

6.000 TREE AND SAPLING DATA

Trees at least 5.0 inches in diameter and 4.5 ft in length are sampled within the subplot. 'Tally trees' are defined as all live and standing dead trees in accessible forest land condition classes encountered on the subplot the first time a subplot is established, and all trees that grow into a subplot thereafter. These data yield information on tree growth, mortality, removals; coarse woody debris; wildlife habitats; forest structure and composition; biomass; and carbon sequestration.

Additional regional data is collected in the Northeast on dead and down trees. However, do not tally dead trees that have been lying on the ground for so long that advanced decay is present.

Trees with a diameter at least 1.0 in but less than 5.0 in and are 4.5 ft in length, termed saplings, are sampled within the microplot (see Seedling Data for locations of microplots). 'Tally saplings' are defined as all live saplings in accessible forest land condition classes encountered the first time a microplot is established, and all saplings that grow into each microplot thereafter are included until they grow to 5.0 in or larger, at which time they are tallied on the 24.0 ft subplot and referenced (new azimuth and distance taken) to the subplot center.

Additional sapling data is collected in Maine. The 5th microplot is located 270° and 12 ft from the center subplot. Minimal data is collected on these saplings. The required sapling data are subplot number, tree number, species, DBH, condition class number, and actual length.

Trees are alive if they have any living parts (leaves, buds, cambium) at or above the point of diameter measurement, either diameter at breast height (DBH). Trees that have been temporarily defoliated are still alive.

Once tallied, dead trees over 5.0 in diameter are tracked until they fall down. **Working around dead trees is a safety hazard - crews should exercise extreme caution! Trees that are deemed unsafe to measure should be noted as such and left alone.**

Broken portions of trees that are completely separated from their base are not treated as separate trees.

Whether live or dead, standing trees do not have to be self-supported. These may be supported by other trees.

High stumps (trees that have been cut) do not qualify as standing dead trees.

Begin tallying trees at an azimuth of 001° from subplot center and continue clockwise around the subplot. Repeat this sequence for trees on the microplot.

6.100 SUBPLOT NUMBER -- Record the subplot number where the tree occurs.

When Collected: All live tally trees ≥ 1.0 in DBH and all dead tally trees ≥ 5.0 in DBH

Field width: 1 digit

Tolerance: No errors

MQO: At least 99% of the time

Values:

- 1 Center subplot
- 2 North subplot
- 3 Southeast subplot
- 4 Southwest subplot
- 5 Additional Maine sapling microplot

6.105 TREE RECORD NUMBER -- Record a code to uniquely and permanently identify each tree on a given subplot. The TREE RECORD NUMBERS must be unique within a subplot – being unique is more important than being sequential. In general, work clockwise from azimuth 001 to 360, and work outwards from subplot center to subplot edge. On remeasured plots, use the tree number assigned at the previous visit. Saplings tallied on microplots will retain their initially assigned tree number if they grow to tree size. Missed trees will be assigned the next available tree number. DO NOT renumber all plot trees in order to assign a more “correct” tree number to a missed tree. Numbers assigned to trees that are subsequently found to be extra will be dropped and not reused.

NOTE: If this is a Phase 3 plot, match the trees on this point to the hard copy list provided. Record the three-digit FHM tree number assigned to each standing tree.

When Collected: All live tally trees ≥ 1.0 in DBH and all dead tally trees ≥ 5.0 in DBH

Field width: 3 digits

Tolerance: No errors

MQO: At least 99% of the time

Values: 001 to 999

6.100 SPECIES -- Record the appropriate SPECIES code from the list in Appendix 4. If you encounter a species not listed in Appendix 4 and are not sure if it should be tallied as a tree, consult your Field Supervisor. If the species cannot be determined in the field, tally the tree, but bring branch samples, foliage, cones, flowers, bark, etc. to your supervisor for identification. If possible, collect samples outside the subplots from similar specimens and make a note to correct the SPECIES code later. Use code 299 for unknown dead conifer and 999 for unknown dead hardwood when the genus or species codes cannot be used. The generic code should only be used when you are sure the species is on the species list, but you cannot differentiate among acceptable species. In this case use the sample collections procedures described earlier in this paragraph.

When Collected: All live tally trees ≥ 1.0 in DBH and all dead tally trees ≥ 5.0 in DBH

Field width: 3 digits

Tolerance: No errors for genus; No errors for species

MQO: At least 99% of the time for genus; At least 95% of the time for species

Values: See Appendix 4

6.120 HORIZONTAL DISTANCE -- Record the measured HORIZONTAL DISTANCE, to the nearest 0.1 ft, from the subplot center (for trees ≥ 5.0 in DBH) or microplot center (for trees 1.0 in and < 5.0 in DBH) to the pith of the tree at the base.

When Collected: All live tally trees ≥ 1.0 in DBH and all dead tally trees ≥ 5.0 in DBH

Field width: 3 digits (xx.y)

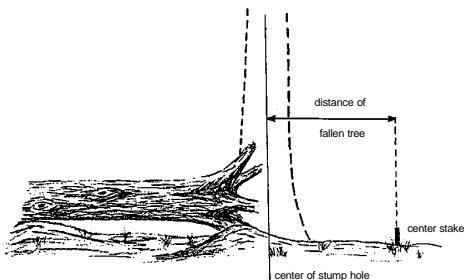
Tolerance: Microplot: ± 0.2 ft; Subplot: ± 0.2 ft

MQO: At least 90% of the time (microplot); At least 90% of the time (subplot)

Values: Microplot: 00.1 to 6.8; Subplot: 00.1 to 24.0

A leaning tree is determined to be "in" or "out" of the plot radius by measuring the horizontal distance from plot center, to the center of the tree at the base. The direction that the tree leans is of no consequence.

For a down and windthrown tree measure the horizontal distance to the spot where the center of the tree would have been if the tree was still standing; i.e., measure the distance to the center of the stump, or ground cavity (see illustration on next page).



A tree on steep terrain, occasionally, cannot be accurately measured by taking a direct horizontal distance. When this happens, the slope distance (measured parallel to the ground) and the percent slope (measured with a clinometer) from subplot center to the tree will be needed to calculate the horizontal distance. The formula for calculating the horizontal distance is as follows:

$$\frac{\text{measured slope distance to tree}}{100 \text{ ft slope distance}} = \frac{\text{horizontal distance to tree}}{100 \text{ ft horizontal distance}}$$

For example, a tree has a slope distance of 23.9 ft and the slope is 48 %. Using the Slope Correction table in Appendix 10 you find that the correction for 100 ft with 48 % slope is 10.9 ft.

All that's left is to solve the equation:

$$\frac{23.9'}{110.9'} = \frac{\text{horizontal distance to tree}}{100'}$$

Solve for the horizontal distance, HD = 21.6 ft.

6.130 AZIMUTH -- Record the AZIMUTH from the subplot center (for trees ≥ 5.0 in DBH) or the microplot center (for trees 1.0 in and < 5.0 in DBH), sight the center of the base of each tree with a compass. Record AZIMUTH to the nearest degree. Use 360 for north.

When two or more trees are on the same azimuth begin by tallying the tree that is closest to plot center, and then proceed to the tree that is farthest away. Follow the same relative procedure with saplings on the four microplots.

When Collected: All live tally trees ≥ 1.0 in DBH and all dead tally trees ≥ 5.0 in DBH

Field width: 3 digits

Tolerance: $\pm 10^\circ$

MQO: At least 90% of the time

Values: 001 to 360

6.140 TREE HISTORY -- A tree history code describes the status of a tree during this inventory as compared to its status during the previous inventory. This is the key variable used to differentiate components of change between inventories. Complete this variable for all trees 5.0 in. DBH, or greater, tallied on subplot 1 of remeasured plots.

Assign a tree history code for:

- Every tree that was tallied as a live tree at the last inventory if it had a DBH of 5.0 inches or greater.
- Every live tree with current DBH of 5.0 inches or greater that is being tallied for the first time during this inventory. (This includes trees previously tallied as saplings that have grown to 5.0 inches DBH, or more, and are being tallied as growing stock for the first time.)
- Standing dead tree that is alive, but not large enough (5.0 inches DBH) to be tallied at the last survey, but which grew to 5.0 inches DBH or greater and died since the last inventory. These are dead ingrowth.
- Standing snag that was dead at the last occasion but are still standing. **Do not mistake a snag for dead ingrowth.** Cedar is an example of a tree that can die and remain standing for a number of years.

When Collected: All live and dead tally trees ≥ 5.0 in DBH on plots that are being remeasured

Field width: 2 digits

Tolerance: No error

MQO: At least 99% of the time

Values:

Survivors -- Live, previously measured tree, or a tree that was a missed tree at the last occasion

- 10** same live tree -- was in before, is in now
- 12** tree was missed at last survey -- should have been tallied but wasn't, is now tallied
- 15*** multiple stemmed tree -- the product of two (possibly more) previously measured trees **of the same species** that had grown together and were treated as one tree (used only in conjunction with code 16)
- 16*** multiple stemmed tree – one of two, or more, trees **of the same species** that were treated as one tree, but are now tallied as individuals (used only in conjunction with code 15)

- 17*** multiple forked tree – the product of two (possibly more) stems that forked above 4.5 ft and were treated as one tree (used only in conjunction with code 18)
- 18*** multiple forked tree – one of two, or more, stems that the diameter measurement is now taken 3.5 ft above the point of pith separation (used only in conjunction with code 17)
- 19** tree that is alive, but was incorrectly tallied as dead at the last occasion (limited to a tree with a **previous** tree class of 5 or 6)

* **Histories 15, 16, 17, and 18 may include dead trees.**

Ingrowth -- Tree that is correctly tallied for the first time,

or

tree that is now on timberland.

- 20** live tree, not previously measured
- 21** live or dead tree, that was tallied before but should not have been, and is a tally tree now
- 22** live or dead tree, that was on nonforest land, and is now on timberland or other forest land
- 23** live or dead tree, that was on unproductive, reserved or urban forest land, and is now on timberland or other forest land
- 24** dead tree or snag, that was too small to tally before but has grown to tally size and died since the previous inventory, is a tally tree now
- 25** dead tree, should have been tallied, was missed, has since died, and is now tallied

Removals -- Previously tallied tree that:

a) has been harvested, killed or presumed to have been harvested during a cultural operation (logging, land clearing, TSI work, etc.)

or

b) is no longer on timberland.

- 30** the location where the tree is, or was, is still timberland, the tree has been killed, it can be standing or down

- 31 the location where the tree was is still forested, the tree has been removed (usually a stump will be present)
- 32 the location where the tree is, or was, is now nonforest, the tree is alive, killed or removed (if no longer alive, it is assumed that the cause of death was not natural mortality). If the tree is no longer present, use the old DBH, distance and azimuth
- 33 the location where the tree is, or was, is now unproductive, reserved, or urban forest land. The tree is alive or has been killed but is still present (if no longer alive, it is assumed that the cause of death was not natural mortality)
- 34 the location where the tree was is now unproductive, reserved, or urban forest land -- the tree has been removed and is no longer present

Mortality -- Previously tallied tree that has died since the last inventory.

- 40 dead tree --standing or down-- tree is still present; when DBH measurement is not possible, or current DBH is smaller than the previous DBH, use previous DBH for current
- 41 dead, down, disintegrated, no evidence remaining; previously measured tree that has died, is down and is in advanced stages of decay or any previously measured tree that cannot be accounted for
- 42 dead tree, standing or down, now located on nonforest land
- 43 dead tree, standing or down, now located on unproductive, reserved, or urban forest land
- 44 dead, down, disintegrated, no evidence remaining; the land where it was located is unproductive, reserved, or urban forest land

Other Trees

- 50 tree that had a recorded horizontal distance of 24.0 ft or less, that now has a horizontal distance greater than 24.0 ft
- 53 tree with a **previous** tree class of 5 or 6 that is still present (standing or down)
- 54 tree with a **previous** tree class of 5 or 6 that is no longer present (no evidence of the tree remains or in advanced stages of decay)

DIAMETER

Diameters are measured at breast height (DBH). Trees with diameters between 1.0- and 4.9-inches are measured on the 6.8-ft radius microplot, those with diameters of 5.0-inches and larger are measured on the 24-ft radius subplots.

In order to accurately remeasure diameter (DBH) at the same point on the tree bole at successive visits, regions have the option of measuring and recording the distance from the ground to the point of diameter, or marking the point of measurement with a scribe, crayon, paint, or aluminum nail. When marking trees for the first time, measure the diameter after the mark is in place. Use caution to avoid damaging trees with scribes and nails.

- Do not scribe or nail trees less than 3.0-inches in diameter.
- Do not scribe species vulnerable to introduction of pathogens (e.g., aspen).
- Do not penetrate the cambium when using a bark scribe.

New trees: The diameter mark is located one-inch below where the diameter is taken, on the side of tree facing the subplot center. If using a bark scribe or paint marker, the mark should be approximately two-inches long. Check for irregularities before making diameter marks. (See “Special DBH Situations” beginning on the next page.)

