North Central Forest Experiment Station 4.02

CENTRAL HARDWOOD NOTES

Measuring Site Index In The Central Hardwood Region

Site index is the average height of dominant and codominant trees growing in well-stocked, even-aged stands at a given age called “index age.” Fifty years is the most commonly used index age in upland hardwoods. Sometimes 25 or 30 years are used for short-rotation bottomland hardwoods. Site index is widely used to indicate site quality because it correlates well with site productivity, is easily measured, and within limits is not affected by stand stocking. You can measure site index either directly or indirectly. It is important to be able to determine site productivity when deciding on biological treatments and levels of economic investments *(see* Note 4.01 *The Importance of Site Quality).*

Direct Measurement of Site Index

Site index is determined directly by measuring the heights and ages of sample trees and then estimating tree heights at the index age from a table or set of curves.

To measure the site index of a well-stocked, even-aged stand:

1. Delineate a stand of uniform site quality.
2. Select 5 to 10 sample trees evenly distributed over the area that best represent average site productivity. Sample trees should be of the same species if possible, and should be:
   - Healthy dominant or codominant trees
   - Straight, vertical, single-stemmed trees (multiple-stemmed trees and those with acute-angle forks are acceptable if others are not available)
   - Trees that have never been suppressed
   - Trees that have not been significantly damaged by fire, grazing, insects, disease, wind, ice, or lightning
   - Trees that do not differ in age by more than 10 years from other trees in the stand.
3. Measure tree heights with a measuring pole or altimeter, clinometer, or similar optical device.
4. Determine tree ages from increment cores, stand records, or stump ring counts. Take increment cores at breast height and add 2 to 5 years to obtain total age. The site index curve publication should indicate the proper number of years to add. Count the rings carefully using a hand lens if necessary, because each l-year error can cause a 1- to 2-foot error in site index. Examine each core or stump and reject trees that have been suppressed at any time. Heights and ages are most easily determined when a cutting is being made, where heights can be measured on felled trees and ages determined from stump ring counts.

5. Use site index curves or tables appropriate for the species and physiographic region. This is important because species often differ from each other in rates and patterns of height growth among different regions. The Carmean, Hahn, and Jacobs publication (1989) contains most site index curves available in the central hardwood region. Service foresters or extension foresters can usually advise you on the best curves to use for specific applications. The curves included at the end of this Note (figs. l-4) are regional curves for four upland oaks in the unglaciated portion of the Ohio Valley and southern Missouri (Carmean 1971).
6. If you cannot get enough sample trees of a single species, convert site indexes of the different species to the equivalent site index of one species with locally developed site index comparison charts or graphs. Conversions are essential because the site indexes often differ among species. For example, in Missouri a black oak site index of 63 feet is equivalent to a scarlet oak site index of 66 feet, and a white oak site index of 60 feet. Because of these differences, site indexes should always be listed by species: for example, white oak site index 58 feet, or black oak site index 67 feet.
7. When the site indexes of all sample trees have been determined and, if necessary, converted to a common species, average all the values to obtain the mean site index of the area.

Indirect Measurement of Site Index

Direct measurement of site index is best, but if suitable sample trees are not available, you can often estimate site index indirectly. Indirect methods used in eastern forests include indicator species, growth intercept, ecological site classification, and soil-site relations. The use of understory indicator species to estimate site quality does not work well in the central hardwood region. And the growth intercept method is only applicable in young stands of species such as eastern white pine that form a single whorl of branches each year. Several ecological site classification systems have been developed recently in the central hardwood region. These systems give average site indexes, by species, for specific physiographic regions and subregions based on landform or landtype, aspect, and soils. One of these systems is described in Note 4.03 Forest *Site Classification in the Interior Uplands.*

In the soil-site relations method, site index and several easily measured soil and topographic factors are correlated mathematically. A variation of this method has been developed for bottomland hardwoods in which various site factors are assigned numerical values, and the sum of these values equals the site index.

Soil and topographic factors often included in soil-site correlations for upland forests are surface soil depth, total soil depth, soil texture, aspect, slope position, and gradient. Factors often included for bottomland areas are elevation, drainage, water table depth, and soil texture.

To use the soil-site method, first delineate an area that is generally uniform for the soil and topographic variables in the equation. Select several sample points throughout the area, and measure the relevant soil and topographic factors at each point. Calculate the site index at each point, and average the sample point site indexes to obtain the mean site index of the area. The number of sample points necessary to achieve a given level of precision can be estimated after the site indexes of several sample points have been determined. If the first sample points vary widely, take more samples. If they do not vary, your sample is probably adequate.

References

Baker, J.B.; Broadfoot, W.M. 1979. A practical field method of site evaluation for commercially important southern hardwoods. Gen. Tech. Rep. SO-26. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station. 51 p.

Carmean, W.H. 1971. Site index curves for black, white, scarlet, and chestnut oaks in the Central States. Res. Pap. NC-62. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 8 p.

Carmean, W.H.; Hahn, J.T.; Jacobs, RD. 1989. Site index curves for forest tree 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.

