1 ac in size, is a patchwork of open areas and clumps of trees.

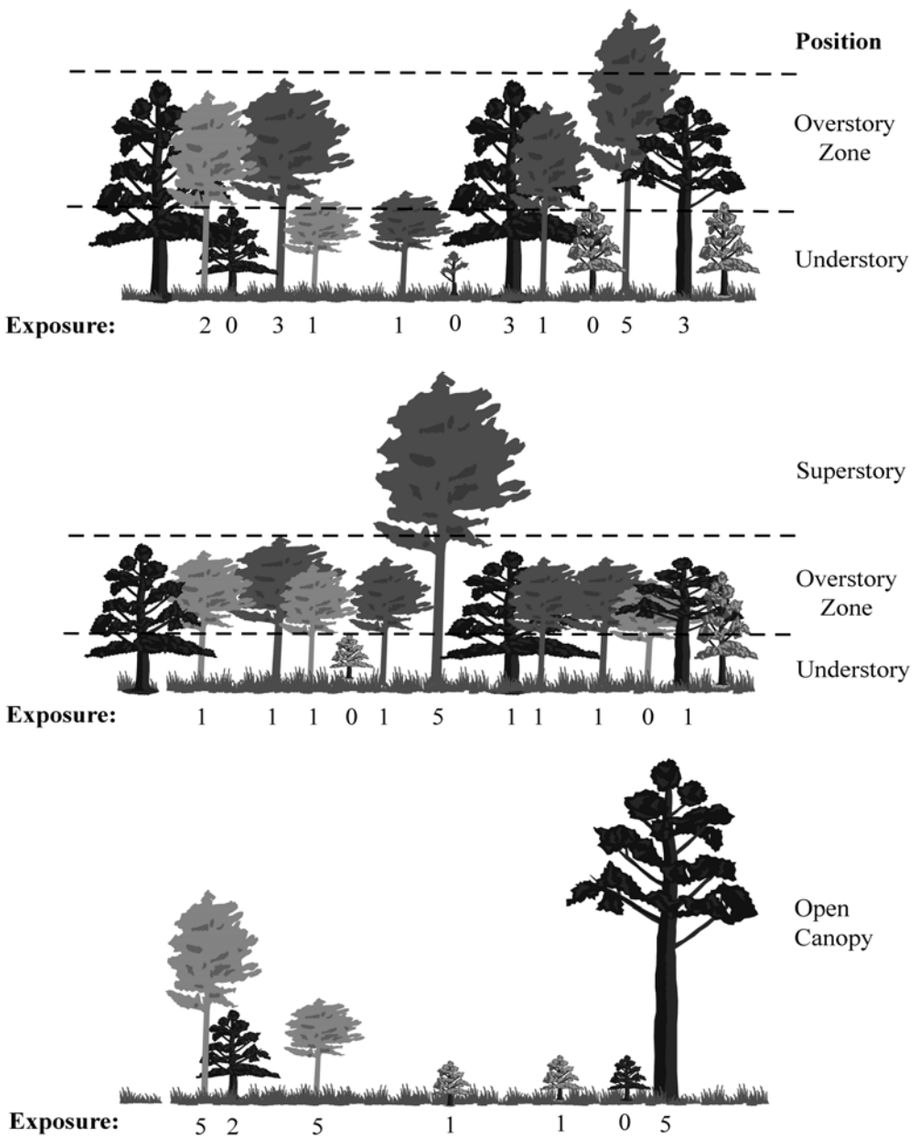


Figure 12-9. CROWN LIGHT EXPOSURE and POSITION.

12.8 VIGOR CLASS

When collected: All live trees ≥ 1.0 in DBH/DRC and < 5.0 in DBH/DRC
Field width: 1 digit
Tolerance: No errors
MQO: 90% agreement
Values:

Class/Code	Definition
1	Saplings must have a UNCOMPACTED LIVE CROWN RATIO of 35 or higher, have less than 5 percent DIEBACK (deer/rabbit browse is not considered as dieback but is considered missing foliage) and 80 percent or more of the foliage present is normal or at least 50 percent of each leaf is not damaged or missing. Twigs and branches that are dead because of normal shading are not included.
2	Saplings do not meet Class 1 or 3 criteria. They may have any UNCOMPACTED LIVE CROWN RATIO, may or may not have DIEBACK and may have between 21 and 100 percent of the foliage classified as normal.
3	Saplings may have any UNCOMPACTED LIVE CROWN RATIO and have 1 to 20 percent normal foliage or the percent of foliage missing combined with the percent of leaves that are over 50 percent damaged or missing should equal 80 percent or more of the live crown. Twigs and branches that are dead because of normal shading are not included.

