



Forestry Resource Manual

*Adapted from North Carolina Envirothon Forestry Resource Manual
Revised July 2018*

Delaware Envirothon Forestry Learning Objectives

Students must be able to...

A. Understand the historical roles of forests in society

1. Know the historical role and importance of forests
2. Explain the various benefits of trees and ecological roles of forests
3. Explain the importance of trees in urban areas and aspects of urban forestry
4. Understand forest land use and ownership in Delaware
5. Know the economic value of forests and the many products they provide

B. Understand and describe the physiology of trees and methods for their identification

1. Know the different parts of a tree and their functions
2. Explain the reproduction of the two main types of trees.
3. Describe the lifecycle of a tree and explain how trees grow
4. Understand the method and terminology required to use a dichotomous tree key
5. Know and identify major tree and shrub species native to Delaware's forests

C. Understand and describe the various characteristics and processes of forest ecology

1. Understand the concept and processes of forest ecology.
2. Identify the abiotic and biotics components of a forest ecosystem
3. Explain the process of photosynthesis and nutrient cycling
4. Understand and illustrate the process and stages of succession
5. Understand the developmental stages, structuring, and types of forests

D. Understand and describe the methods and practices of sustainable forest management

1. Identify and describe the various silvicultural principles and treatments
2. Understand tree harvesting and regeneration methods
3. Describe the various forest management objectives
4. Explain forestry best management practices
5. Explain the forest management cycle and each of its component parts

E. Understand and describe the methods and tools used in a forest inventory

1. Understand the importance of forestry measurements and identify the tools used for each
2. Demonstrate proficiency using various forestry tools and interpreting the collected data
3. Explain plot measurement procedures used in a forest inventory
4. Understand and explain the various objectives for completing a forest inventory
5. Explain what site index means and know to read a site index graph

F. Understand and describe practices involved in the conservation of forest resources

1. Explain the importance of forest health
2. Understand the major issues affecting Delaware's forests
3. Identify Delaware's main forest pests and diseases
4. Understand the programs available aimed at conserving forest resources
5. Explain the various laws and regulations aimed at conserving forest resources

Key Concept 5: Forest Inventory and Mensuration

Forestry Measurements

Forestry is more than just trees. Part of forestry is the industrial aspect of it. We depend on the forests for many of the things we use every day, and because of this, the timber industry is very important. Like any other discipline, forestry has its own unique set of measurements that will be discussed in this section.

The first important measurement to an individual is to know one's own pacing. Pacing involves counting the number of steps it takes you to travel a certain distance. In forestry this distance is 66 feet. To determine your pace use a tape measure to measure out 66 feet. Then, count the number of steps it takes you to walk that distance. Every time a foot hits the ground is a step, so two steps make a pace. Do this several times to make sure you get the same results each time. Being able to pace off 66 feet accurately is important and plays a part in many of the other forestry measurements that you will make.

In forestry, the standard unit for measuring distance is the **chain**. A chain is equal to 66 feet. In the past, surveyors and foresters actually hauled 66-foot chains around with them to measure properties. During this time, measurements were made in chains and links. Chains are important because many forestry tools are designed to be used at a distance of one chain. These tools will only provide correct and accurate measurements when used at that distance. Some other useful chain measurements are eighty chains equal one mile and ten square chains equal one acre. One square mile equals 640 acres.