Remeasured trees: When remeasuring the diameter of a tree tallied at a previous survey, always take the measurement at the location marked by the previous crew unless it is not physically possible (e.g., tree buried by mudslide), or the previous location is more than 12 inches beyond where the diameter should be measured according to current protocols (either because protocols have changed or the previous crew made a mistake). Assign a Diameter Check code of 2 whenever the point of measurement is moved.

When reconciling dead trees and snags, if the current diameter is less than the previous diameter, record the previous diameter as the current diameter.

6.150 DIAMETER AT BREAST HEIGHT (DBH) -- Unless one of the “Special DBH Situations” described on the following pages, measure DBH at 4.5 ft above the ground line on the uphill side of the tree. **Round each measurement down to the last 0.1 inch.** For example, a reading from a diameter tape of 3.68 inches is recorded as “036” on the tally sheet or data recorder.

- For trees on the 24.0 ft radius subplot, measure single-stemmed trees 5.0 inches in diameter or larger.
- For trees on the 6.8 ft radius microplot, measure single-stemmed trees between 1.0 inch and 4.9 inches in diameter.

When Collected: All live tally trees ≥ 1.0 in DBH and all dead tally trees ≥ 5.0 in DBH

Field width: 3 digits (xx.y)

Tolerance: ± 0.1 in per 20.0 in of diameter on trees with a measured diameter. E.g., A tree with a diameter of 41.0 in would have a tolerance of plus or minus 0.3 in

MQO: At least 95% of the time

Values: 001 to 999

NOTE: The MQO for point of measurement is ± 0.2 in when the tree is first measured and within 1 ft of the location established by the previous crew when the tree is remeasured.

Special DBH Situations:

1. Forked tree: In order to qualify as a fork, the stem in question must be at least 1/3 the diameter of the main stem and must branch out from the main stem at an angle of 45° or less. Forks originate at the point on the bole where the piths intersect. Forked trees are handled differently depending on whether the fork originates below 1.0 ft, between 1.0 and 4.5 ft, or above 4.5 ft.
 - Trees forked below 1.0 ft. Trees forked in this region are treated as distinctly separate trees (Figure 10). Distances and azimuths are measured individually to the center of each stem where it splits from the stump (Figure 13 A-C). DBH is measured for each stem at 4.5 ft above the ground. When stems originate from pith intersections below 1 ft, it is possible for some stems to be within the limiting distance of the microplot or subplot, and others to be beyond the limiting distance. If stems originating from forks that occur below 1.0 ft and fork again between 1.0 and 4.5 ft, the DBH of each fork is measured at a point 3.5 ft above the pith intersection (Figure 13-B).

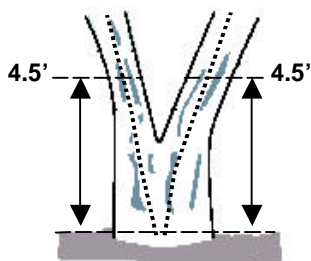


Figure 10. Forked below 1.0 ft

- Trees forked between 1.0 ft and 4.5 ft. Trees forked in this region are also counted as separate trees (Figure 11), but only one distance and azimuth (to the central stump) is used for all (Figure 13 D-F). **Although a single azimuth and distance applies to all, multiple stems should be recorded as they occur in clockwise order (from front to back when one stem is directly in front of another).** The DBH of each fork is measured at a point 3.5 ft above the pith intersection. When forks originate from pith intersections between 1.0 and 4.5 ft, the limiting distance is the same for all forks--they are either all on, or all off the plot.

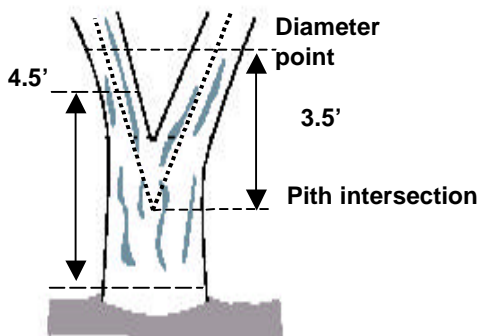


Figure 11. Forked between 1.0-4.5 ft

Multiple forks are possible if they all originate from approximately the same point on the main stem. In such cases, measure DBH on all stems at 3.5 ft above the common pith intersection (Figure 13 F).

Once a stem is tallied as a fork that originated from a pith intersection between 1.0 and 4.5 ft, do not recognize any additional forks that may occur on that stem. Measure the diameter of such stems at the base of the second fork as shown in Figure 13-E (i.e., do not move the point of diameter the entire 3.5 ft above the first fork).

- Trees forked at or above 4.5 ft. Trees forked in this region count as one single tree (Figure 12). If a fork occurs at or immediately above 4.5 ft, measure diameter below the fork just beneath any swelling that would inflate DBH.

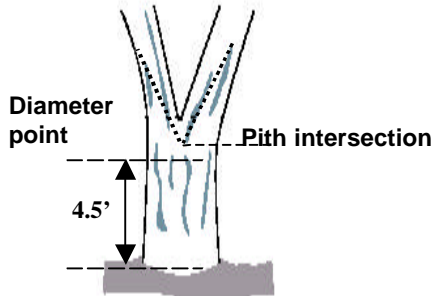
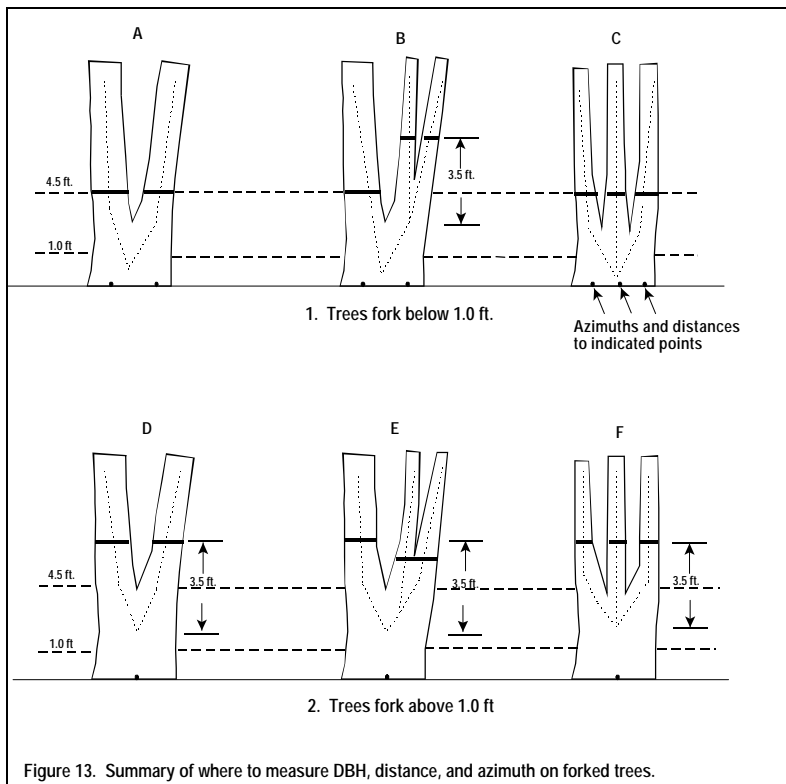


Figure 12. One tree



2. Stump Sprouts. Stump sprouts originate between ground level and 4.5 ft on the boles of trees that have died or been cut. Stump sprouts are handled the same as forked trees, with the exception that stump sprouts are not required to be 1/3 the diameter of the dead bole. Stump sprouts originating below 1.0 ft are measured at 4.5 ft from ground line. Stump sprouts originating between 1.0 ft and 4.5 ft are measured at 3.5 ft above their point of occurrence. As with forks, rules for measuring distance and azimuth depend on whether the sprouts originate above or below 1.0 ft.

3. Tree with butt-swell or bottleneck: Measure these trees 1.5 ft above the end of the swell or bottleneck if the swell or bottleneck extends 3.0 ft or more above the ground (Figure 14)

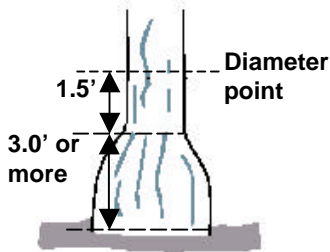


Figure 14. Bottleneck tree

4. Tree with irregularities at DBH: On trees with swellings (Figure 15), bumps, depressions, and branches (Figure 16) at DBH, diameter will be measured immediately above the irregularity at the place it ceases to affect normal stem form.

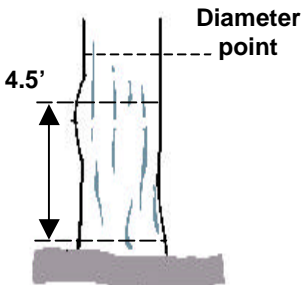


Figure 15. Tree with swelling

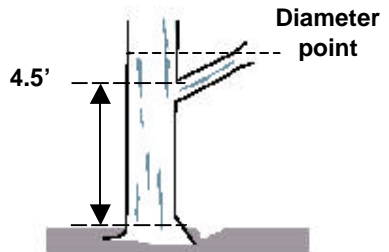


Figure 16. Tree with branch

5. Tree on slope: Measure diameter at 4.5 ft from the ground along the bole on the uphill side of the tree (Figure 17).

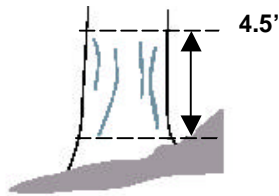


Figure 17. Tree on a slope

6. Leaning tree: Measure diameter at 4.5 ft from the ground along the underside face of the bole. The 4.5 ft distance is measured along the underside face of the bole (Figure 18).

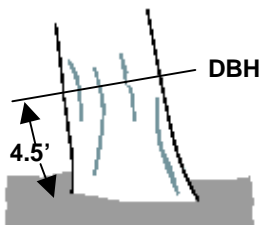


Figure 18. Leaning tree

7. Turpentine tree: On trees with turpentine face extending above 4.5 ft, estimate the diameter at 10.0 ft above the ground and multiply by 1.1 to estimate DBH outside bark.
8. Independent trees that grow together: If two or more independent stems have grown together at or above the point of DBH, continue to treat them as separate trees. Estimate the diameter of each, set the "Diameter Check" code to 1, and explain the situation in the notes.

9. Missing wood or bark. Do not reconstruct the DBH of a tree that is missing wood or bark or at the point of measurement. Record the diameter, to the nearest 0.1, of the wood and bark that is still attached to the tree (Figure 19). If a tree has a localized abnormality (gouge, depression, etc.) at the point of point of DBH, apply the procedure described for trees with irregularities at DBH (Figure 14).

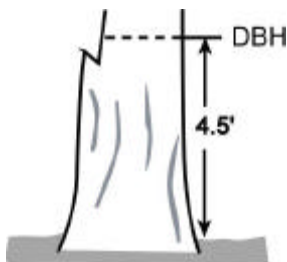


Figure 19. Tree with broken stem

10. Live wind-thrown tree: Measure from the top of the root collar along the length to 4.5 ft (Figure 20).

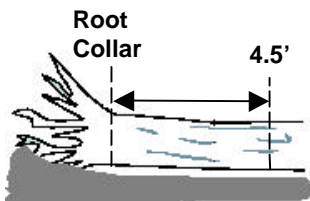


Figure 20. Tree on the ground

11. Down live tree with tree-form branches growing vertical from main bole. When a down live tree, touching the ground, has vertical (<math><45^\circ</math> from vertical) tree-like branches coming off the main bole, first determine whether or not the pith of the main bole (averaged along the first log of the tree) is above or below the duff layer.
- If the pith of the main bole is above the duff layer, use the same forking rules specified for a forked tree, and take all measurements accordingly (Figure 21).
 - If the pith intersection of the main down bole and vertical tree-like branch occurs below 4.5 ft from the stump along the main bole, treat that branch as a separate tree, and measure DBH 3.5 ft above the pith intersection for both the main bole and the tree-like branch.
 - If the intersection between the main down bole and the tree-like branch occurs beyond the 4.5 ft point from the stump along the main bole, treat that branch as part of the main down bole.

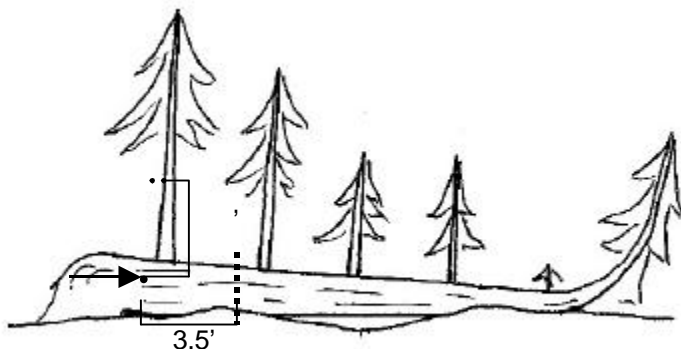


Figure 21. Down tree above duff

- If the pith of main tree bole is below the duff layer, ignore the main bole, and treat each tree-like branch as a separate tree; take DBH and length measurements from the ground, not necessarily from the top of the down bole (Figure 22). However, if the top of the main tree bole curves out of the ground towards a vertical angle, treat that portion of that top as an individual tree originating where the pith leaves the duff layer.