See Figure 12-10 for a visual description of the sapling vigor classes.

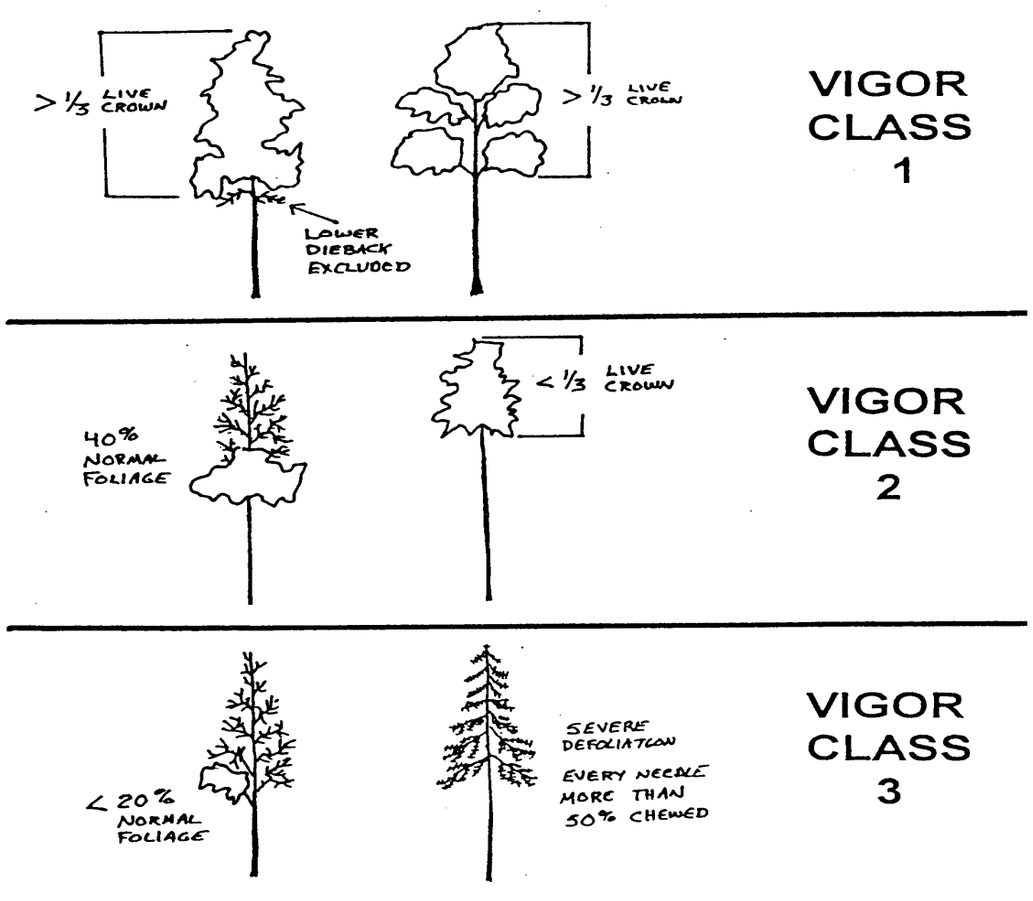


Figure 12-10. Sapling VIGOR classes.

12.9 CROWN DENSITY

When collected: All live trees ≥ 5.0 in DBH/DRC
Field width: 2 digits
Tolerance: +/- 10% (2 classes)
MQO: 90% agreement
Values:

Code	Definition	Code	Definition	Code	Definition
00	0%	35	31-35%	70	66-70%
05	1-5%	40	36-40%	75	71-75%
10	6-10%	45	41-45%	80	76-80%
15	11-15%	50	46-50%	85	81-85%
20	16-20%	55	51-55%	90	86-90%
25	21-25%	60	56-60%	95	91-95%
30	26-30%	65	61-65%	99	96-100%

Note: Class code is the percentage of the upper limits of the class, i.e., Code 10 is 6% to 10%, etc. Estimates are recorded to the nearest 5 percent to be consistent throughout this guide with other procedures and to allow estimator flexibility.

