

Protocol for repeated observations of target trees

CTFS Global Forest Carbon Research Initiative
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Introduction

Hundreds of trees are equipped with dendrometers in sub-plots within CTFS plots (e.g. 100 sub-plots of 40 m x 40 m in a plot of 50 hectares). The dendrometers are read twice a year (see another protocol on this). During these same visits the technician carries out also the protocol described in this document to quantify production and decomposition of coarse woody debris (diameter above 100 mm) and volume of snags.

The preparatory tasks and inventory of snags

Equipment needed:

- 1) Compass
- 2) Rangefinder / Clinometer
- 3) Diameter tape
- 4) Decaymeter
- 5) Small hammer
- 6) Nails (approximately 100 mm long, various tops forms and sizes)
- 7) Paint (various bright colors)
- 8) An instrument to smear paint (stripe width 10-30 mm)
- 9) Sheet holder
- 10) Forms
- 11) Pencil

The preparatory tasks are carried out at the same time when the dendrometers are read the first time commonly a few months after their installation.

Mark all pieces of woody debris with a diameter of at least 100 mm within the sub-plots. In addition, mark pieces of woody debris outside the sub-plot beneath the canopies of dendrometer-trees having their base in the subplot. This possibly includes pieces up to 15 m outside the borders of the sub-plot. Paint stripes parallel to the central axis of the piece of woody debris with a color used only for this purpose. Drive a nail vertically to the highest point of the cross section approximately 1 m from the end at the direction towards the base when the piece was part of a living tree so that only the top remains out of the piece of woody debris.

At the same time with the preparatory tasks for the repeated inventories an inventory of snags (standing dead trees) is carried out. Use the definition of the plot in question to determine whether the tree is dead or living. A dead tree is a snag if it is not fallen i.e. supported by its upper parts of stem or branches touching the ground) and the base of its stem has not moved more than 1 m (Fig. 1). Measure the diameter at breast height with a diameter tape and if the stem is broken (height less than for a typical living tree) its height with rangefinder or clinometer of all standing dead trees above 1.3 m height and with a diameter at breast height of at least 100 mm from the sub-plots (40 m x 40 m) used (Fig. 2). In addition locate stumps (snags with a height less than 1.3 m and volume estimated with plain eye to be more than 10 liters) from the sub-plots and measure their height with the diameter tape (use the side with a mm-scale and not the side used for measuring circumference) and diameter from approximately 45 % of the total height (e.g. from 0.45 m height from a stump 1.0 m height; this will give approximately the correct volume for both cones and cylinders when volume calculated with the equation of cylinder). For snags of all heights measure the stage of decay with a decaymeter inserted horizontally at the height of the diameter measurement on the southern side of the snag.

Repeated inventories

Equipment needed:

- 1) Compass
- 2) Diameter tape (for pieces larger than 1250 mm)
- 3) Decaymeter
- 4) Metal labels
- 5) Measuring tape (e.g. 20 m)
- 6) Large caliper (0-1270 mm)
- 7) Large modified caliper (0-1270 mm)
- 8) Sheet holder
- 9) Forms
- 10) Pencil

Carry out the first inventory approximately six months after the marking of woody debris as part of the preparatory tasks in each sub-plot. Locate all new pieces of woody debris with a diameter of at least 100 mm at least in some part of the piece. For the repeated inventories a piece of woody debris is non-branching and only the largest section is continuation of the same piece (Fig. 3). For all new pieces of woody debris (either fallen from a living tree or tree dying as it falls) identify by looking in the canopy whether the piece is from a tree with a dendrometer. If not, mark it in the same way as when marking woody debris as part of the preparatory tasks using the same color and top of nails. If yes, identify the end that was closer to the base of the stem (or for branches the base of the branch) when the tree was living.

Measure the diameter with a caliper and the height with a modified caliper at 1.3 m, 4.3 m and thereafter every 3 m starting from the end that was closer to the base until the

diameter is less than 100 mm and the piece does not seem to thicken to over 100 mm anymore. In addition to the measurement points with dimensions over 100 mm record the dimensions at the first point with diameter below 100 mm. Measure the diameter in the same way as in the one-time inventory of woody debris. However, measure the height perpendicularly to central axis and not vertically as in the one-time inventory. Measure the distances from the base (0.3 m, 1.3 m etc.) with the measuring tape along the piece of woody debris (bending the tape if the piece bends). In addition to dimensions, measure the stage of decay at the same locations with a decaymeter inserting the instrument perpendicularly to the central axis of the piece at the highest point of the cross section. Mark the locations for measurements with nails (different top in each inventory) and paint (different color in each inventory) with stripes around the piece (as opposed to stripes parallel to the central axis in preparatory tasks). Do not mark the measurement points with a diameter of less than 100 mm as these will not be remeasured. Put a label in the point of 1.3 m indicating the tree from which the piece came from and the number of the inventory when it was found.

In subsequent surveys remeasure the same pieces in the same locations and drive in new nails and apply new paint (different nail tops and paint color). Of the earlier nails drive in deeper with a hammer only the nail with the label. Carry out measurements in same locations (except those with a diameter of less than 100 mm) until the piece of woody debris disappears in that location or its diameter becomes less than 20 mm. If the piece breaks into two or more pieces this does not influence remeasuring unless the breaking happens parallel to the central axis. If this is the case measure all the pieces separately. For example if a piece splits into half into pieces not attached together at the location measure both halves with a caliper and modified caliper.

When a tree with a dendrometer dies standing its decomposition while standing is followed. In each inventory measure the diameter at 1.3 m and the stage of decay using a decaymeter on the southern side. In addition observe the stem and if its height is less than for a typical living tree measure it with a rangefinder or clinometer.

When a tree with a dendrometer dies standing or the falling causes the dying the cause of death is estimated based on the following classification (up to three causes can be selected):

- 1) Drought
- 2) Flood
- 3) Forest fire
- 4) Uprooted because of wind
- 5) Stem broken because of wind
- 6) Uprooted because wind falling neighboring trees
- 7) Stem broken because of wind falling neighboring trees
- 8) Lightning strike
- 9) Suppression by woody climbers
- 10) Suppression by a strangler fig
- 11) Competition by neighboring trees
- 12) Pathogens and herbivores

13) Other

14) Unknown



Fig. 1. This hanging dead stem is not snag as it is not anymore in its original location. It is excluded also from the inventory of fallen woody debris. In addition, dead branches still in their original location are not included in either of the inventories.



Fig. 2. Measure the height of snags from the top (marked with a blue line).



Fig. 3. Portions A and B are considered to be different pieces of woody debris in the repeated inventories. When a piece of woody debris forks the thicker branch is part of the branch closer to the base. Note that the portion of piece A shown with the green arrow is part of piece A and should be included in measuring the dimensions (depending on the location of the measurement point). The woody debris beyond the blue arrow is part of A as the fibers keep the parts together and if one would pull from the base the part beyond the blue arrow would remain attached.