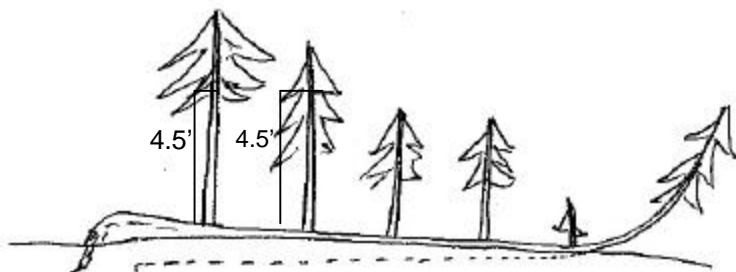


Figure 22. Down tree below duff

6.155 DIAMETER CHECK – Record the code to identify any irregularities in diameter measurement positions (e.g., abnormal swellings, diseases, damage, new measurement positions, etc.) that may affect the use of this tree in diameter growth/change analyses.

When Collected: All live tally trees ≥ 1.0 in DBH and all dead tally trees ≥ 5.0 in DBH

Field width: 1 digit

Tolerance: No errors

MQO: At least 99% of the time

Values:

- 0** Diameter measured accurately
- 1** Diameter estimated
- 2** Diameter measured at different location than previous measurement (remeasurement trees only)

NOTE: If both codes 1 and 2 apply, use code 2.

6.160 CONDITION CLASS NUMBER -- Record the CONDITION CLASS NUMBER in which each tree is located. Often, a referenced boundary is approximate, and trees selected for tally are assigned to the actual condition in which they lie regardless of the recorded approximate boundary (Figure 9).

When Collected: All live tally trees ≥ 1.0 in DBH and all dead tally trees ≥ 5.0 in DBH

Field width: 1 digit

Tolerance: No errors

MQO: At least 99% of the time

Values: 1 to 9

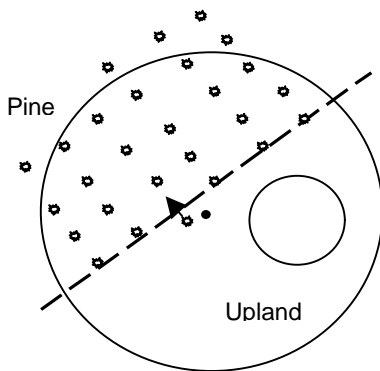


Figure . Ragged CONDITION CLASS boundary

6.170

--

condition classes for all trees 5.0 in DBH and larger. Broken tops must

≥ 5.0 in DBH

Field width: 1 digit

MQO: At least 99% of the

Values: 1 to 8

live tree, live intact top

2 live tree, broken top

3 (tops may merely be defoliated --

with caution.

dead tree, intact top

check the cambium layer for moisture)

de (before recording as dead, use a scribe

to check the cambium layer for moisture)

6 (do not tally if advanced decay is present and

wood is punky)

7

snag, broken top

6.175 LEAN ANGLE -- Record the code that describes the angle of lean from vertical of the tree, from base to top of ACTUAL LENGTH. A tree supported by other trees or by its own branches is considered standing.

When Collected: All live and dead tally trees ≥ 5.0 in DBH

Field width: 1 digit

Tolerance: No errors

MQO: At least 99% of the time

Values:

- 0** Standing (less than 45° of lean from vertical)
- 1** Down (more than 45° of lean)

NOTE: LEAN ANGLE is a national core variable that is recorded independently of other variables. The use of “down” in other variables (i.e., TREE HISTORY and TREE CONDITION 6) refers to a dead tree where the majority of the bole is touching the ground.

6.180 TREE GRADE -- Record a tree grade for all softwood trees 9.0 in DBH, or greater, and all hardwood trees 11.0 in DBH, or greater, according to the tree grade specifications in Appendix 9. For live trees, record one-digit codes that correspond to the tree grade numbers.

When Collected: All live and dead tally trees ≥ 9.0 in DBH if softwood, and ≥ 11.0 in DBH if hardwood

Field width: 1 digit

Tolerance: No errors

MQO: At least 99% of the time

Values: 0, 1, 2, 3, 4 or 5

Hardwoods Use the Hardwood Tree Grades (grades **1**, **2**, and **3**) or the Tie and Timber Grade specifications (grade **4**) for all hardwood trees. Grade **5** will be used for trees that do not meet minimum specifications of the Hardwood Tree Grades or the Tie and Timber Grade.

Eastern White Pine Use the Eastern White Pine Tree Grades, (grades **1** through **4**), for Eastern White Pine only. Grade **5** will be used for trees that do not meet minimum specifications.

Southern Pine The Southern Pine Tree Grades, (grades **1** through **3**), will be used for all pines except Eastern White Pine. Grade **5** will be used for trees that do not meet minimum specifications. There is no grade 4 for the Southern Pine Tree Grades.

Spruce, fir, cedar, larch (tamarack), and hemlock

larch (tamarack), and hemlock will be graded as either merchantable (grade 1, 2, 3, or 4), or as cull (grade 5) based on merchantability specifications.

All dead trees, no matter what species, must receive a tree grade

within the butt 16 ft of the tree (Hardwood Tree Grades, grades for spruce, fir, cedar, larch, and hemlock). The entire 16 ft, of the butt section of the tree gives a better grade than the 12 ft section, the grade of the longer section is recorded. The butt length (pinus must be at least 12 ft) in order for the tree to be assigned one of the merchantable tree grades (grades 1, 2, 3 or 4). Butt sections less than twelve feet in length must receive a tree grade of 5.

Pines cannot be given a merchantable grade (1 through 4 for white pine, 5 for red pine). Spruce, fir, cedar, larch, and hemlock cannot be given a merchantable grade if they have a fork in the first 12 ft of bole.

For tree grading purpose only in order to assign a tree grade to the entire tree.

Any section containing metal should be culled. In hardwoods, if you are able to obtain a 12 ft grading section free of metal in the butt 16 ft section, then the tree can receive a grade 1-4 based on the other grading criteria. Because hardwood tree grades have a sliding 12 ft section in the butt 16 ft, the metal does not necessarily render a tree grade 5 unless the metal is present in the butt 12 ft section. It is impossible to get a 12 ft section free of metal in the butt 16 ft.

In the spruce-fir, cedar, larch, and hemlock tree grades; any metal in the butt 16 ft will render a tree grade 5, softwood tree grades have no sliding 12 ft section in the butt 16 ft.

6.190

--

foot of all sawtimber-
from a 1 ft stump to (in order of priorities):

1. The point, where no physical log, whether or not merchantable, can be produced because of excessive limbs, forks, or crooks.

one log, 8 ft or longer, is present. **(A log is a section at least 8 ft long, not containing a fork, sufficiently straight enough to yield at least an 8 ft board.)**

2. Minimum top sawlog diameter:
 - a. 9" DOB (diameter outside bark) for hardwoods
 - b. 7" DOB for softwoods
3. On broken-off trees, to the point of the break.

When a tree forks into two or more sawlog-sized sections, measure the section with the largest diameter immediately above the fork regardless of its condition or whether the other fork may yield more sawlog length. Sawlog length, *in general*, should terminate at the second fork in hardwood trees.

If the sawtimber-sized tree does not contain at least one 12 ft or two non-contiguous 8 ft logs, record 00 for sawlog length.

When Collected: All live and dead tally trees ≥ 9.0 in DBH if softwood, and ≥ 11.0 in DBH if hardwood

Field width: 2 digits

Tolerance: ± 4 ft

MQO: At least 90% of the time

Values: 00, 12 to 99

6.200 BOLE LENGTH -- For all live and dead trees record bole length to the nearest whole foot from a 1 ft stump to the first of:

1. The point, where no 4 ft section, whether or not merchantable, can be produced because of excessive limbs, forks, or crooks. Bole length should not extend above this point unless at least one section, four feet or longer, is present.
2. A four inch top DOB (diameter outside bark)
3. Where the central stem terminates by branching before reaching four inches DOB. However, bole length can extend up through major subdivisions of the central stem. For trees that fork above DBH, measure length along the larger diameter fork. Bole length, *in general*, should terminate at the third fork in hardwood trees.
4. On broken-off trees, to the point of the break.

Minimum bole length that can be recorded is 4 ft, otherwise record 00.

When Collected: All live and dead tally trees ≥ 5.0 in DBH

Field width: 2 digits

Tolerance: ± 4 ft

MQO: At least 90% of the time

Values: 00, 04 to 99

6.205 TOTAL LENGTH -- Record the TOTAL LENGTH of the tree, to the nearest 1.0 ft, from ground level to the tip of the apical meristem. For a tree growing on a slope, measure on the uphill side of the tree. If the tree has a broken or missing top (Tree Condition 2, 5 and 8), estimate what the total length would be if there was no missing or broken top. A forked tree is treated the same as an unforked tree.

When Collected: P2 CORE - All live and dead tally trees ≥ 5.0 in DBH;
P3 - All live tally trees ≥ 1.0 in DBH

Field width: 3 digits

Tolerance $\pm 10\%$ of true length

MQO: At least 90% of the time

Values: 005 to 150

6.206 ACTUAL LENGTH -- For a tree with a broken or missing top (Tree Condition 2, 5, and 8), record the ACTUAL LENGTH of the tree to the nearest foot from ground level to the highest remaining portion of the tree still present and attached to the bole. Use the length to the break for ACTUAL LENGTH until a new leader qualifies as the new top for TOTAL LENGTH; until that occurs, continue to record ACTUAL LENGTH to the break. **If the top is intact (Tree Condition 1, 3, 4, and 7), this variable may be omitted.** Forked trees should be treated the same as unforked trees.

NOTE: Trees with previously broken tops are considered recovered (i.e., actual length = total length) when a new leader is 1/3 the diameter of the broken top at the point where the top was broken (not where the new leader originates from the trunk).

When Collected: P2 CORE - All live and dead tally trees (with broken or missing tops) ≥ 5.0 in DBH; Maine - All live tally trees ≥ 1.0 in DBH and all dead tally trees ≥ 5.0 in DBH; P3 - All live and standing dead tally trees (with broken or missing tops) ≥ 1.0 in DBH

Field width: 3 digits

Tolerance: $\pm 10\%$ of true length

MQO: At least 90% of the time

Values: 005 to 400

6.207 LENGTH METHOD -- Record the code that indicates the method used to determine a tree length. **The length for the first three trees encountered on each subplot must be measured** – all others may be estimated.

When Collected: P2 CORE - All live and dead tally trees ≥ 5.0 in DBH;
 P3 - All live tally trees 1.0 in DBH
 Field width: 1 digit
 Tolerance: No errors
 MQO: At least 99% of the time
 Values:

- 1 All lengths are field measured with a measurement instrument (e.g., clinometer, relascope, tape)
- 2 Total length is visually estimated, other lengths are measured with an instrument
- 3 All lengths are visually estimated

6.210 BOARD-FOOT CULL -- Board-foot cull is the volume within the sawlog length of a tree that cannot be used to produce boards, because of rot, sweep, crook, excessive limbs, and other defects. The total board-foot cull for the tree includes the entire volume of sections that do not meet minimum size, length and grade requirements, and the cull volume within acceptable sawlog sections.

To determine the amount of board-foot cull in the tree, it is necessary to visually divide the entire sawlog length into sections that are 8 ft or longer. **The amount of cull to be recorded is the total volume of logs that do not meet minimum grade requirements, sections that do not qualify as logs, and the amount of cull within logs.**

Some examples are:

- a. A 12 ft section lies between two forks. The section exceeds the minimum length and diameter requirements for a log, but does not meet the minimum grade specifications for a 12 ft log. The entire volume of the 12 ft section is cull unless an 8 or 10 ft log within the 12 ft section does qualify as a merchantable sawlog. If a 8 or 10 ft section within the 12 ft log does qualify as merchantable, that 8 or 10 ft section would not be deducted for board foot cull. The remaining 2 or 4 ft section that kept the initial 12 ft section from meeting grade would be culled in this example.
- b. A six-foot section of perfectly sound and straight wood lies between two forks. Since logs cannot contain forks, and since the section is less than eight feet long, it is not a log. The entire volume of the six-foot section is cull.

A tree with more than 16 ft of sawlog length may be classified as cull, depending on the situation. If the tree does not have one merchantable 12 ft sawlog or two merchantable 8 ft sawlog; or if the upper logs and the butt log do not meet minimum grade specifications, the entire tree is cull.

If a tree has more than 16 ft of sawlog length and grade 5, the entire “graded section” (12, 14 or 16 ft) is not necessarily cull. If a portion of the graded section is merchantable and at least 8 ft in length, cull is determined just for the non-merchantable portion of the graded section, provided that there is another merchantable log at least 8 ft in length within the recorded sawlog length. Again, if the tree does not contain at least one 12 ft or two non-contiguous 8 ft logs that are merchantable, then the entire tree is cull.