CROWN DENSITY estimates crown condition in relation to a typical tree for the site where it is found. DENSITY also serves as an indicator of expected growth in the near future. CROWN DENSITY is the amount of crown branches, foliage and reproductive structures that blocks light visibility through the crown. Each tree species has a normal crown that varies with the site, genetics, tree damage, etc.

Two people measure CROWN DENSITY (Figure 12-3). To determine the crown shape, select the crown base on the stem used for UNCOMPACTED LIVE CROWN RATIO. Project a full "mirror image" crown based on that tree's shape where it is growing to the crown top (missing, dead or live). Foliage below the crown base is not included (Figure 12-1). If the top is broken or missing, mentally re-establish that portion of the tree before estimating DENSITY. Mentally project half-sided trees as full crowns by using the "mirror image" of the existing half of the crown. Include CROWN DIEBACK and open areas in this outline (Figures 12-11 and 12-12).

After determining the crown shape, each person should use the crown density - foliage transparency card (Figure 12-2). Along the line of sight, estimate what percentage of the outlined area is blocking sunlight. In cases where portions of the tree may be missing, i.e., half-sided trees, it may be easier to determine the percent of the crown shape missing and the actual density of the tree's remaining portion. Then use the table on the back of the crown density - foliage transparency card to arrive at the final CROWN DENSITY. When two individuals disagree with their estimates, follow the guidelines listed at the end of section 12.1 *Overview*. The estimate is placed into one of 21 percentage classes.

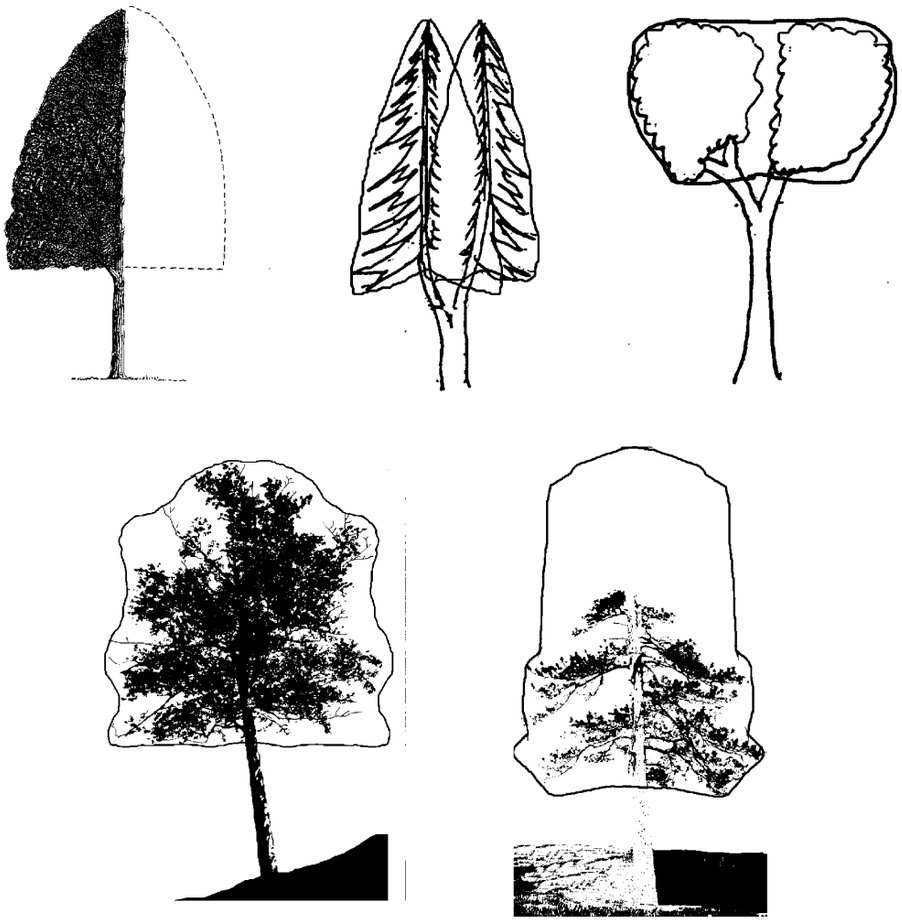


Figure 12-11. CROWN DENSITY rating outline examples.

