

## Measuring Site Index

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Site index (SI) is a measurement commonly used by foresters to describe the productivity of a site. Typically this measurement is used to describe sites growing well-stocked even-aged forests. Site index is the average height of the dominant<sup>1</sup> and codominant<sup>2</sup> trees on the site, at a given age (base age). Typically, the base age for hardwoods and white pine in Virginia is 50 years, while the base age for loblolly pine is 25 years. For example, a SI of 75, base age 50, means that the average height of the dominant and codominant trees on a site will be 75 feet when they are 50 years old ( $SI_{50}=75$ ). The higher the SI, the higher the site productivity (trees will grow faster than on a site with a lower SI).

To calculate SI, first identify dominant and codominant trees representative of the forest site. The total height and ages of these trees are needed to calculate SI. The number of dominant and codominant trees that should be measured is dependent on the variability of their heights. A statistical analysis can be performed to determine the required measurement intensity, but this is beyond the scope of this publication. For our purposes, measurement of one dominant and one codominant tree of a similar species is adequate.

### Using a Clinometer to Measure Height

A clinometer (Figure 1) is commonly used to measure tree height. This tool works through simple trigonometry. Holding the clinometer vertically with the wheel on the left side. Look through the small window with your right eye. Keep your left eye open so that you can view the tree (figure 2).



Looking through the window, you will see a scale similar to that shown in figure 3. Usually, on the left is a percent scale (the number on horizontal sighting line in the window corresponds to a percentage of the distance from the clinometer to the sighted object), and on the right side a scale in feet is displayed. The scale used in the clinometer pictured in figure 1 is one foot per tick mark.

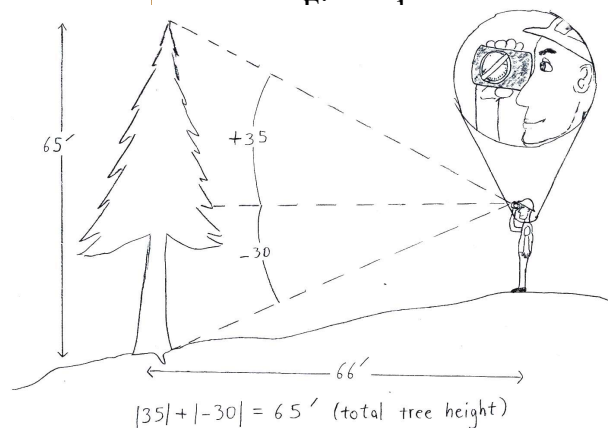


Figure 2

Walk out 66' (one surveyor's chain) from the tree and

<sup>1</sup> Dominant trees: Trees with crowns extending above surrounding trees that capture sunlight from above and around the crown. Trees must have been free to grow and not suppressed.

<sup>2</sup> Codominant trees: Similar to dominant trees, except the crowns only receive full light from above, and comparatively little from the sides.

view the clinometer as shown in figure 2. Looking up at the tree's top, the right hand clinometer scale will show a positive value, while looking down at the tree's base, the scale shows a negative value. Add the absolute values of these numbers together for total tree height (figure 2).

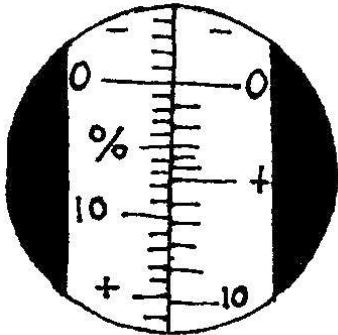


Figure 3

### Using an Increment Borer to Measure Tree Age

An increment borer (Figure 4) is used to extract a core of wood from a tree, allowing a view of the growth rings.

To use an increment borer, unscrew the extractor from the handle and open the lock in the center of the handle. Insert the non-auger end of the auger into the hole and replace the lock (Figure 4). Hold the borer with the auger perpendicular to the tree and while applying pressure, turn the handle clockwise until the auger catches. Continue to drill into the tree until the center is reached. Carefully slide the extractor into the auger under the wood core. Turn the handle counter-clockwise one full turn and carefully pull out the extractor. The wood core should be on top of the extractor.