If a tree has 16 ft or less of sawlog length and grade 5, the entire tree is cull.

Estimate cull volume by using the appropriate cull estimating aids for sawtimber trees found in Appendix 10. Record the actual percentage of total board-foot cull, except:

- cull less than 4 % may be recorded as 00
- 100 % cull is recorded as 99

When Collected: All live and dead tally trees ≥ 9.0 in DBH if softwood, and ≥ 11.0 in DBH if hardwood

Field width: 2 digits

Tolerance: ! 10%,

MQO: At least 90% of the time

Values: 00 to 99

6.220 PERCENT SOUNDNESS (OF BOARD-FOOT CULL) -- This is a percentage of the entry made in variable 6.210. Record the code that indicates the percentage of the board-foot cull that is sound cull. Sound cull is caused by form defects; sweep, crook, limbs, forks. Sound cull can consist of entire logs that do not meet the minimum sawlog grade specifications because of form and sound defects.

Percent soundness can be represented by the following formula.

$$\frac{\% \text{ sound cull}}{\% \text{ total cull}} = \% \text{ soundness}$$

Codes **0** through **4** indicate **predominantly unsound** cull, whereas codes **5** through **9** indicate **predominantly sound** cull. Each section must be individually assigned a soundness of 0, all rotten, or 9, all sound.

When Collected: All live and dead tally trees ≥ 9.0 in DBH if softwood, and ≥ 11.0 in DBH if hardwood

Field width: 2 digits

Tolerance: \pm one class

MQO: At least 90% of the time

Values:

0	00 – 09 %	5	50 – 59 %
1	10 – 19 %	6	60 – 69 %
2	20 – 29 %	7	70 – 79 %
3	30 – 39 %	8	80 – 89 %
4	40 – 49 %	9	90 – 100 %

Example 1:

A hardwood tree has 32 ft of sawlog. The first section has 15% cull and is rotten. The seventh (11%) and eighth (10%) sections are cull due to form defects, i.e., all sound. The total board foot cull is 36%. Twenty-one percent (the amount of cull in sections 7 and 8) of the 36% is sound cull, resulting in soundness for the sawlog of 58%, or code 5 for percent soundness of board-foot cull.

Example 2:

A softwood tree has 16 ft of sawlog. The first section is rotten cull (33%), and the fourth section is sound cull (19%). The total cull for the sawlog is 52%. Nineteen percent of the 52% is sound cull, resulting in a sawlog that has 37% sound, or code 3 for percent soundness of board-foot cull.

6.230 CUBIC-FOOT CULL -- Cubic-foot cull is the volume of the bole length of a tree that is not suitable for products because of rot, decay, large limbs, forks, sweep, crook, embedded wire, and other defects.

Starting at the 1 ft stump, visually divide the entire bole length into 4 ft sections. Use the following as guides to estimating cubic-foot cull:

- Sections that contain true forks are cull.
- Cull any section in which more than 50% of the volume is lost due to rot.
- Cull any section that contains wire fence or metal objects such as a tap for sugar maple.
- If sweep or crook causes a straight line between the center of each end of a section to fall outside the bark at any point, the section is cull. Field personnel may use discretion. For example, a line stretched from one end to the other end of a 10 ft section of bole might fall outside the bark at one point. However, if this section were treated as two 5 ft sections, or a 4 ft and a 6 ft section, the centerline for each bole would not fall outside the bark. These sections cannot be less than 4 ft.

- Make partial deductions for large bumps and heavy bird peck, especially when occluded. Make slight deductions for dead limbs, if it is suspected that pockets of rot lie behind them.
- Sections that contain limbs whose collars exceed one third of the stem diameter (DOB) at the point of occurrence.

Determine the percentage of cubic-foot cull in poletimber and sawtimber trees by using the appropriate cull estimating aids in Appendix 10. Record the actual percentage of total cubic-foot cull, except:

- cull less than 4 % cull should be recorded as 00
- 100 % cull is recorded as 99

When Collected: All live and dead tally trees \geq 5.0 in DBH

Field width: 2 digits

Tolerance: \pm 10%,

MQO: At least 90% of the time

Values: 00, 04 to 99

6.240 PERCENT SOUNDNESS (OF CUBIC-FOOT CULL) -- This is a percentage of the entry made in variable 6.230. Record the code that indicates the percentage of the cubic-foot cull that is sound cull (due to sweep, crook, forks, etc.). Percent soundness can be represented by the following formula.

$$\frac{\% \text{ sound cull}}{\% \text{ total cull}} = \% \text{ soundness}$$

Codes **0** through **4** indicate cull that is predominantly **unsound**. Codes **5** through **9** indicate predominantly **sound** cull. Refer to Percent Soundness of Board-foot cull section for examples.

When Collected: All live and dead tally trees \geq 5.0 in DBH

Field width: 1 digit

MQO: \pm one class, 90% of the time

Values:

0	00 – 09 %	5	50 – 59 %
1	10 – 19 %	6	60 – 69 %
2	20 – 29 %	7	70 – 79 %
3	30 – 39 %	8	80 – 89 %
4	40 – 49 %	9	90 – 100 %

6.250 CROWN CLASS -- Rate the tree crown in relation to the sunlight received and proximity to neighboring trees (Figure 20). Base the assessment on the position of the crown at the time of observation. Example: a formerly suppressed tree, which is now dominant due to tree removal, is classified as dominant.

When Collected: All live tally trees ≥ 1.0 in DBH

Field width: 1 digit

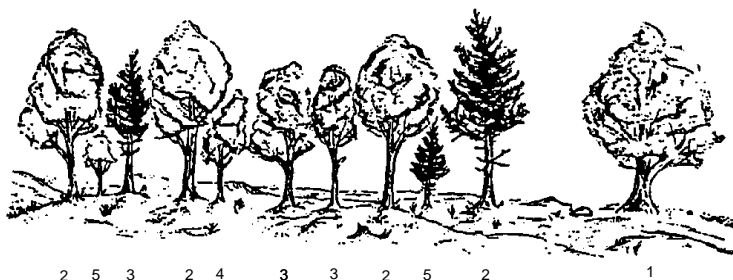
Tolerance: No errors

MQO: At least 85% of the time

Values:

- 1 Open Grown: Tree with a crown that receives full light from above and from all sides throughout most of its life, particularly during its early developmental period.
- 2 Dominant: Tree with a crown extending above the general level of the crown cover and receives full light from above and partly from the sides. These trees are taller than the average trees in the stand and their crowns are well developed, but they could be somewhat crowded on the sides.
 - Also, trees whose crowns have received full light from above and from all sides during early development and most of their life. Their crown form or shape appears to be free of influence from neighboring trees.
- 3 Co-dominant: Tree with a crown at the general level of the crown canopy. The crown receives full light from above but little direct sunlight penetrates the sides. Usually these trees have medium-sized crowns and are somewhat crowded from the sides. In stagnated stands, co-dominant trees have small-sized crowns and are crowded on the sides.
- 4 Intermediate: Tree that is shorter than dominants and co-dominant, but the crown extends into the canopy of co-dominant and dominant trees. The tree receives little direct light from above and none from the sides. As a result, intermediates usually have small crowns and are very crowded from the sides.
- 5 Overtopped: Tree with a crown entirely below the general level of the crown canopy that receives no direct sunlight either from above or the sides.

Rate a tree crown in relation to the sunlight received and proximity to neighboring trees.



6.260 COMPACTED CROWN RATIO – Record the COMPACTED CROWN RATIO for each live tally tree, 1.0 in and larger to the nearest 1%. COMPACTED CROWN RATIO is that portion of the tree supporting live foliage and is expressed as a percentage of the actual tree length. To determine COMPACTED CROWN RATIO, ocularly transfer lower live branches to fill in large holes in the upper portion of the tree until a full, even crown is visualized.

When Collected: All live tally trees 1.0 in DBH

Field width: 2 digits

Tolerance: $\pm 10\%$,

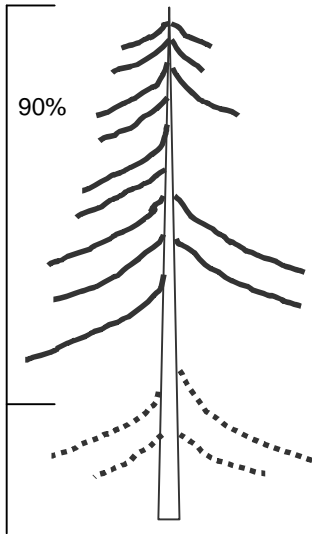
MQO: At least 80% of the time

Values: 00 to 99

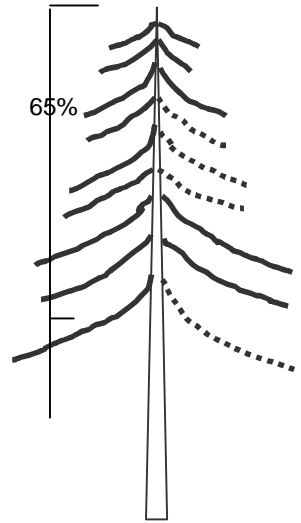
Do not over-compact trees beyond their typical full crown situation. For example, if tree branches tend to average 2-feet between whorls, do not compact crowns any tighter than the 2-foot spacing. See illustrations on the next page.

Open-crown conifer (e.g., white pine) –

Uncompacted:

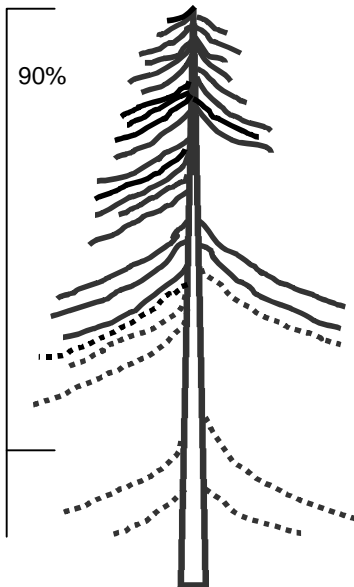


Compacted:

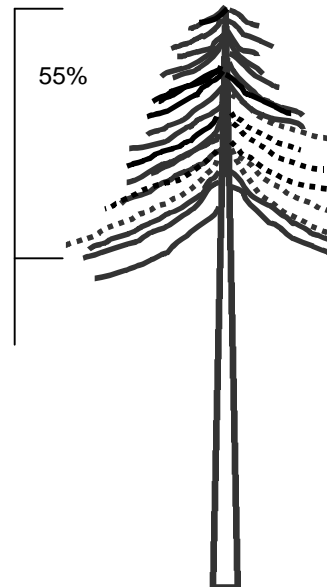


Dense-crown conifer (e.g., balsam fir) –

Uncompacted:



Compacted:



6.264 UNCOMPACTED CROWN RATIO -- Record the UNCOMPACTED CROWN RATIOS to the nearest 1%. UNCOMPACTED LIVE CROWN RATIO is the percentage of total tree height supporting live foliage that is effectively contributing to tree growth. UNCOMPACTED LIVE CROWN RATIO is determined by the ratio of live crown length to top of live crown (Figure 25). **Live crown length is determined from the last live foliage at the crown top (dieback in the upper portion of the crown is not part of the live crown) to the “base of live crown”**. Many times, there are additional live branches below the “base of live crown”. These branches are only included if they have a basal diameter greater than 1 in and are within 5 ft of the base of the obvious live crown. 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.

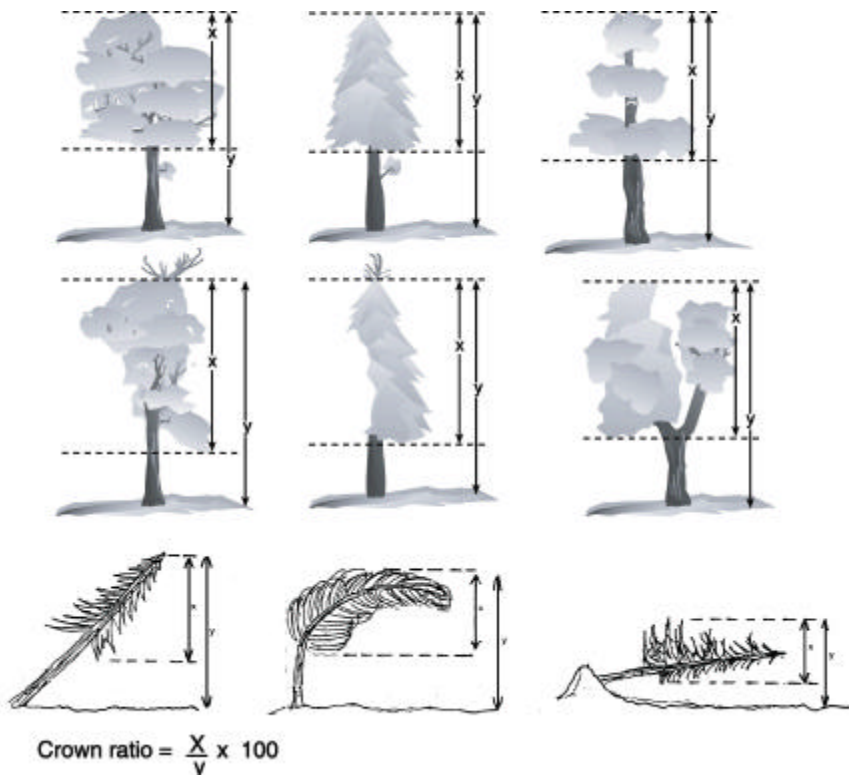


Figure 25. UNCOMPACTED LIVE CROWN RATIO examples

Determine sapling LIVE CROWN RATIO by dividing the live crown length by total tree height to the live crown top. Live crown length is the distance between the top live foliage (dieback and dead branches are not included) and the lowest live twig for saplings. The live crown base for saplings is different from trees 5.0 in DBH and larger; the 1-in/5 ft rule does not apply in this case. Do not include sprigs or leaves on the main stem below the lowest live twig (Figure 26).