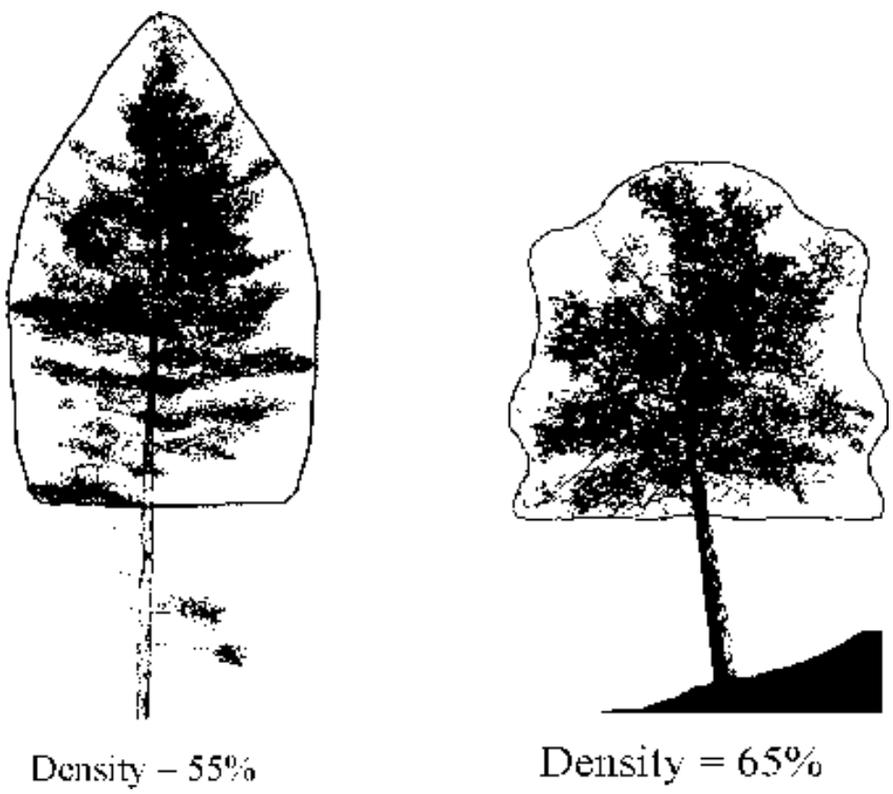


Figure 12-12. Crown density outline and rating examples

12.10 CROWN DIEBACK

When collected: All live trees ≥ 5.0 in DBH/DRC
Field width: 2 digits
Tolerance: +/- 10% (2 classes)
MQO: 90% agreement
Values:

Code	Definition	Code	Definition	Code	Definition
00	0%	35	31-35%	70	66-70%
05	1-5%	40	36-40%	75	71-75%
10	6-10%	45	41-45%	80	76-80%
15	11-15%	50	46-50%	85	81-85%
20	16-20%	55	51-55%	90	86-90%
25	21-25%	60	56-60%	95	91-95%
30	26-30%	65	61-65%	99	96-100%

Note: Class code is the percentage of the upper limits of the class, i.e., Code 10 is 6% to 10%, etc. Estimates are recorded to the nearest 5 percent to be consistent throughout this guide with other procedures and to allow estimator flexibility.

CROWN DIEBACK estimates reflect the severity of recent stresses on a tree. Estimate CROWN DIEBACK as a percentage of the live crown area, including the dieback area. The crown base should be the same as that used for the UNCOMPACTED LIVE CROWN RATIO estimate. Assume the perimeter of the crown is a two-dimensional outline from branch-tip to branch-tip, excluding snag branches and large holes or gaps in the crown (Figures 12-13 and 12-14).