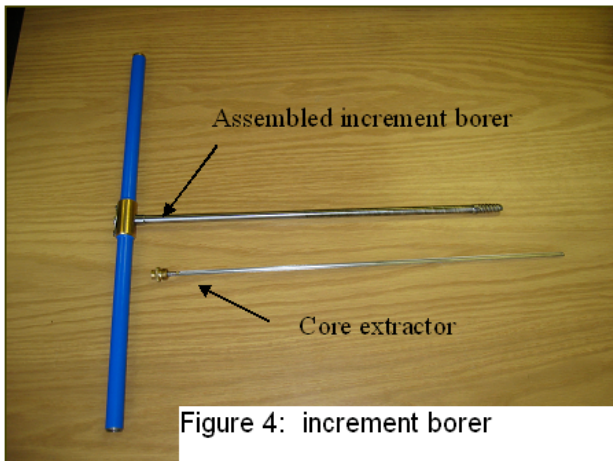


Figure 4: increment borer

The rings on the tree core can be used to determine the age of the tree. Each year trees put on one annual growth ring, comprised of one light band of wood early in the season (earlywood) and one dark

band late in the season (latewood). The age of the tree can be estimated by counting each pair of light and dark rings as one year.

Keep in mind some species (e.g. oaks and beeches) are much more difficult to core than others (pines and poplars) due to their wood densities. The rings of some are more difficult to read than others as well. Finally, accurately reaching the center of the tree can be difficult. For these reasons, tree coring takes some practice to continually get a good core from the tree.

### Site Index Curves

To determine the SI of a site, take the average of the heights and ages of the trees that were measured. These numbers are then used in conjunction with site index curves, which have been published by various researchers for a number of different tree species at numerous locations. Select a SI curve that well represents the species and location where the data were collected.

The site index curves at the end of this text are suitable for the Appalachians and the Piedmont of Virginia. Age is on the x-axis and height of dominants and codominants (in feet) is on the y-axis. Determine the point where age and height intersect. The logarithmic line that most closely intersects this point is the SI. The higher the SI, the more productive the site.

The site index curves included at the end of this publication and over 120 others are compiled in the USDA Forest Service publication, "Site Index Curves for Forest Tree Species of the Eastern United States". The publication also includes additional information on using site index curves.

## Sources

Figure 2 from Amateis, Ralph L.; Burkhart, Harold E. 1985. Site index curves for loblolly pine plantations on cutover site-prepared lands. *Southern Journal of Applied Forestry* 9:166-169.

Beck, Donald E. 1962. Yellow-poplar site Index Curves. Res. Note 180. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station. 2 p.

Fig. 1 from Beck, Donald E. 1971. Height-growth patterns and site Index of eastern white pine in the southern Appalachians. *Forest Science* 17:252-260.

Beck, Donald E. 1971b. Polymorphic site Index curves for white pine in the southern Appalachians. Res. Pap. SE-80. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station. 8 p.

Olson, David F., Jr. 1959. Site Index curves for upland oak in the southeast. Res. Note 125. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station. 2 p.

### *All in:*

Carmean, Willard H.; Hahn, Jerold T.; Jacobs, Rodney D. 1989. Site index curves for forest species in the eastern United States. Gen. Tech. Rep. NC-128. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 142 p.  
*Available online at [www.treesearch.fs.fed.us](http://www.treesearch.fs.fed.us)*