When collected: P2 (CORE OPTIONAL) – All live tally trees 5.0 in DBH – **Not collected in ME and PA**; P3 (CORE) – All live tally trees \geq 1.0 in DBH

Field width: 2 digits

Tolerance: \pm 10%

MQO: At least 90% of the time

Values: 00 to 99

NOTE: On P2 plots, the UNCOMPACTED LIVE CROWN RATIO is used only to determine the “base of live crown.” This base is used as the termination of the “upper bole” in tree damage locations. (See Figure 29, page 133.)

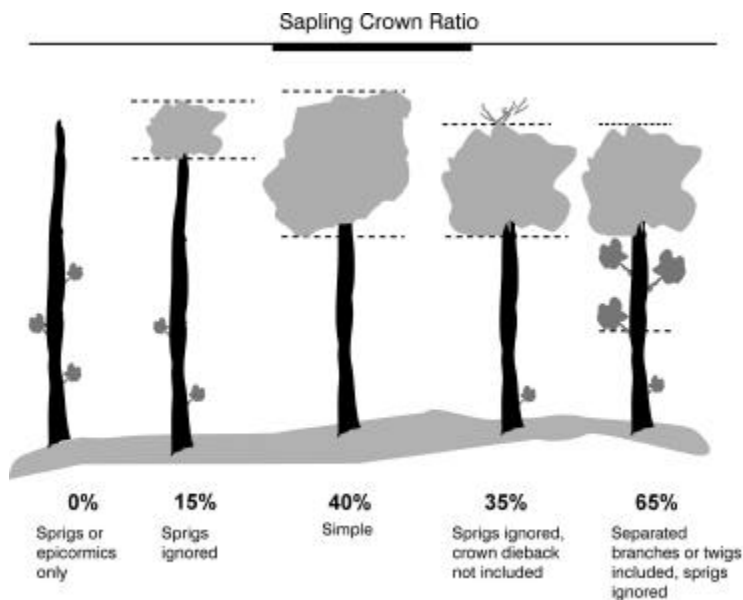


Figure 26. Sapling UNCOMPACTED LIVE CROWN RATIO determination examples.

6.270 CAUSE OF DEATH – Record a cause of death for all trees that have died or been cut since the previous survey on remeasure plots. On new plots, record cause of death for all dead trees. If cause of death cannot be reliably estimated, record unknown/not sure.

When Collected: All dead trees

Field width: 2 digits

Tolerance: No errors

MQO: At least 80% of the time

Values:

- 10** Insect
- 20** Disease
- 30** Fire
- 40** Animal
- 50** Weather
- 60** Vegetation (suppression, competition, vines/kudzu)
- 70** Unknown/not sure/other (include notes)
- 80** Human-caused (cultural, logging, accidental, etc.)
- 90** Physical (hit by falling tree)

TREE DAMAGE

Record up to two different damages per tree. Damage is characterized according to three attributes: location of damage, type of damage, and severity of damage. Damages must meet severity thresholds (defined in variable 6.273, DAMAGE SEVERITY) in order to be recorded.

The tree is observed from all sides starting at the roots. Damage signs and symptoms are prioritized and recorded based on location in the following order: roots, roots and lower bole, lower bole, lower and upper bole, upper bole, crownstem, and branches recorded as location code 0 (for no damage), or DAMAGE LOCATION 1-9.

Within any given location, the hierarchy of damage follows the numeric order of DAMAGE TYPE possible for that location. The numeric order denotes decreasing significance as the code number goes up, i.e., DAMAGE TYPE 01 is more significant than DAMAGE TYPE 25. A maximum of two damages are recorded for each tree. If a tree has more than two damages that meet the threshold levels, the first two that are observed starting at the roots are recorded.

When multiple damages occur in the same place, the most damaging is recorded. For example, if a canker, DAMAGE TYPE 02, meets the threshold and has a conk growing in it, record only the canker. Another example: if an open wound meets threshold and has resinosis, record only the open wound.

6.271 DAMAGE LOCATION 1 -- Record the location on the tree where DAMAGE TYPE 1 is found (Figure 29). If the same damage continues into two or more locations, record the appropriate code listed below, or if the combination of locations does not exist (damage extends from crownstem to roots), record the lowest location that best describes the damage (see Figure 30). Multiple damages may occur in the same location, but record the higher priority damage (lower code number) first. If the damages are coincident (a conk within a canker), record only the higher priority damage.

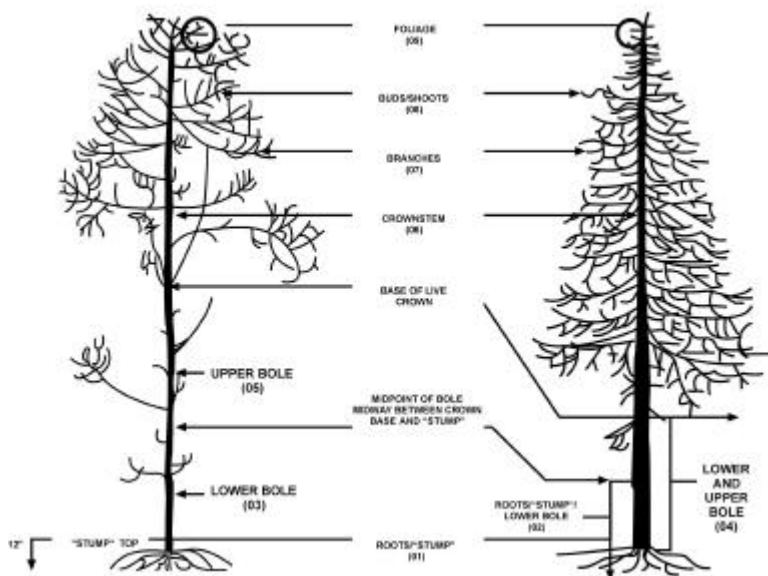


Figure 29. Location codes for damage.

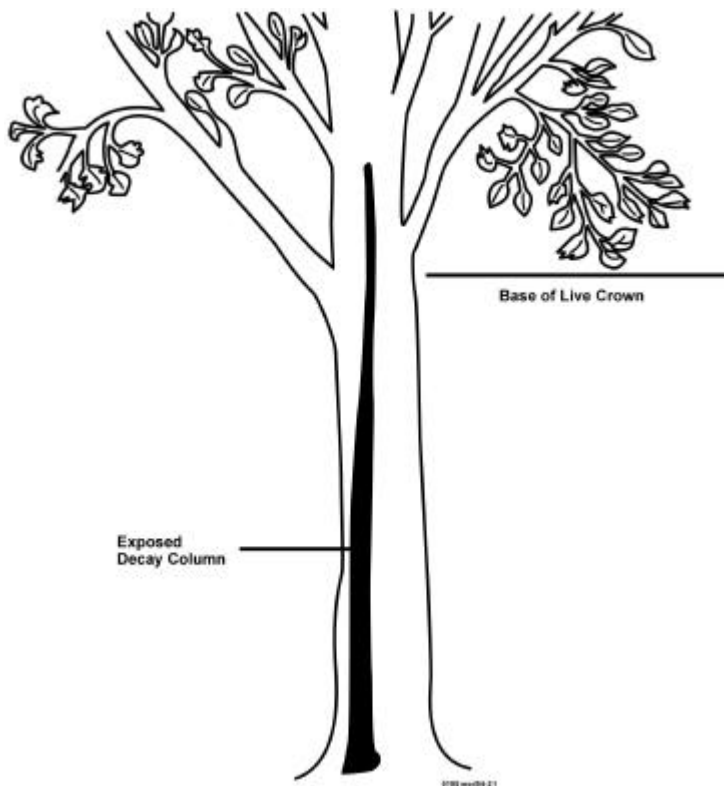


Figure 30. The damage runs from stump to crownstem. Code here should be 02 (roots and "stump" and lower bole) which represents the lowest locations of this multi-location damage.

The "base of the live crown" is defined as the horizontal line which would touch the lowest part of the foliage, excluding branches towards the base of the tree which are less than 1.0 inch or more than 5 ft from the rest of the crown. See variable 6.264 (UNCOMPACTED LIVE CROWN RATIO) for more details.

When Collected: CORE: All live tally trees ≥ 5.0 in DBH

Field width: 1 digit

Tolerance: ± 1 location class

MQO: At least 80% of the time

Values:

- 0 No damage
- 1 Roots (exposed) and stump (12 inches in height from ground level)
- 2 Roots, stump, and lower bole
- 3 Lower bole (lower half of the trunk between the stump and base of the live crown)
- 4 Lower and upper bole
- 5 Upper bole (upper half of the trunk between stump and base of the live crown)
- 6 Crownstem (main stem within the live crown area, above the base of the live crown)
- 7 Branches (>1 in at the point of attachment to the main crown stem within the live crown area)
- 8 Buds and shoots (the most recent year's growth)
- 9 Foliage

6.272 DAMAGE TYPE 1 -- Record the first damage type observed that meets the damage threshold definition in the lowest location. Damage categories are recorded based on the numeric order that denotes decreasing significance from damage 01 - 31.

When Collected: All tally trees where DAMAGE LOCATION 1 > 0

Field width: 2 digits

Tolerance: No errors

MQO: At least 80% of the time

Values:

- 01** Canker, gall: Cankers may be caused by various agents but are most often caused by fungi. The bark and cambium are killed, and this is followed by death of the underlying wood, although the causal agent may or may not penetrate the wood. This results in areas of dead tissue that become deeper and wider, or galling (including galls caused by rusts), on roots, bole, or branches. Due to the difficulty in distinguishing some abnormal

swellings (e.g., burls) from classic galls and cankers, all are recorded as damage 01. A canker may be:

Annual (enlarges only once and does so within an interval briefer than the growth cycle of the tree, usually less than one year),

Diffuse (enlarges without characteristic shape or noticeable callus formation at margins), or

Perennial (enlarges during more than one year - often has a target appearance).

- 02** Conks, fruiting bodies, and signs of advanced decay: Fruiting bodies on the main bole, crownstem, and at the point of the branch attachment are signs of decay. "Punky wood" is a sign of decay and is evidenced by soft, often moist, and degraded tissue.

Cavities into the main bole that are oriented in such a way that they act as catchment basins for water are signs of decay. Bird cavities are signs of decay.

Rotten branches or branches with conks are not indicators of decay unless the threshold is met (>20% of branches are affected).

Rotting stumps associated with coppice regeneration (e.g., northern pin oak, maple) are excluded from coding.

- 03** Open wounds: An opening or series of openings where bark has been removed or the inner wood has been exposed and no signs of advanced decay are present. Improper pruning wounds that cut into the wood of the main stem are coded as open wounds, if they meet the threshold; those which leave the main stemwood intact are excluded.
- 04** Resinosis or gummosis: The origin of areas of resin or gum (sap) exudation on branches and trunks.
- 05** Cracks and seams: Cracks in trees are separations along the radial plane greater than or equal to 5 ft. When they break out to the surface they often are called frost cracks. These cracks are not caused by frost or freezing temperature, though frost can be a major factor in their continued development. Cracks are most often caused by basal wounds or sprout stubs, and expand when temperatures drop rapidly. Seams develop as the tree attempts to seal the crack, although trees have no mechanism to compartmentalize this injury.

Lightning strikes are recorded as cracks when they do not meet the threshold for open wounds.

- 11 Broken bole or roots (less than 3 ft from bole): Broken roots within 3 ft from bole either from excavation or rootsprung for any reason. For example, those which have been excavated in a road cut or by animals.