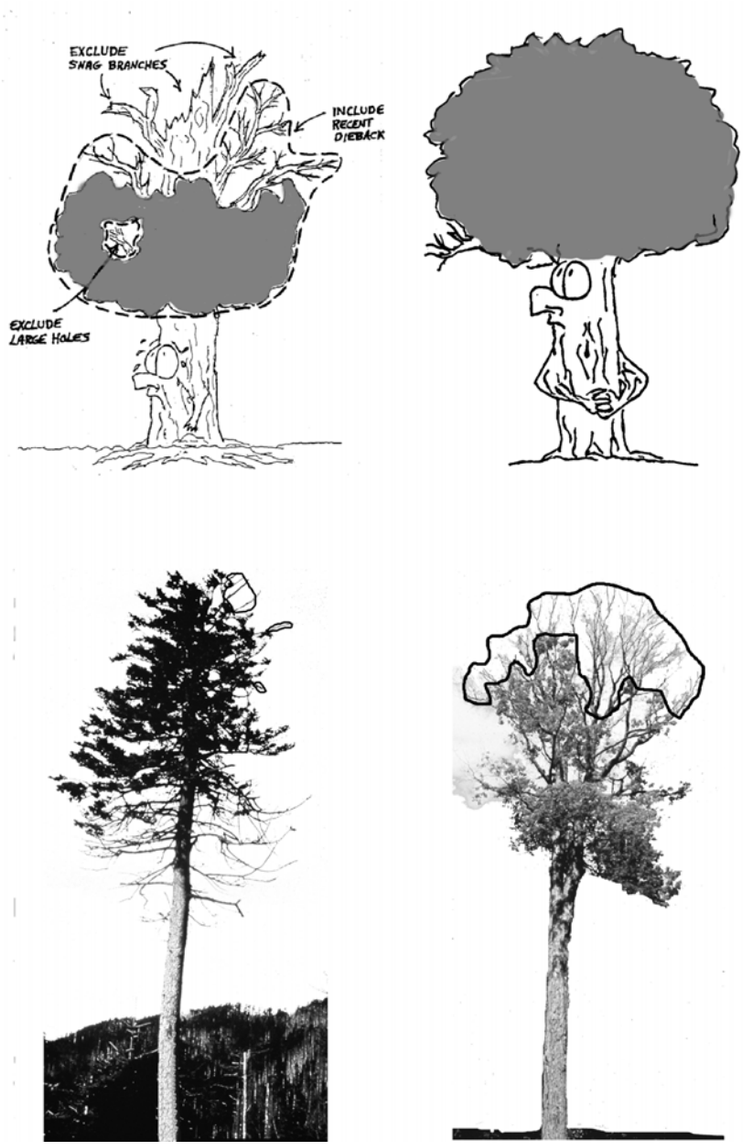


Figure 12-13. CROWN DIEBACK rating outline examples.

Two people measure CROWN DIEBACK (Figure 12-3). Binoculars should be used to assist in the data collection. Observers should be conscious of lighting conditions and how light affects the day's observations. Under limited-light conditions, observers should take extra time. Poor lighting can make the measurement more difficult.

Each individual should mentally draw a two-dimensional crown outline, block in the dieback and estimate the dieback area. When two individuals disagree with their estimates, follow the guidelines listed at the end of section 12.1 *Overview*. The estimate is placed into one of 21 percentage classes.

Figure 12-14. Dieback outline and rating examples

12.11 FOLIAGE TRANSPARENCY

When collected: All live trees ≥ 5.0 in DBH/DRC
Field width: 2 digits
Tolerance: +/- 10% (2 classes)
MQO: 90% agreement
Values:

Code	Definition	Code	Definition	Code	Definition
00	0%	35	31-35%	70	66-70%
05	1-5%	40	36-40%	75	71-75%
10	6-10%	45	41-45%	80	76-80%
15	11-15%	50	46-50%	85	81-85%
20	16-20%	55	51-55%	90	86-90%
25	21-25%	60	56-60%	95	91-95%
30	26-30%	65	61-65%	99	96-100%

Note: Class code is the percentage of the upper limits of the class, i.e., Code 10 is 6% to 10%, etc. Estimates are recorded to the nearest 5 percent to be consistent throughout this guide with other procedures and to allow estimator flexibility.

Foliage transparency is the amount of skylight visible through the live, normally foliated portion (where you see foliage, normal or damaged, or remnants of its recent presence) of the crown. A recently defoliated tree except for one or two live leaves should have a transparency rating of 99 not 0!! Check with binoculars to assess which branches are alive and should have foliage.

Different tree species have a normal range of foliage transparency, which may be more or less than that of other species. Changes in foliage transparency can also occur because of current damage, frequently referred to as defoliation, or from reduced foliage resulting from stresses during preceding years.

Estimate FOLIAGE TRANSPARENCY using the crown density - foliage transparency card (Figure 12-2). Exclude vine foliage from the transparency estimate as best you can. Dead branches in the lower live crown, snag branches, crown dieback and missing branches or areas where foliage is expected to be missing are deleted from the estimate (Figure 12-15).