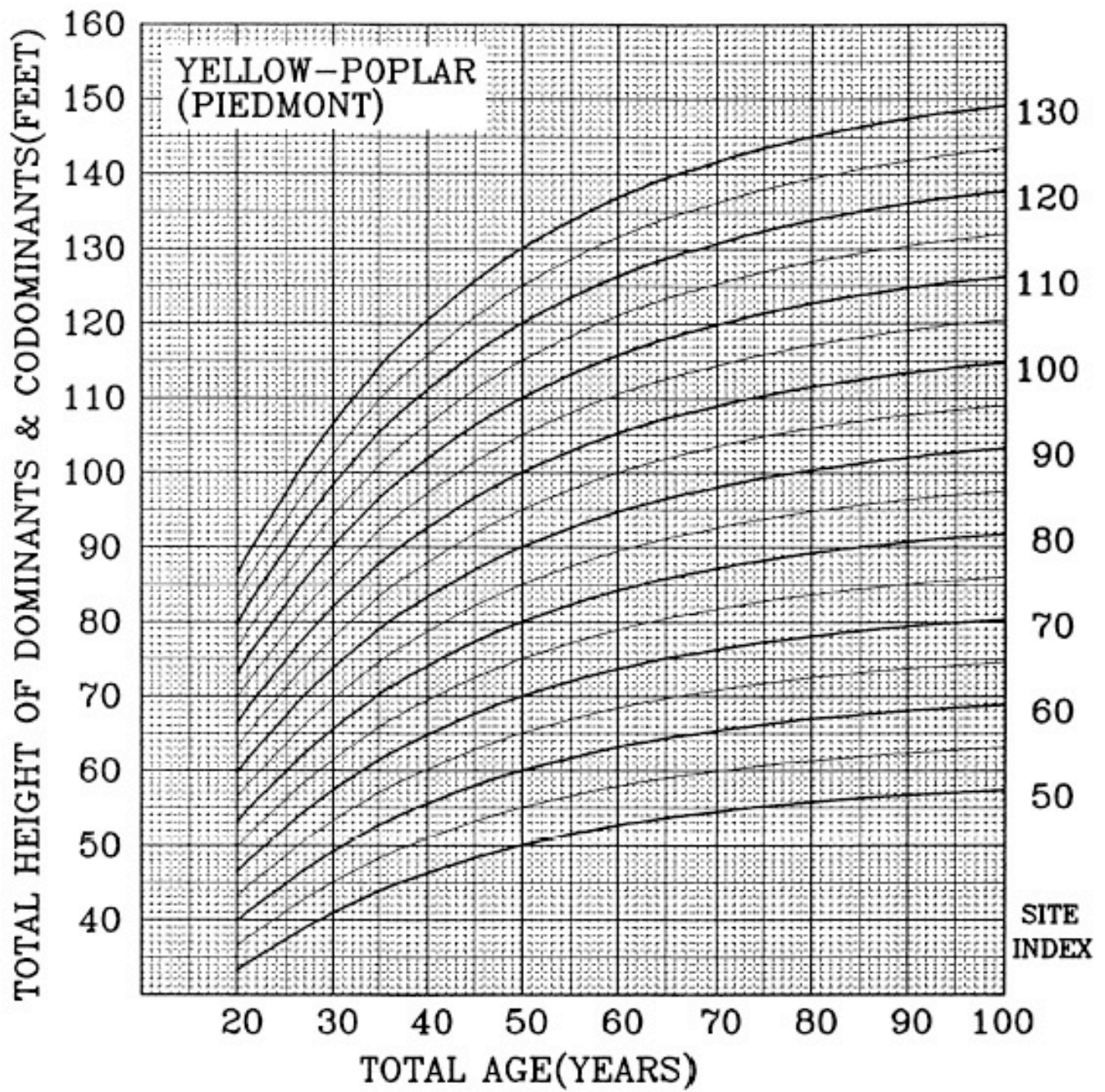


Figure 23.—Yellow-poplar—Piedmont (Beck 1962)  
Piedmont of Carolinas and Virginia