Stem broken in the bole area (below the base of the live crown) and tree is still alive.
- 12 Brooms on roots or bole: Clustering of foliage about a common point on the trunk. Examples include ash yellows witches' brooms on white and green ash and eastern and western conifers infected with dwarf mistletoes.
- 13 Broken or dead roots (beyond 3 ft): Roots beyond 3 ft from bole that are broken or dead.
- 20 Vines in the crown: Kudzu, grapevine, ivy, dodder, etc. smothers tree crowns. Vines are rated as a percentage of tree crown affected.
- 21 Loss of apical dominance, dead terminal: Mortality of the terminal of the crownstem caused by frost, insect, pathogen, or other causes.
- 22 Broken or dead: Branches that are broken or dead. Branches with no twigs are ignored and not coded as dead. Dead or broken branches attached to the bole or crownstem outside the live crown area are not coded. 20% of the main, first order portion of a branch must be broken for a branch to be coded as such.
- 23 Excessive branching or brooms within the live crown area: Brooms are a dense clustering of twigs or branches arising from a common point that occur within the live crown area. Includes abnormal clustering of vegetative structures and organs. This includes witches' brooms caused by ash yellows on green and white ash and those caused by dwarf mistletoes.
- 24 Damaged buds, foliage or shoots: Insect feeding, shredded or distorted foliage, buds or shoots >50% affected, on at least 30% of foliage, buds or shoots. Also includes herbicide or frost-damaged foliage, buds or shoots.
- 25 Discoloration of foliage: At least 30% of the foliage is more than 50% affected. Affected foliage must be more of some color

other than green. If the observer is unsure if the color is green, it is considered green and not discolored.

- 31 Other:** Use when no other explanation is appropriate. Specify in “General Notes.” Code 31 is used to maintain consistency with the Phase 3 crown damage protocols

Legal Combinations of DAMAGE TYPE by DAMAGE LOCATION

For each of the following location codes, possible damage codes and damage definitions are presented. Minimum damage thresholds are described in variable 6.273, DAMAGE SEVERITY.

Location 1: Roots and stump

- 01 Canker, gall -- exceeds 20% of circumference of stump
- 02 Conks, fruiting bodies, and signs of advanced decay -- any occurrence
- 03 Open wounds -- exceeds 20% of circumference of stump
- 04 Resinosis or gummosis -- origin of flow width exceeds 20% of circumference of stump
- 05 Cracks and seams – 5 ft minimum length
- 11 Broken bole or roots less than 3 ft from bole -- any occurrence
- 12 Brooms on roots or bole -- any occurrence.
- 13 Broken or dead roots -- exceeds 20% of roots, beyond 3 ft from bole, broken or dead
- 31 Other

Location 2: Roots, stump, and lower bole

- 01 Canker, gall -- exceeds 20% of circumference of stump
- 02 Conks, fruiting bodies, and signs of advanced decay -- any occurrence
- 03 Open wounds – exceeds 20% at the point of occurrence, or for the portion in root zone, 20% of the circumference of stump
- 04 Resinosis or gummosis -- origin of flow width exceeds 20% at the point of occurrence, or for the portion in root zone, 20% of circumference of stump.
- 05 Cracks and seams - 5 ft minimum length
- 11 Broken bole or roots less than 3 ft from bole -- any occurrence
- 12 Brooms on roots or bole - -any occurrence.
- 13 Broken or dead roots -- exceeds 20% of roots, beyond 3 ft from bole, broken or dead
- 31 Other

Location 3: Lower bole

- 01 Canker, gall -- exceeds 20% of circumference at the point of occurrence
- 02 Conks, fruiting bodies, and signs of advanced decay -- any occurrence
- 03 Open wounds -- exceeds 20% of circumference at the point of occurrence
- 04 Resinosis or gummosis -- origin of flow width exceeds 20% of circumference at the point of occurrence
- 05 Cracks and seams -- 5 ft minimum length
- 11 Broken bole or roots less than 3 ft from bole -- any occurrence
- 12 Brooms on roots or bole -- any occurrence
- 31 Other

Location 4: Lower and upper bole -- same as lower bole.

Location 5: Upper bole - same as lower bole.

Location 6: Crownstem

- 01 Canker, gall -- exceeds 20% of circumference of crownstem at the point of occurrence
- 02 Conks, fruiting bodies, and signs of advanced decay -- any occurrence
- 03 Open wounds - exceeds 20% of circumference at the point of occurrence -- any occurrence
- 04 Resinosis or gummosis -- origin of flow width exceeds 20% of circumference at the point of occurrence
- 05 Cracks and seams -- all woody locations -- 5 ft minimum length
- 21 Loss of apical dominance, dead terminal -- any occurrence
- 31 Other

Location 7: Branches >1 in at the point of attachment to the main or crown stem

- 01 Canker, gall -- exceeds 20% of circumference on at least 20% of branches
- 02 Conks, fruiting bodies and signs of advanced decay -- more than 20% of branches affected
- 03 Open wounds -- exceeds 20% of circumference at the point of occurrence on at least 20% of branches
- 04 Resinosis or gummosis -- origin of flow width exceeds 20% of circumference at the point of occurrence on at least 20% of branches
- 05 Cracks and seams -- 5 ft minimum length, and on at least 20% of branches

- 20 Vines in the crown -- more than 20% of live crown affected
- 22 Broken or dead -- more than 20% of branches affected within the live crown area
- 23 Excessive branching or brooms -- more than 20% of branches affected
- 31 Other

Location 8: Buds and shoots

- 24 Damaged buds, shoots or foliage - more than 30% of buds and shoots damaged more than 50%
- 31 Other

Location 9: Foliage

- 24 Damaged buds, shoots or foliage - more than 30% of foliage damaged more than 50%.
- 25 Discoloration of foliage - more than 30% of foliage discolored more than 50%.
- 31 Other.

6.273 DAMAGE SEVERITY 1 -- Record a code to indicate the amount of affected area (above threshold) in DAMAGE LOCATION 1 recorded for TREE DAMAGE 1. Severity codes vary depending on the type of damage recorded.

When Collected: All tally trees where DAMAGE LOCATION 1 > 0

Field width: 2 digits

Tolerance: No errors

MQO: At least 80% of the time

Values: The codes and procedures for SEVERITY 1 values are defined for each DAMAGE TYPE 1.

DAMAGE TYPE Code 01 -- Canker, gall

Measure the affected area from the margins (outer edges) of the canker or gall within any 3 ft vertical section in which at least 20% of circumference is affected at the point of occurrence. For location 7, and location 1, 20% of branches and roots beyond 3 ft, respectively, must be affected, then record in 10% classes. See Figure 31.

Severity classes for code 01 (percent of circumference affected):

Classes	Code	Classes	Code
20-29	2	60-69	6
30-39	3	70-79	7
40-49	4	80-89	8
50-59	5	90-99	9

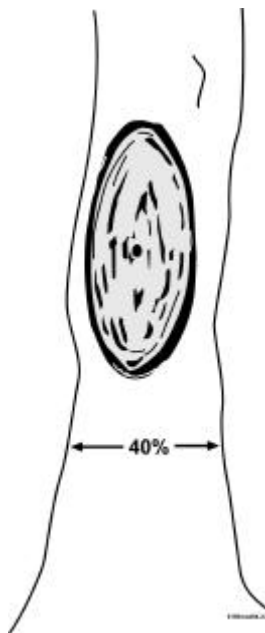


Figure 31. A canker which exceeds threshold. Since 40% of circumference is visible from any side, and since over half the visible side is taken up by the canker, it obviously exceeds the 20% minimum circumference threshold.

DAMAGE TYPE Code 02 -- Conks, fruiting bodies, and signs of advanced decay

Severity classes for code 02: **None**. Enter code 0 regardless of severity, except for roots > 3 ft from the bole, or number of branches affected - 20%

DAMAGE TYPE Code 03 -- Open wounds

The damaged area is measured at the widest point between the margins of the exposed wood within any 3 ft vertical section in which at least 20% of the circumference is affected at the point of occurrence. For location 7, and location 1, 20% of branches and roots beyond 3 ft, respectively, must be affected, then record in 10% classes. See Figure 32.

Severity Classes for code 03 (percent of circumference affected):

Classes	Code	Classes	Code
20-29	2	60-69	6
30-39	3	70-79	7
40-49	4	80-89	8
50-59	5	90-99	9

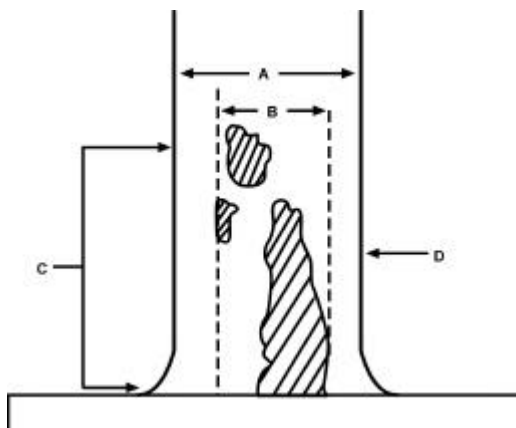


Figure 32. Multiple damage in "stump" and lower bole. A=approximately 40% of tree circumference; B=portion of tree circumference affected by damage; C=vertical distance within one meter; D=midpoint of occurrence at which circumference is measured.

DAMAGE TYPE Code 04 -- Resinosis or gummosis

Resinosis or gummosis is measured at the widest point of the origin of the flow width in which at least 20% of the circumference is affected at the point of occurrence. For location 7, and location 1, 20% of branches and roots beyond 3 ft, respectively, must be affected, then record in 10% classes.

Severity classes for code 04 (percent of circumference affected):

Classes	Code	Classes	Code
20-29	2	60-69	6
30-39	3	70-79	7
40-49	4	80-89	8
50-59	5	90-99	9

DAMAGE TYPE Code 05 -- Cracks and seams greater than or equal to 5 ft

Severity classes for code 05 -- Record "0" for the lowest location in which the crack occurs. For location 7 and location 1, 20% of branches and roots beyond 3 ft, respectively, must be affected, then record in 10% classes.

DAMAGE TYPE Code 11 -- Broken bole or roots less than 3 ft from bole

Severity classes for code 11: None. Enter code 0 regardless of severity.

DAMAGE TYPE Code 12 -- Brooms on roots or bole

Severity classes for code 12: None. Enter code 0 regardless of severity.

DAMAGE TYPE Code 13 -- Broken or dead roots

At least 20% of roots beyond 3 ft from bole that are broken or dead.

Severity classes for code 13 (percent of roots affected):

Classes	Code	Classes	Code
20-29	2	60-69	6
30-39	3	70-79	7
40-49	4	80-89	8
50-59	5	90-99	9

DAMAGE TYPE Code 20 -- Vines in crown

Severity classes for code 20 (percent of live crown affected):

Classes	Code	Classes	Code
20-29	2	60-69	6
30-39	3	70-79	7
40-49	4	80-89	8
50-59	5	90-99	9

DAMAGE TYPE Code 21 -- Loss of apical dominance, dead terminal

Any occurrence (> 1%) is recorded in 10% classes as a percent of the crownstem affected. Use trees of the same species and general DBH class in the area or look for the detached portion of the crownstem on the ground to aid in estimating percent affected. If a lateral branch has assumed the leader and is above where the previous terminal was, then no damage is recorded.

Severity classes for code 21:

Classes	Code	Classes	Code
01-09	0	50-59	5
10-19	1	60-69	6
20-29	2	70-79	7
30-39	3	80-89	8
40-49	4	90-99	9

DAMAGE TYPE Code 22 -- Broken or dead branches (> 1in above the swelling at the point of attachment to the main or crown stem within the live crown area)

At least 20% of branches are broken or dead.

Severity classes for code 22 (percent of branches affected):

Classes	Code	Classes	Code
20-29	2	60-69	6
30-39	3	70-79	7
40-49	4	80-89	8
50-59	5	90-99	9

DAMAGE TYPE Code 23 -- Excessive branching or brooms on branches or crownstem within the live crown area

At least 20% of branches or crown volume must be comprised of brooms.

Severity classes for code 23 (percent of area affected):

Classes	Code	Classes	Code
20-29	2	60-69	6
30-39	3	70-79	7
40-49	4	80-89	8
50-59	5	90-99	9

DAMAGE TYPE Code 24 - Damaged buds, shoots or foliage

At least 30% of the buds, shoots or foliage (i.e., chewed or distorted) are more than 50% affected.

Severity classes for code 24:

Classes	Code	Classes	Code
		60-69	6
30-39	3	70-79	7
40-49	4	80-89	8
50-59	5	90-99	9

DAMAGE TYPE Code 25 - Discoloration of Foliage

At least 30% of the foliage is more than 50% affected.

Severity classes for code 25 (percent affected):

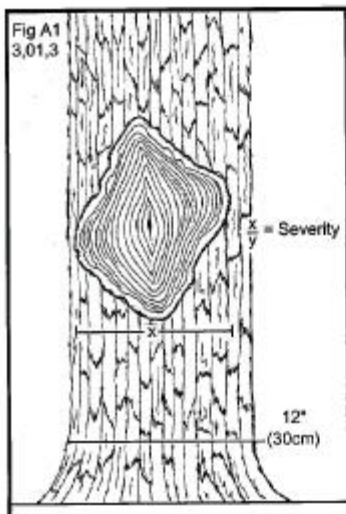
Classes	Code	Classes	Code
		60-69	6
30-39	3	70-79	7
40-49	4	80-89	8
50-59	5	90-99	9

DAMAGE TYPE Code 31 -- Other

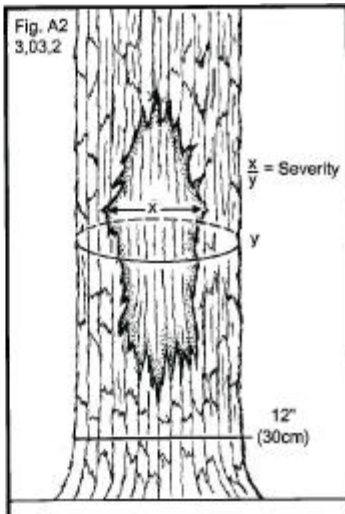
Severity classes for code 31:

None. Enter code 0 regardless of severity. Describe condition in tree notes.