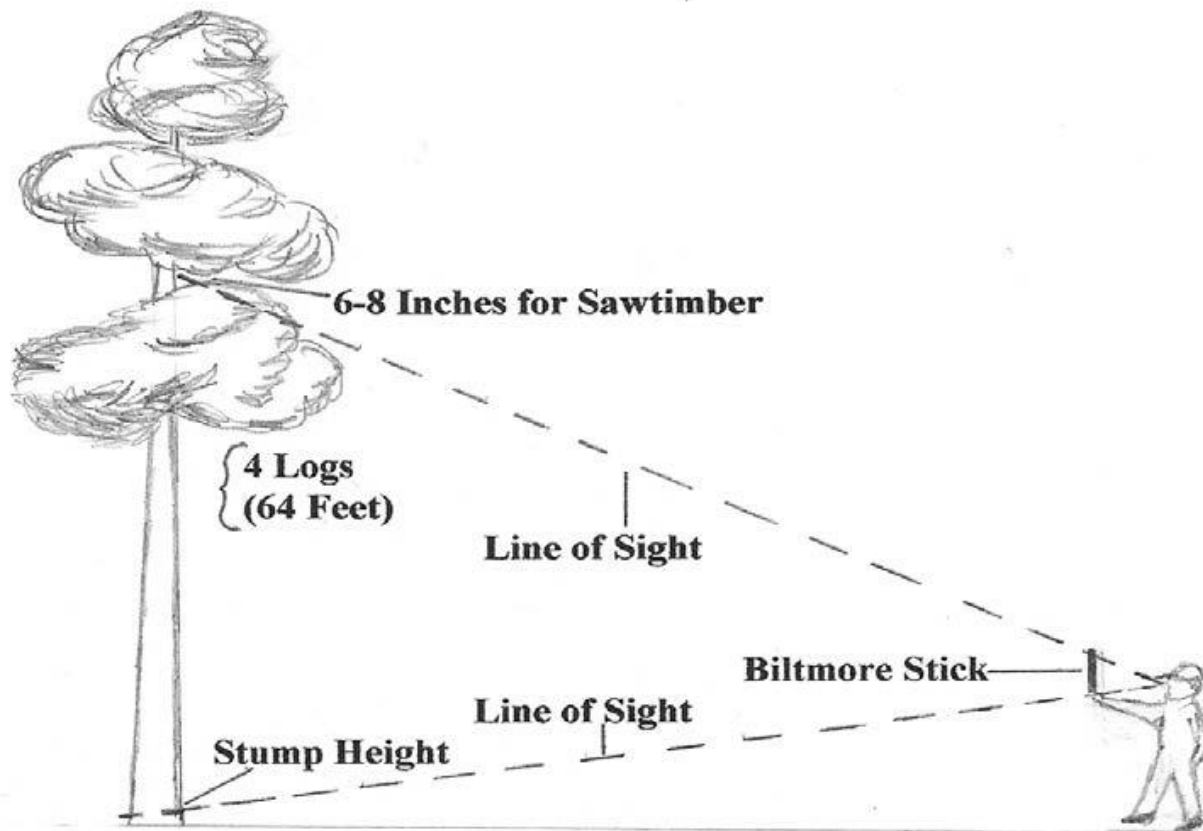
Tree Diameter

A measurement of the diameter of a tree can be very useful in determining tree growth and overall health of a tree. Tools that are commonly used to measure diameter are a diameter tape (or d-tape) and a Biltmore stick. Diameter is measured at 4 and 1/2 feet above the ground, giving you **diameter at breast height** (DBH).

Diameter is measured on the uphill side of the tree. It is usually measured to the nearest tenth of an inch when using a d-tape. The diameter tape is calibrated so that you are measuring diameter while actually placing the tape around the circumference of the tree at breast height.

Determining the Number of Logs in a Tree

Knowing the number of logs that a tree will produce is important in the timber industry. A **log** equals 16 feet. Logs are generally measured using a Biltmore stick starting from the base of the tree (where the stump would be if the tree were cut down) up to where the tree has an eight inch diameter or forks (splits). The Biltmore stick is one of the instruments specifically designed to give accurate readings only at 66 feet. It uses principles of geometry and similar triangles to produce these measurements. (See determining height on pages 64 and 65 for details.)



Other Important Forestry Measurements

There are many other measurements you will come across in your study of forestry. Some of these are listed here:

- Board Foot- an imaginary piece of wood measuring 12 inches long by 12 inches wide and 1 inch thick. It equals 144 cubic inches of wood or lumber. Board feet (B.F.) are determined using diameter measurements and the number of logs a tree will produce. There are tables on most Biltmore sticks that convert these two measurements into board feet.
- Cord of wood- a cord of wood is a stack of wood 4 feet high by 4 feet wide and 8 feet long. This equals 128 cubic feet of wood and air space. Air space must be included because of the voids between the pieces of wood.

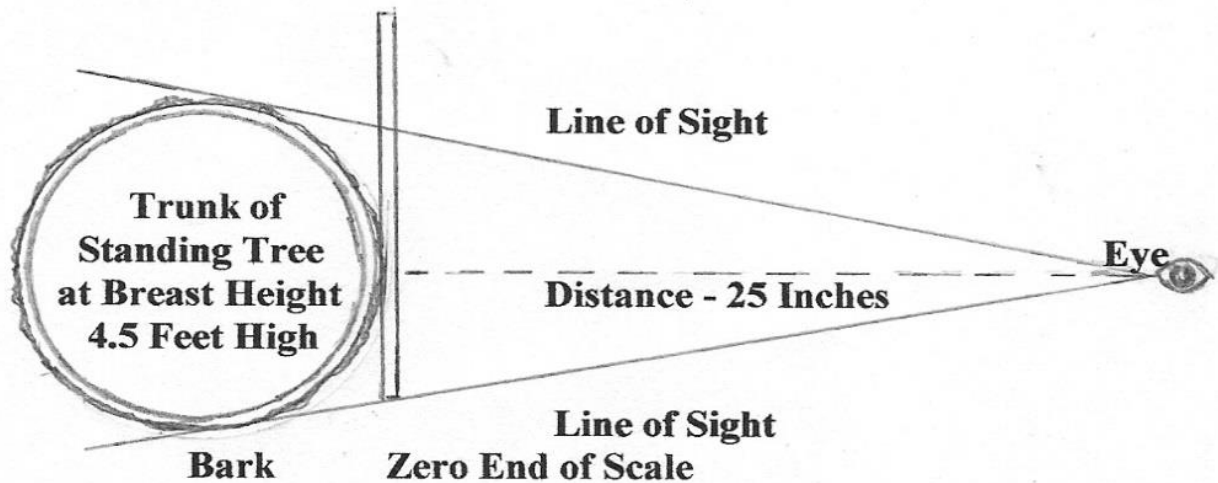
Other uses for the Biltmore Stick include:

- Diameter of a log
- Diameter of a standing tree
- Volume of timber in a log
- Volume of timber in a standing tree
- Height of a tree
- Number of logs in a tree

How to use a Biltmore Stick to Determine Height and Diameter

Diameter

1. Find four and half feet up from the ground on the uphill side of the tree. This is known as breast height and is where you will make your measurement.
2. Hold the Biltmore stick in a horizontal position 25 inches (the length of the stick) away from you with the left end of the stick along one side of the tree.
3. Close one eye and without moving your head, read where the other side of the tree lines up with the Biltmore stick. This is the diameter of the tree at breast height (DBH).



Height

The Biltmore stick is specifically designed to determine the amount of merchantable (saleable) timber. However, it can also be used to roughly determine the height of trees.

1. Pace off 66 feet, or one chain, in a straight line away from the tree.
2. Hold the stick vertically 25 inches away from you with the end of the stick level with the base of the tree.
3. Using the scale on the stick count the number of 16 foot logs that could be made from the tree. Use your best judgment in determining what part of a log any area left would be.
4. To determine height in feet multiply the number of logs by 16 and then add any partial log (in feet) that may exist.

Site Index

Site index is a measurement of the quality of the soil for a particular tree species. It is based on the height of the dominant trees at a specific age. In the eastern United States this age is set at 50 years old. In the western United States site index is measured when the trees are 100 years old. Each tree species has its own site index. Charts have been developed that determine what the site index is, and you simply read the chart. For example, a site index of 70 would mean that after 50 years the dominant and co-dominant trees of the selected species would reach an average height of 70 feet.

A Wedge Prism

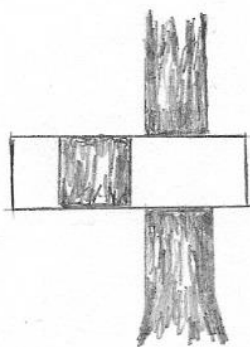
A prism is a thin wedge of glass that bends light rays as they pass through. Prisms are a simple, fast, very accurate tool for foresters. The wedge prism is used to determine which trees should be counted in a timber cruise sample. It eliminates the need for sample plots and individual tree measurements used in traditional cruising. The prism allows for point-sampling to select trees to count based on their size rather than on frequency as in traditional cruising.

The prism provides one of the easiest methods for estimating **basal area**, or cross-sectional area of trees at breast height. The basal area is used to determine:

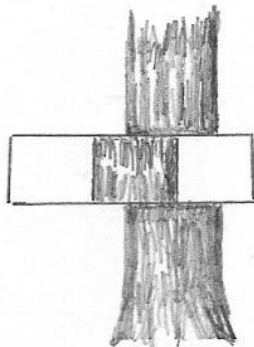
- the degree of stocking of a stand of trees
- the amount of timber to remove in thinning an over-stocked stand
- timber volume

Prisms are ground to a specific basal area. The most common size is 10. The wedge prism is used to determine basal area as follows:

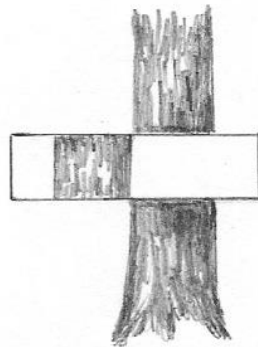
1. Hold the prism at eye level over the center of a point for the sample.
2. Look through the prism and count the number of trees, which should be tallied or recorded. (See figure below for determining what trees should be tallied.)
3. Multiply the tree count by the basal area factor of the prism to obtain the basal area per acre in square feet. (5 trees X BAF 10 = 50 sq. ft. basal area/acre)
4. Repeat the process at a series of points.
5. Average the basal area from all sampling points to calculate the average basal area for the stand.



Don't Tally



Tally



**Borderline
Tally Every Other One**

Cruising Timber

The only way for a landowner or timber company to know what trees are marketable is by a timber cruise. **Cruising** is the estimation of the volume of standing timber. This may be done as a partial cruise where only a sample or fraction of the trees are measured or as a 100 per cent cruise where all the trees are measured. A 100% cruise is only done if the trees are very valuable or if the area to be cruised is small.