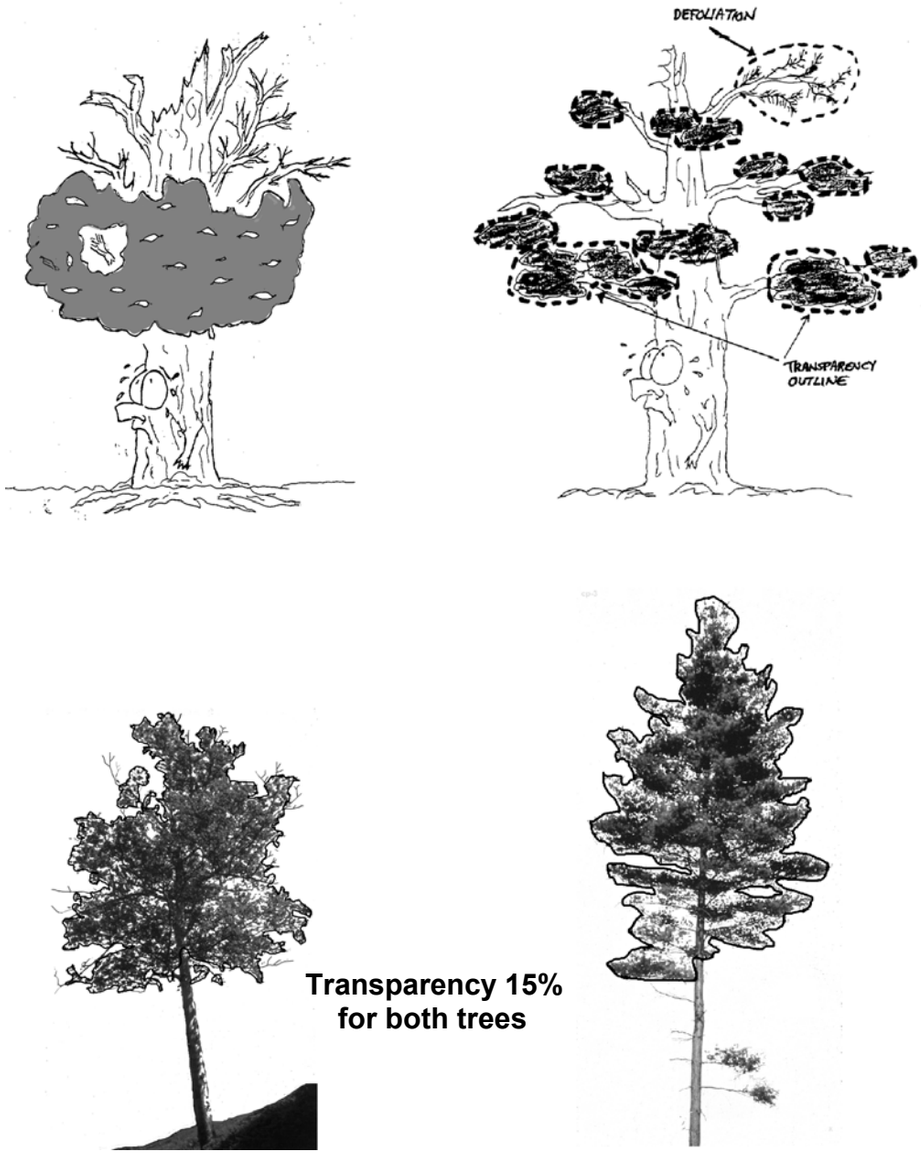


Figure 12-15. CROWN TRANSPARENCY rating outline examples.

When defoliation is severe, branches alone will screen the light, but you should exclude the branches from the foliage outline and rate the area as if the light was penetrating those branches. For example, an almost completely defoliated dense spruce may have less than 20 percent skylight coming through the crown, but it will be rated as highly transparent because of the missing foliage. Old trees and some hardwood species, have crowns with densely foliated branches that are widely spaced. These spaces between branches should not be included in the FOLIAGE TRANSPARENCY rating. When FOLIAGE TRANSPARENCY in one part of the crown differs from another part, the average FOLIAGE TRANSPARENCY is estimated.

Two people rate FOLIAGE TRANSPARENCY (Figure 12-3). First, each individual will mentally draw a two-dimensional crown outline. Second, the foliated area will be blocked into the crown outline. Third, estimate the transparency of the normally foliated area. When two individuals disagree with their estimates, follow the guidelines listed at the end of section 12.1 Overview. The estimate is placed into one of 21 percentage classes.

12.12 ACKNOWLEDGEMENTS

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