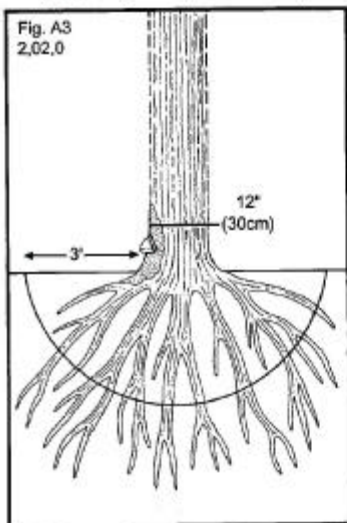
Examples are shown in Figures 33 – 39.



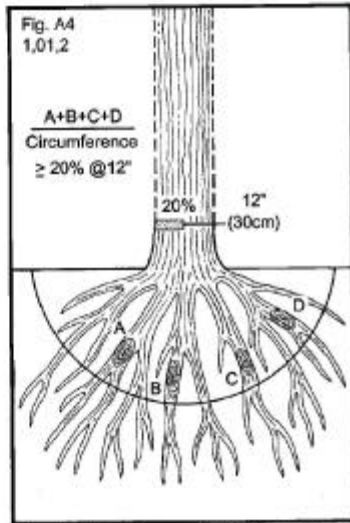
01 - Canker measured as widest distance between the outside of canker swelling (refer to Fig. 2 for y measurement)



03 - Open wound measured at widest point inside of wound margins

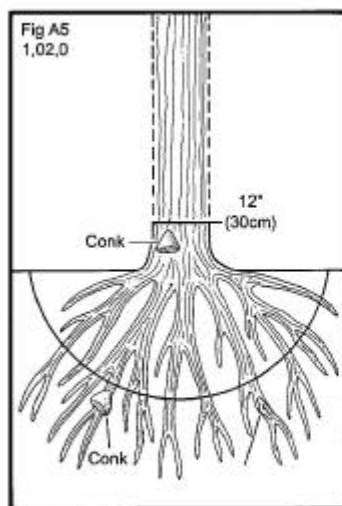


02 - Decay indicator on roots and lower bole

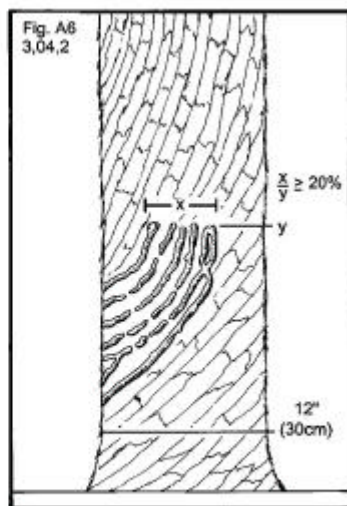


01 - Canker / gall on roots (within 3' of bole)

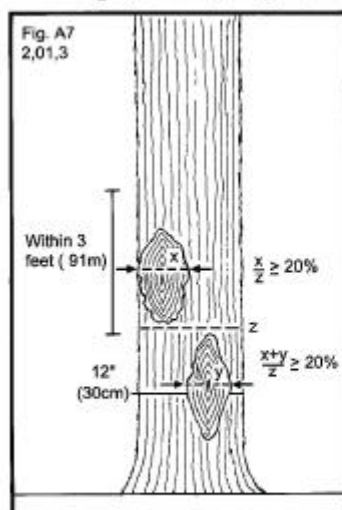
Figure 33. Examples of damage coding.



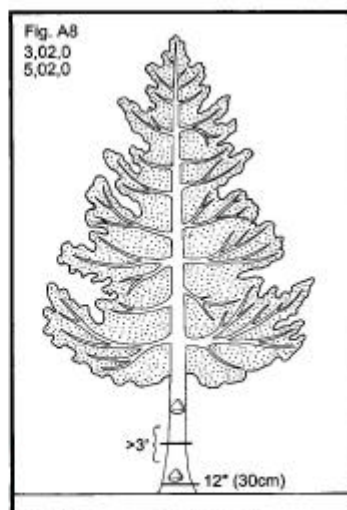
02 - Indicator of decay within 3' of bole. Beyond 3' of bole, indicators must affect $\geq 20\%$ of roots (see fig. 12)



04 - Origin of resinosis in lower bole

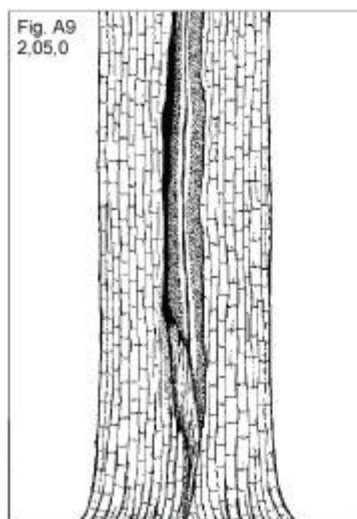


01 - Additive cankers within 3' in roots and lower bole

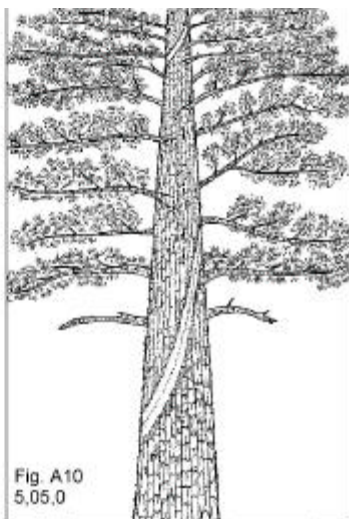


02 - Conks separated by $>3'$; 2 damages

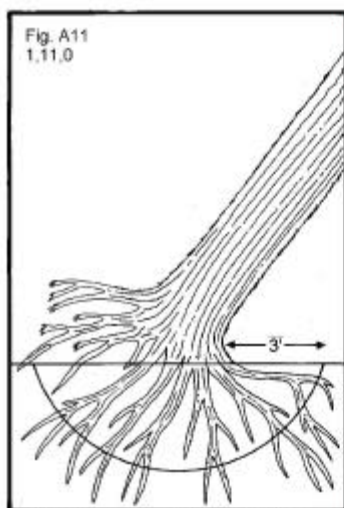
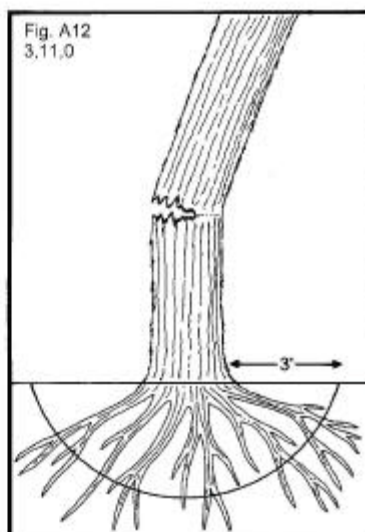
Figure 34. Examples of damage coding.

Fig. A9
2.05,0

05- Cracks and seams

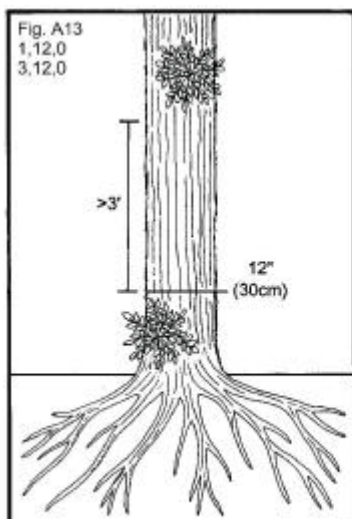
Fig. A10
5.05,0

05 - Lightning strike

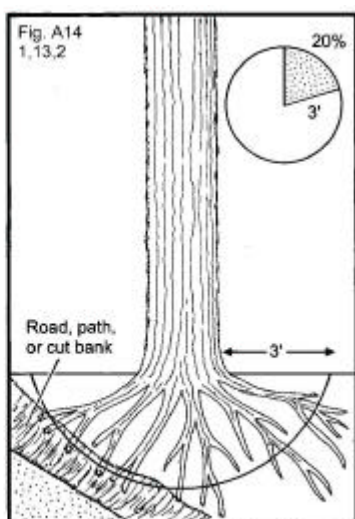
Fig. A11
1.11,011 - Broken bole or roots <3' from bole,
broken roots must be visibleFig. A12
3.11,0

11 - Broken bole or roots <3' from bole

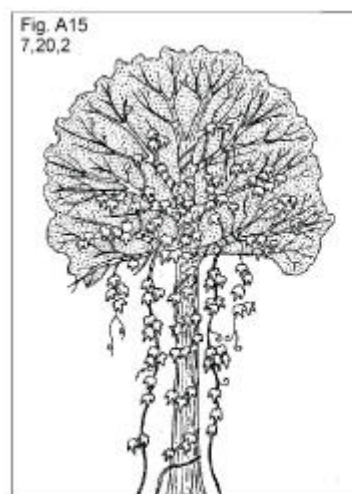
Figure 35. Examples of damage coding.



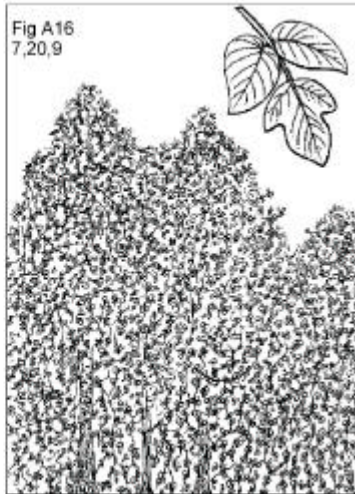
12 - Brooms on roots or bole



13 - Broken or dead roots >3' from bole

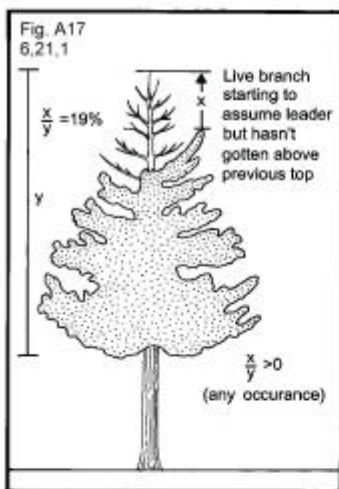


20 - Vines in crown

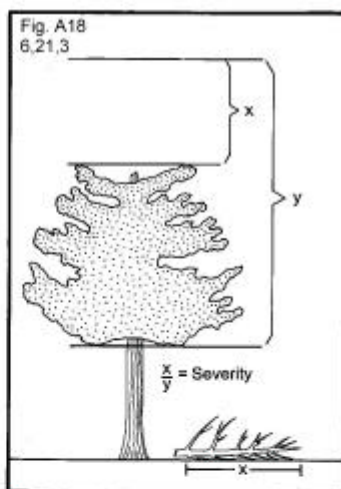


20 - Vines in crown

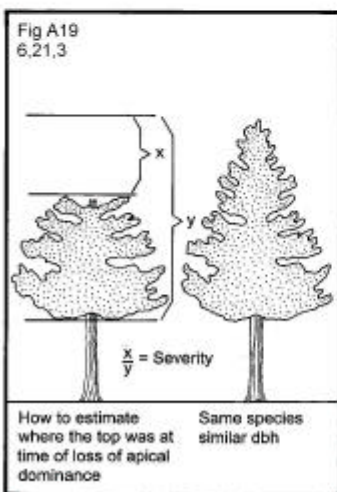
Figure 36. Examples of damage coding.