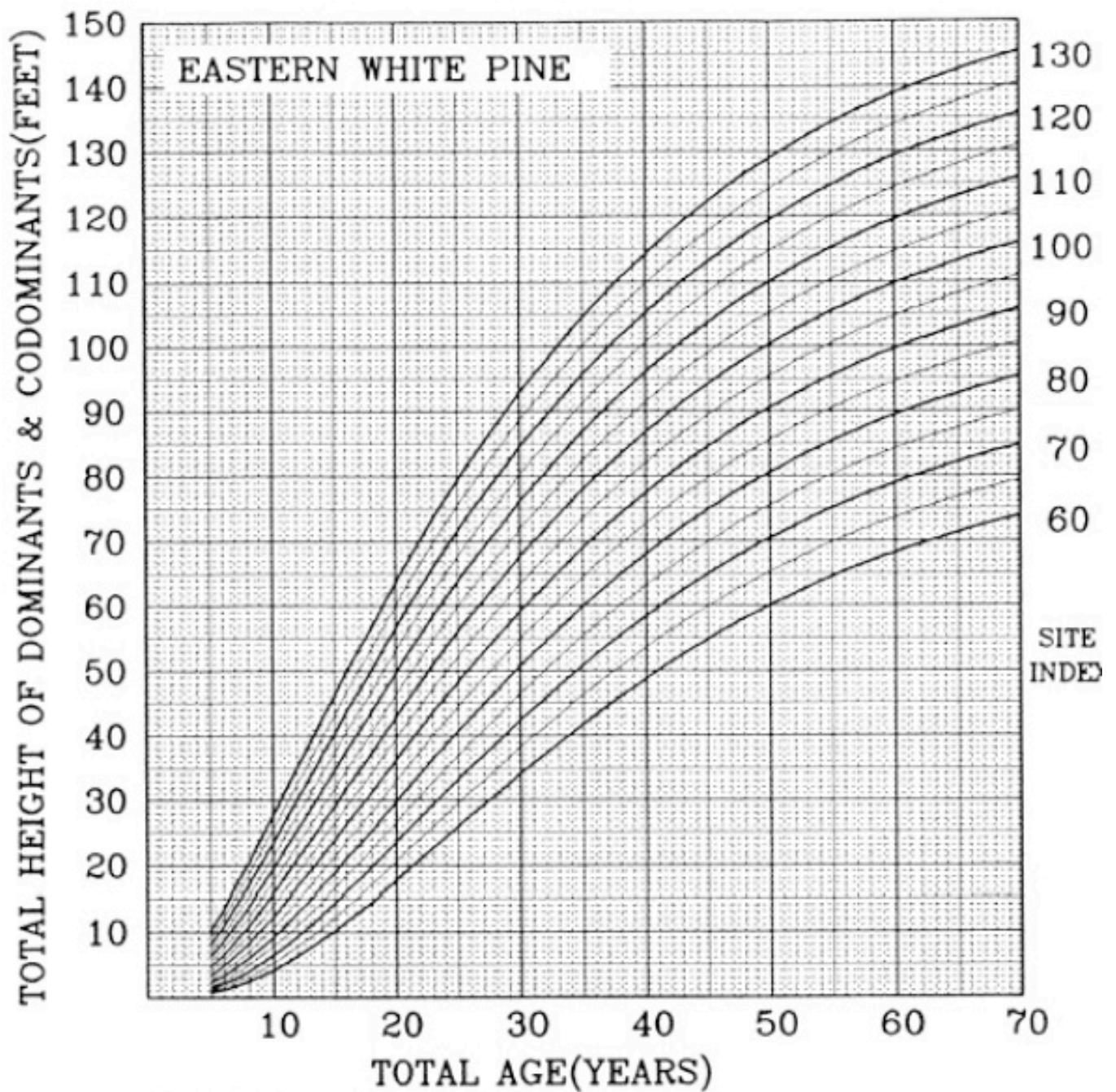


Figure 104.—Eastern white pine (Beck 1971a, 1971b)  
Appalachian Mountains of Virginia, Tennessee, North Carolina, and Georgia