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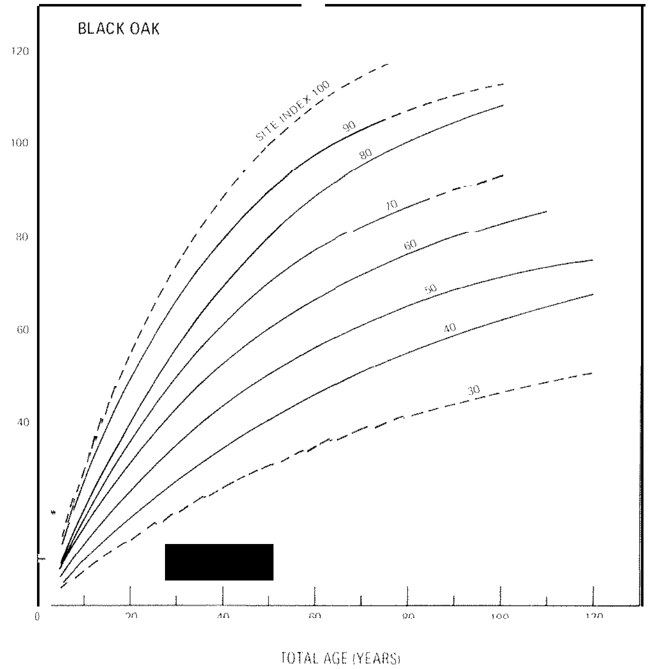

Figure 1 .-Site index curves for black oak in the Central States. Based on trees located in the unglaciated portions of southeastern Ohio, eastern Kentucky, southern Indiana, southern Illinois, and southern Missouri.

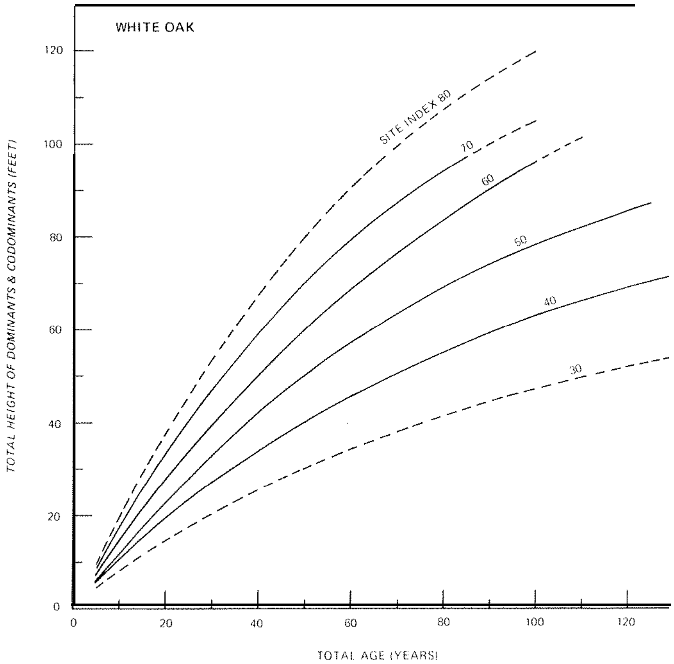

Figure 2.-Site index curves for white oak in the Central States. Based on trees located in the unglaciated portions of southeastern Ohio, eastern Kentucky, southern Indiana, southern Illinois, and southern Missouri.

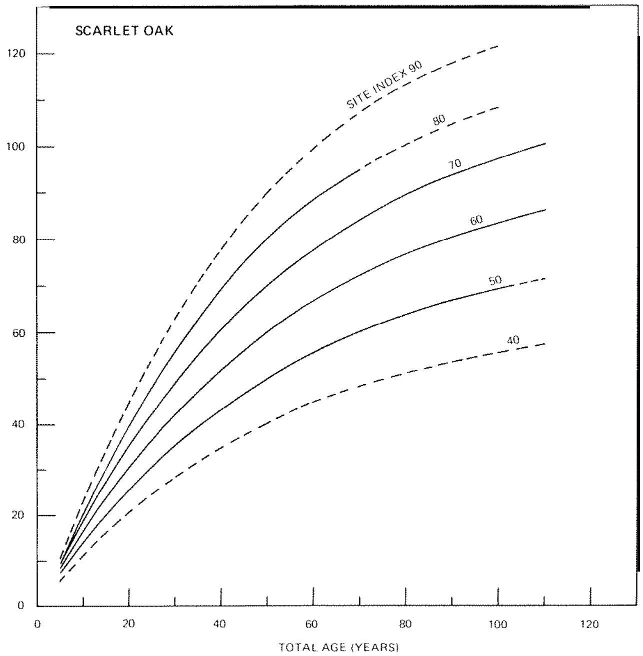

Figure 3.-Site index curves for scarlet oak in the Central States, Based on trees located in the unglaciated portions of southeastern Ohio, eastern Kentucky, southern Illinois, and southern Missouri.

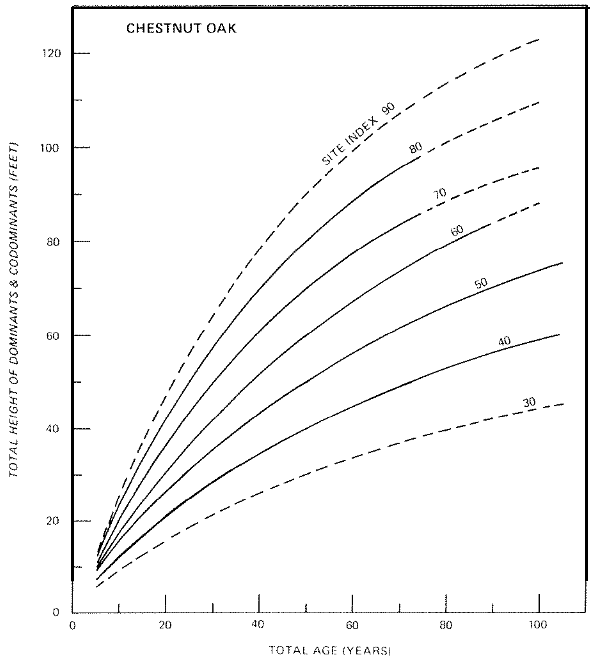

Figure 4.-Site index curves for chestnut oak in the Central States. Based on trees located in the unglaciated portions of southeastern Ohio, eastern Kentucky, and southern Indiana.