21 - Loss of apical dominance



21 - Loss of apical dominance, look for old top to estimate the top of x and y



21 - Loss of apical dominance, look for same species of similar dbh

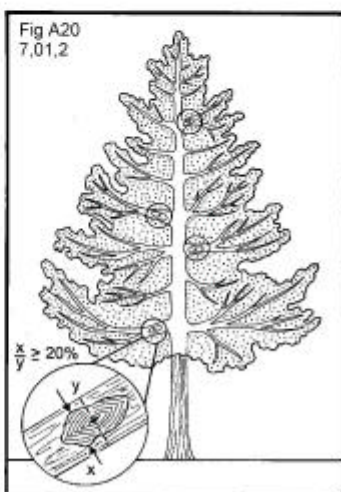
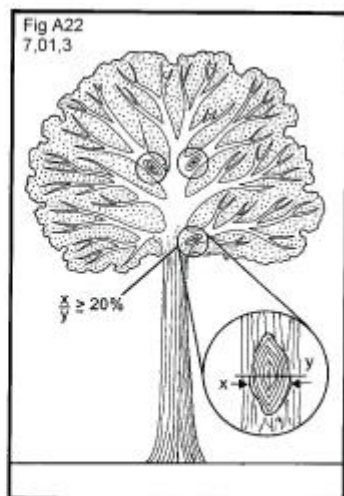
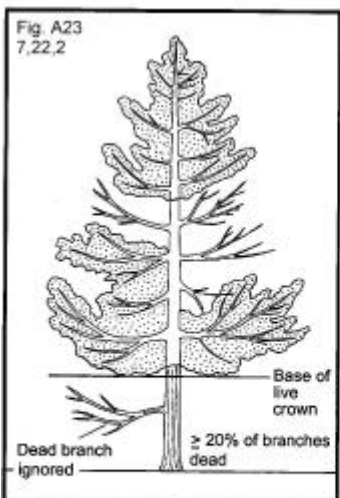
01 - Cankers above the threshold on $\geq 20\%$ of branches

Figure 37. Examples of damage coding.

02 - Cankers on $\geq 20\%$ of branches01 - Cankers above threshold on $\geq 20\%$ of branches

22 - Dead branches within the live crown area. If branches cannot easily be counted, estimate % area of live crown affected

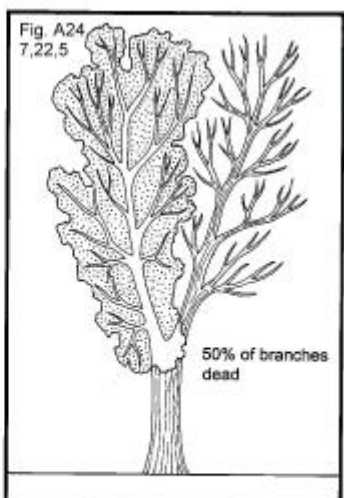
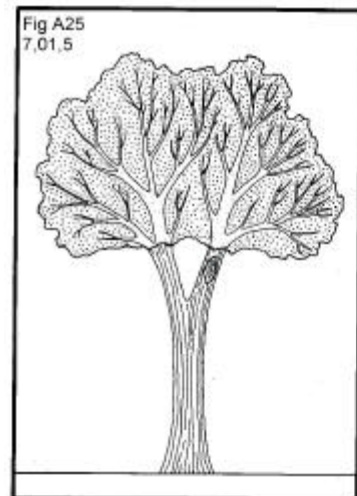
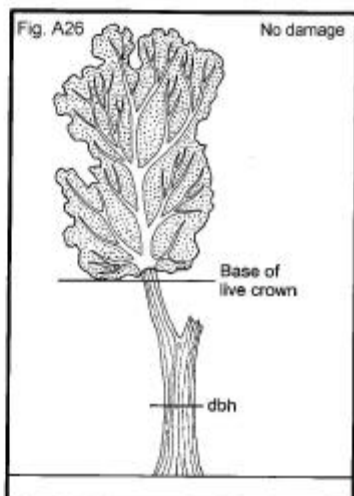
22 - Dead branches; only 2 branches present within live crown area, fines present and $\geq 20\%$ of branch dead

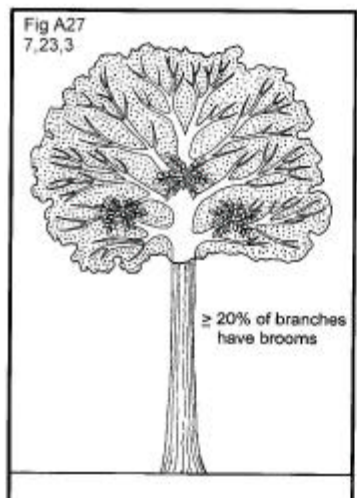
Figure 38. Examples of damage coding.



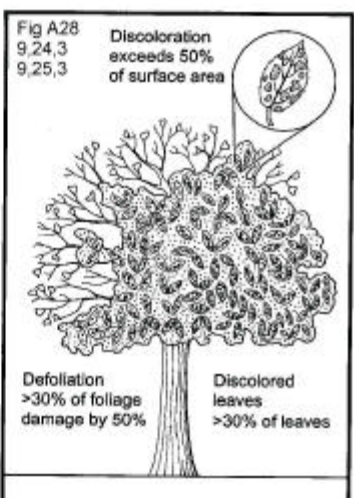
01 - Canker; no crown stem and only 2 branches present



No damage - base of live crown is above old fork, stub is a snag branch



23 - Excessive branching or brooms in crown



24 - Defoliation, 25 - Discoloration

Figure 39. Examples of damage coding.

Procedures to Record Multiple Occurrences of the Same Damage

Damage codes 01 (canker), 03 (open wounds), and 04 (resinosis/gummosis) must meet a threshold of 20 percent of the circumference at the point of occurrence, within any 3 ft section. Multiple cankers or open wounds which are directly above one another pose no more threat to long term tree survival than would a single damage incidence of the same width. However, should multiple damages be located horizontally within any 3 ft section, the translocation of water and nutrients would be significantly affected. The widths of each individual damage are added and compared as a percent, to the total circumference at the midpoint of the 3 ft section (Figure 32).

Procedures to Measure Circumference Affected

A practical approach is to observe every face of the "stump", bole, or crownstem. About 40% of the circumference of a face can be observed at any one time. The damage is measured horizontally between the margins. If the cumulative area affected within a 3 ft section exceeds 1/2 of any face, then the 20% minimum threshold has been met. The percent of the circumference affected by damage is then estimated in 10% classes. If in doubt, measure the damage and circumference at the widest point of occurrence on the bole with a linear tape, and determine the percent affected.

6.274 DAMAGE LOCATION 2 -- Record the location on the tree where TREE DAMAGE 2 is found. Follow the same procedures as for DAMAGE LOCATION 1.

6.275 DAMAGE TYPE 2 -- RECORD the second damage type observed that meets the damage threshold definition in the lowest location. Follow the same procedures as for DAMAGE TYPE 1.

6.276 DAMAGE SEVERITY 2 -- Record the amount of affected area (above threshold) in DAMAGE LOCATION 2 recorded for DAMAGE TYPE 2. Follow the same procedures as for DAMAGE SEVERITY 1.

6.290 TREE CLASS -- This code represents a classification of the overall quality of a tree that is 5.0 inches DBH and larger.

- **Classifies the quality of a sawtimber tree based on the present condition.**
- **Classifies the quality of a poletimber tree as a prospective determination, i.e., a forecast of potential quality when and if the tree becomes sawtimber size.**

When Collected: All live and dead tally trees \geq 5.0 in DBH

Field width: 1 digit

Tolerance: No errors

MQO: At least 90% of the time

Values:

- 1 **Preferred** – **live tree** that would be favored in cultural operations. Mature tree, that is older than the rest of the stand; has less than 20 percent total board foot cull; is expected to live for 5 more years: and is a low risk tree.

The following are offered as general guideline requirements for a preferred tree. Crews may use their discretion in applying the guidelines, except for the first one dealing with damage.

- must be free from “general” damage (i.e., damages that would now or prospectively cause a reduction of tree class, significantly deter growth, or prevent it from producing marketable products in the next 5 years)
- should have no more than 10 percent board-foot cull due to form defect
- should have good vigor, usually indicated by a crown ratio of 30% or more and dominant or co-dominant
- usually has a grade 1 butt log

- 2 **Acceptable** -- this class includes:

- **live sawtimber tree** that does not qualify as a preferred tree but is not a cull tree (see Rough and Rotten Cull)
- **live poletimber tree** that prospectively will not qualify as a preferred tree, but is not now or prospectively a cull tree (see Rough and Rotten Cull)

- 3 **Rough Cull** -- this class includes:
- **live sawtimber tree** that:

currently has 67% or more predominately sound board-foot cull; or does not contain one merchantable 12 ft sawlog or two non-contiguous merchantable 8 ft sawlogs
 - **live poletimber tree** that:

currently has 67% or more predominately sound cubic-foot cull;

or

prospectively will have 67% or more predominately sound board-foot cull; or will not contain one merchantable 12 ft sawlog or two non-contiguous merchantable 8 ft sawlogs
- 4 **Rotten Cull** – this class includes:
- **live sawtimber tree** that currently has 67% or more predominately unsound board-foot cull
 - **live poletimber tree** that:

currently has 67% or more predominately unsound cubic-foot cull;

or

prospectively will have 67% or more predominately unsound board-foot cull
- 5 **Dead** -- **tree that has recently died** (within the last several years); but still retains many branches (including some small branches and possibly some fine twigs); and has bark that is generally tight and hard to remove from the tree.
- 6 **Snag** -- **dead tree, or what remains of a dead tree, that is at least 4.5 ft tall and is missing most of its bark.** This category includes a tree covered with bark that is very loose. This bark can usually be removed, often times in big strips, with very little effort. A snag is not a recently dead tree. Most often, it's has been dead for several years -- sometimes, for more than a decade.

6.300 Merchantability Class -- This variable classifies a sawtimber and poletimber tree on the basis of the relative amounts of sound and unsound cull present (board-foot cull for a sawtimber tree, and cubic-foot cull for a poletimber tree).

When Collected: All live and dead tally trees ≥ 5.0 in DBH

Field width: 1 digit

Tolerance: No errors

MQO: At least 90% of the time

Values:

- 0** no cull (0-3%)
- 1** cull that is present is predominantly **sound** cull
- 2** cull that is present is predominantly **unsound** cull

NOTE: The combinations of Tree Class 3 with Merch Class 2, and Tree Class 4 with Merch Class 1 are illegal for sawtimber.

6.310 DECAY CLASS -- Record for each standing dead tally tree, 5.0 inches in diameter and larger, the code indicating the tree's stage of decay.

When Collected: All dead tally trees ≥ 5.0 in DBH

Field width: 1 digit

Tolerance: ± 1 class

MQO: At least 90% of the time

Values: Use the following table for guidelines:

NOTE: The table on the next page shows characteristics for Douglas-fir. Dead trees of other species may vary somewhat. Use this only as a guide.

DECAY CLASS

Decay stage (code)	Limbs and branches	Top	% Bark Remaining	Sapwood presence and condition*	Heartwood condition*
1	All present	Pointed	100	Intact; sound, incipient decay, hard, original color	Sound, hard, original color
2	Few limbs, no fine branches	May be broken	Variable	Sloughing; advanced decay, fibrous, firm to soft, light brown	Sound at base, incipient decay in outer edge of upper bole, hard, light to reddish brown
3	Limb stubs only	Broken	Variable	Sloughing; fibrous, soft, light to reddish brown	Incipient decay at base, advanced decay throughout upper bole, fibrous, hard to firm, reddish brown
4	Few or no stubs	Broken	Variable	Sloughing; cubical, soft, reddish to dark brown	Advanced decay at base, sloughing from upper bole, fibrous to cubical, soft, dark reddish brown
5	None	Broken	Less than 20	Gone	Sloughing, cubical, soft, dark brown, OR fibrous, very soft, dark reddish brown, encased in hardened shell

6.320 UTILIZATION CLASS -- Record the code to identify cut trees that have been removed from the site.

When Collected: **(This field is not required. It will be generated during data processing.)**

Field width: 1 digit

Tolerance: No errors

MQO: At least 99% of the time

Values:

- 0** Not utilized - can still be found on the site
- 1** Utilized – some portion of the tree cannot be found on site, assumed to have been removed

6.330 PREVIOUS DBH -- This is the DBH assigned at the previous inventory. Any change made to this field signifies an error at the time of the previous inventory. Variable 6.155 DIAMETER CHECK should be coded 2 and an explanation is required in the notes if PREVIOUS DBH is changed.

When Collected: All remeasured trees

Field width: 3 digits

Tolerance: No errors

MQO: At least 99% of the time

Values: Copy directly from previous records

6.340 PREVIOUS TREE CLASS / MERCHANTABILITY CLASS -- Transfer the TREE CLASS and MERCHANTABILITY CLASS information recorded at the previous occasion from previous tally sheets.

When Collected: All remeasured trees

Field width: 2 digits

Tolerance: No errors

MQO: At least 99% of the time

Values: Copy directly from previous records

6.350 NOTES -- This three-digit field can be used to record common items of interest about the tree being tallied. Each note is one character long. Enter up to three notes per tree. Additional tree notes may be recorded in the "General Notes."

When Collected: All tally trees ≥ 1.0 in DBH

Field width: 3 digit

Tolerance: N/A

MQO: N/A

Values:

- 0** No notes
- 1** Witness tree
- 2** High DBH – above 4.5 ft
- 3** Low DBH – below 4.5 ft
- 4** Abnormal DBH
- 5** Metal (wire, nails, etc.) in butt log
- 6** Species misidentified at previous occasion
- 7** One of a clump of two, or more, trees (i.e., fork occurs below 4.5 ft)
- 8** Fork (i.e., occurs above 4.5 ft), crook, or split in the first sixteen feet
- 9** Not listed, see General Notes for details