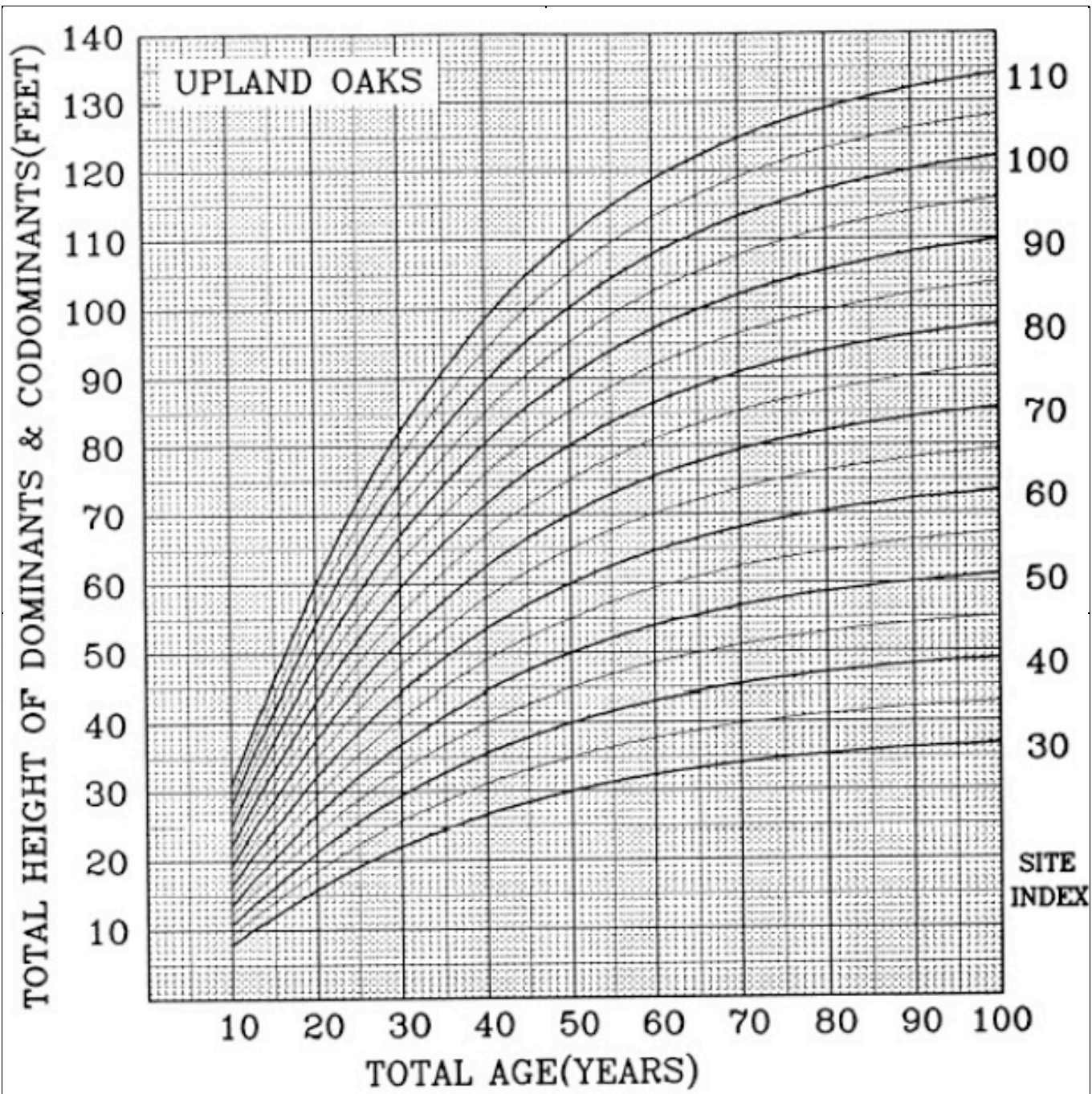


Figure 37.—Upland oaks (Olson 1959)  
 Virginia-Carolina Piedmont and northern Appalachian Mountains  
 269 plots in Piedmont, 428 plots in Appalachians, combined data for  
 white, northern red, southern red, scarlet, black, and chestnut  
 oaks; number of dominant and codominant trees not given

