Measuring the Growth of Trees

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This method describes how to equate tree growth into the same terms used to measure the growth of grasses and forbs; that is, to reduce all measurements to reflect the average annual growth in pounds per acre air-dried. By being able to measure the average annual growth of all types of vegetation in pounds per acre air-dried, it is possible to inventory and describe all natural plant communities, whether they occur as grasslands, forests, or savanna by the following criteria:

1. Kind of vegetation—the different number of species growing in a plant community.
2. Proportion of the total composition of all species in the plant community based on pounds per acre of air-dried material.
3. Average annual production per acre of the total biomass of the plant community.

Heretofore, tree growth has been measured and expressed in terms such as poles, site indices, cords, saw logs, and posts. While grass and forb production has been measured in pounds, grams, and tons, this method makes it possible to measure the average annual production of both trees and grass in pounds per acre. Being able to equate production of all types of vegetation to one common denominator not only simplifies procedures for inventorying natural plant communities but provides more usable information for resource planning than was being obtained when separate inventories were being made of the overstory or understory of savanna and forest ecosystems.

The inventory procedure used to collect the necessary data to calculate the average annual growth of trees in pounds per acre air-dried is a simple and rapid method to use. It is based primarily, upon the zig-zag transect method developed by Lloyd (1973) for inventorying woodlands for conservation planning.

How to Use a Zig-Zag Transect

The following is a brief explanation of how to use the zig-zag transect method for inventorying trees. Like any field method for inventorying vegetation, the reliability of the data collected will depend on the care and wisdom exercised in selecting the study area. The location selected to take a transect should be representative of the entire plant community. Transitions or ecotones between plant communities, disturbed areas or isolate colonies of any particular species should be avoided if at all possible in making the selection.

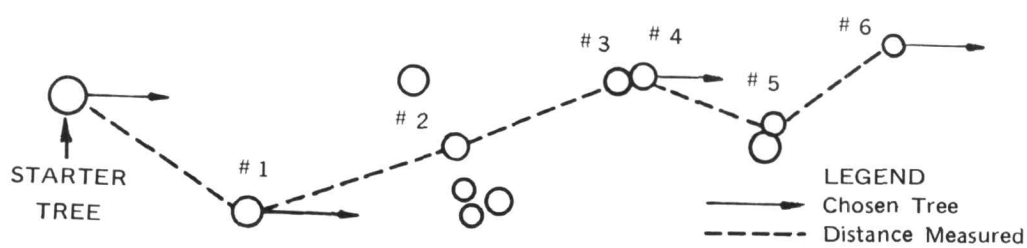
Once the general location has been selected, the person collecting the data must decide on the exact location from which to start and the direction to go to get the best possible data from the zig-zag transect. A tree should be selected from which to start the transect. The chosen line of travel from the starter tree should be toward a visible marker. On a clear day, the sun is a convenient directional marker, because each tree will cast a shadow.

With his back against the starter tree, facing the chosen direction of travel, the person then places his heels together with feet making a 90° angle. The closest tree within the 90° angle projected by the feet is selected as the first tree to be measured on the transect. This process is repeated at tree number 1 to selected tree number 2 and so on until at least 20 trees have been selected and measured, as illustrated. It takes about one hour to measure 20 trees along a zig-zag transect.

When several species are involved or a savanna is being inventoried, the transect should be extended over a long enough distance to obtain an adequate sample.

Individual Tree Measurements

There are a minimum number of individual tree measurements that must be taken in order to calculate the total biomass of trees in any plant community. Once the total biomass is determined, then it is a simple mathematical procedure to reduce it to average annual production per acre air-dried. The following are the kind of



How to select trees to measure along a zig-zag transect.

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measurements to be taken, how to take them, and the units of measure:

1. Measure only the diameter of cone-shaped tree trunks at breast height. (D.b.h.). This measurement can be taken to the nearest inch with a woodland information stick or with a diameter tape. Because a cone-shaped tree tapers to 0 at the top, the only other measurement taken is the height of the trunk or in this case, the height of the tree.

