

Virginia Tech Biomass Sampling Protocol for Conifers – White Pine – 1/21/2013

Tree Location and Plot Measurements

For each destructively sampled tree, a 24' radius circular plot centered around the subject tree is established, and the diameter at breast height (DBH), total height, and species of all trees ≥ 4 " DBH are determined. Additionally, the distance and direction (azimuth) from the subject tree to each tree in the plot is also measured.

Standing Tree Measurements

These measurements are taken on standing conifers

Tree – The following measurements are taken on the standing tree:

1. Total tree height (0.1') determined using the Criterion RD 1000.
2. Diameter at breast height using a D-tape.

Crown - The following measurements are taken on the crown of standing conifers:

1. Canopy class - (open-grown, dominant, co-dominant, intermediate, suppressed)
2. Crown Width – Two measurements of crown width are taken: (1) at its widest point, and (2) at a 90° angle to the first measurement. Both measurements are taken using the TruPulse 360° Rangefinder's HD_ML function.

Main Stem – The following measurements are taken on the main stem of standing conifers:

1. Diameter (0.1") at stump height (0.5'), 2.5', 4.5', 8', and then at 4' intervals until the main stem is no longer visible or cannot be measured. Diameters are measured with both the Criterion RD 1000 and Haglof Gator Eyes. The height where the diameter is measured is determined using the Criterion RD 1000.
2. Additional main stem diameters and heights:
 - a. Diameter at 17.3' (Girard Form Class Height).
 - b. Diameter at $\frac{1}{2}$ of the total height of the tree (Hossfeldt's diameter).
 - c. Diameter and height at the base of the live crown.
 - d. Height to 8" top (if applicable).
 - e. Height where the stem diameter is $\frac{1}{2}$ of DBH (Pressler's height).

Felled Tree Measurements

These measurements are taken on trees after they have been felled.

Tree – Total tree height (0.1') of the felled tree determined using a tape measure.

Crown – Crown Width (0.1') measured on felled trees by taping level with the ground, extending the tape across the width of the crown at its widest point.

Main Stem – The following measurements are taken on the main stem of felled conifers:

1. Diameter (0.1") at stump height (0.5'), 2.5', 4.5', 8', and then at 4' intervals until reaching the tip of the main stem.
2. Additional main stem diameters and heights:
 - a. Diameter at 17.3' (Girard Form Class Height).
 - b. Diameter at $\frac{1}{2}$ of the total height of the tree (Hossfeldt's diameter).
 - c. Diameter and height at the base of the live crown.
 - d. Height to 8" top (if applicable).
 - e. Height where the stem diameter is $\frac{1}{2}$ of DBH (Pressler's height).

Branches – The following procedure is for all primary branches $\geq 0.1''$:

1. Number of dead branches, small branches (defined as $< 0.5''$), and large branches (defined as $\geq 0.5''$) per 4' section.
2. All dead branches in a section are then compiled to be dried together.
3. Two small branches and two large branches are then selected per 4' section: one small and one large branch from near the bottom of the section, and one small and one large branch from near the top of the section. The basal diameter and total length of each branch is measured, and the height where the branch attaches to the main stem is also recorded. These branches are then bagged and dried separately.
4. All remaining small branches are then compiled and dried together, as are all remaining large branches.
5. Branch wood, bark, and foliage are then dried at 65°C until a constant weight is reached.

Dissected Tree Fresh Measurements

Stem Sections - Stem sections are numbered consecutively starting with the first section above the stump. The large end of the section is marked with a black lumber crayon to

avoid confusion while processing. The following measurements are then recorded from each stem section:

1. Length (0.01') determined using a tape measure.
2. Diameter outside bark (0.1") of the bottom/lower end of the stem section. To account for stem eccentricity, one caliper reading is taken across the largest diameter of the section end and a second at a right angle to the first, and then averaged.
3. Diameter outside bark (0.1") of the top/upper end of the stem section. To account for stem eccentricity, one caliper reading is taken across the largest diameter of the section end and a second at a right angle to the first, and then averaged.
4. Green weight (in pounds) measured to at least 3 significant digits. If a section is too light to have three significant digits (for example, a less than 10 lb section weighed using a scale that is accurate to the nearest 0.1 lb), the entire section is brought back and then dried.

Stem Disks – Two disks (1" to 3" thickness; labeled 'A' and 'B') are cut from the bottom of each stem section to determine dry-to-green weight ratios, bark-to-wood ratios, and basic density measurements. Saw-kerf loss is also determined when cutting the disks (see 'Kerf Weight' below).

The following measurements are then taken for each stem disk:

1. Midpoint green diameter, large axis, measured with calipers (0.1 cm).
2. Midpoint green diameter, 90° from large axis, measured with calipers (0.1 cm).
3. Disk thickness (0.1 cm) average of four caliper measurements spaced uniformly around the disk circumference.
4. Green weight (0.1 g) of entire disk (wood and bark).
5. Interior defect diameters are measured across the cut surface in two or more directions, the average of which is recorded and classified as 1) sound, 2) unsound, or 3) hollow.

Fresh Bark Measurements – These measurements provide a means to develop estimators of green bark weight and volume. The bark is removed using a chisel as soon as possible after felling. The following measurements are then taken:

1. Inside-bark midpoint diameter, large axis, measured with calipers (0.1 cm).
2. Inside-bark midpoint diameter, 90° from large axis, measured with calipers (0.1 cm).
3. Fresh bark weight (0.1 g).
4. Wood-only green weight (0.1 g).

5. Disk wood and bark are then dried at 100°C until a constant weight is reached.

Kerf Weight – This procedure is designed to account for biomass lost during the dissection of the tree. Saw kerf weight loss is measured by subtracting stem weight sections before and after cutting disks, and dividing by the number of cuts made. The following weight measures and calculations are made:

1. Denote stem section green weight as GW_1 .
2. Following the cutting of disks, weigh the remaining stem section(s) and disks together, denoted as GW_2 .
3. Denote the number of cuts made as k .
4. Compute the average kerf weight loss as $KW = \frac{GW_1 - GW_2}{k}$
5. Record the diameter (0.1") of the stem where the cuts were made.
6. Record the chainsaw chain width or relevant specifications (pitch/gauge/cutter type).

Dry Weight Measurements

Dry weight measurements are recorded in the same units and same decimal precision as the green weights.

Branches - After a constant weight as been reached, needles are separated from the small twigs and branches to determine foliage weight. The four branches that were selected for detailed measurements (see 'Felled Tree Measurements: Branches' in this document) are weighed individually and then added to the composite branches from each 4' section to obtain the total branch wood/bark and foliage per section.

Stem Disks – The dry-weight to green-weight ratio obtained from each disk is used to determine the dry weight of each stem section. The bark-to-wood ratio is used to determine the weight of bark and of wood-only for each stem section.