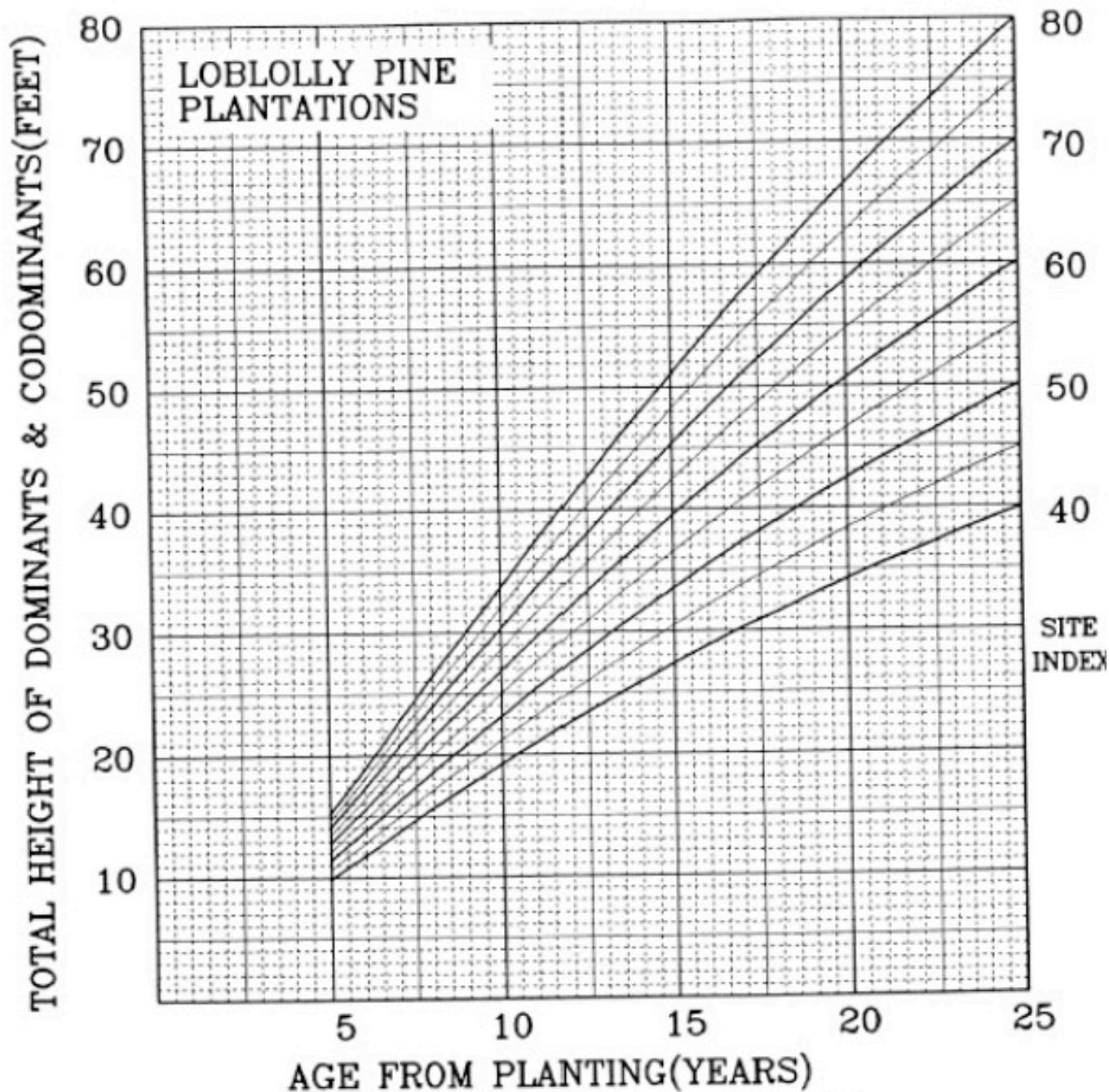


Figure 116.—Loblolly pine plantations—Coastal Plain (Amateis and Burkhart 1985)  
Coastal Plain throughout most of natural range