2. Measure the D.b.h. and top diameter of paraboloid-shape tree trunks in inches. These are tree trunks that terminate or divide into several large branches. The top diameter is usually estimated based upon the taper and length or height of the trunk. The height of the trunk is recorded in feet. A woodland information stick can be used to measure the diameter and height of a paraboloid tree trunk.

3. Measure the length of the crown with a woodland information stick in feet. Divide this measurement by the height or length of the tree trunk. The answer is in percent.

4. The distance between trees is measured to the nearest foot by pacing.

5. The age of each species is determined after all trees measurements have been taken and the average size tree has been determined. The age of a tree is measured by taking a boring at breast height with an increment bore. The number of rings plus the number of years it takes a tree to grow to a height of 4 feet is the age of the tree.

Volume of Biomass per Acre

The total biomass, above-ground, for individual trees is the sum total of the volume in cubic feet of material in the trunk plus the volume in cubic feet of material in the branches, twigs and leaves. The total biomass per acre is computed by calculating the biomass for an average size tree times the number of trees per acre. Different formulas must be used to calculate the volume of different shaped tree trunks.

The biomass in the crown of a tree is estimated to be in direct proportion or ratio of the volume of material in the trunk. The ratio is based on the length of the crown to the length of the trunk. For example, a cone-shaped trunk 60 feet tall with a 13-inch D.b.k. has 18 cubic feet of biomass in it. If the length of the crown on that same tree is 20 feet, then the estimated biomass in the crown would be 6 cubic feet or ⅓ as much as in the trunk because the crown is ⅓ as long as the trunk. Or, if there is 4 cubic feet in a paraboloid shaped trunk that is 20 feet tall and the length of the crown is 40 feet, the estimated biomass in the crown would be 8 cubic feet because the crown is twice as long as the trunk.

Number of Trees per Acre

The average number of trees per acre in any given plant community can be determined from a zig-zag transect. The total length of the transect divided by the number of trees measured equals the average distance between trees. Divide the number of square feet in an acre, which is 43,560, by the square of the average distance between trees. The answer is the number of trees per acre.

Converting Biomass into Annual Production per Acre

The initial measurement of tree biomass is measured in cubic feet. The number of cubic feet of biomass is measured in cubic feet. The number of cubic feet of biomass in an individual tree multiplied by the weight per cubic foot equals pounds per tree. This figure multiplied by the number of trees per acre equals the total pounds of tree biomass per acre. The biomass of different trees has different specific gravity. Therefore, it is important to know both the green and dry weight per cubic foot of biomass for the major species within a given region.

The *average annual growth* is determined by dividing the total pounds of biomass produced per tree or per acre of an individual species in terms of green or dry weight by the average age. The answer is the average amount of biomass, in pounds, produced annually.

Once the average annual production has been determined for each of the major tree species and/or grasses, and forbs in the understory, percent composition of the most important species growing in a particular plant community can be determined by dividing the average annual production per acre of the entire plant community into the average annual production per acre of each species.

Author's Note: This is a breakthrough for describing the composition of a total plant community on a common denominator. It is a method that could be used to evaluate wildlife habitat and could be useful in evaluating fuel volumes (tons per acre) on brushlands with scattered trees.

For further detailed information on how to use the zig-zag transect method and how to obtain work sheets for field use contact the Soil Conservation Service Technical Center, Box 6577, Ft. Worth, Texas 76115.

Bison Workshop

A workshop on the management of grasslands for the American buffalo and the mangement of the buffalo itself will be held April 10-12 at the Hilton Inn in Salina, Kans. Headquartered at the Hilton Inn, the workshop is cosponsored by the Kansas Game and Fish Commission and the K-O Section, SRM. For information, contact: *Bison Management Workshop, PO Box 489, Concordia, Kans. 66901 (913) 243-3857.*