



# CENTRAL HARDWOOD NOTES

## Stocking Chart For Upland Central Hardwoods

The upland hardwoods stocking chart, introduced by Gingrich in 1967, has become one of the forest manager's most useful tools. The chart allows you to determine the condition of the present stand in relation to a stocking standard. The stocking of a stand is extremely helpful in prescribing various silvicultural treatments such as intermediate thinnings, improvement cuts, or regeneration cuts.

After determining the number of trees per acre and the basal area per acre, you can read the percent stocking directly from the graph (fig. 1). Percent stocking tells us how completely a particular stand is occupying its area relative to these charts, and also how much of the stand may be removed without wasting growing space. Stocking charts can help make other management decisions besides timber harvesting, regeneration, or thinnings. They are particularly useful for wildlife and watershed management decisions when appropriate standards are available for comparison.

The A line on the chart was developed from stands of average maximum density, and the B line was developed from open-grown trees. Upland hardwood stands can be grown over a wide range of percent stocking and still use all the growing space. Total basal area growth *per acre* of surviving trees will be about equal for stands of similar site and species composition falling between the A and B lines on figure 1. However, diameter growth of *individual trees* will vary greatly within this density range; the slowest rates occur near the A line, then continue to increase as percent stocking is lowered (*see Note 5.03 Estimating Oak Growth and Yield*).

The chart is easy to use as long as you know the *basal area per acre* and the *number of trees per acre*. Both these variables can be readily obtained in the field with a wedge prism and a tree count. The point where the number of trees per acre intersects the basal area per acre represents the present stand conditions. For example, from your stand tally you find 600 trees per acre and 80 square feet of basal area. Then from figure 1 the point of intersection indicates your stand has a mean diameter of about 5 inches and is approximately 90 percent stocked. When the tree tally is recorded by species and size class it provides extremely useful information for prescribing silvicultural treatments. For example, a simple classification system where trees are tallied by acceptable or unacceptable growing stock and cull, based on species, quality, and size class, can help the manager decide whether the stand is worth managing or whether it should be replaced now with a thrifty new stand. Also a simple classification of stand stocking by size classes such as saplings, poles, small sawtimber, and large sawtimber is helpful in making the appropriate prescription.

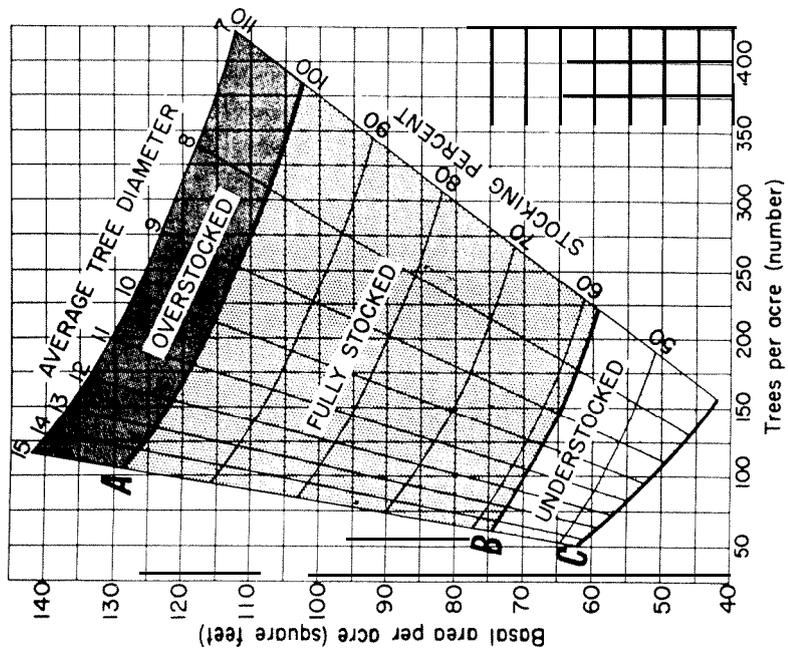
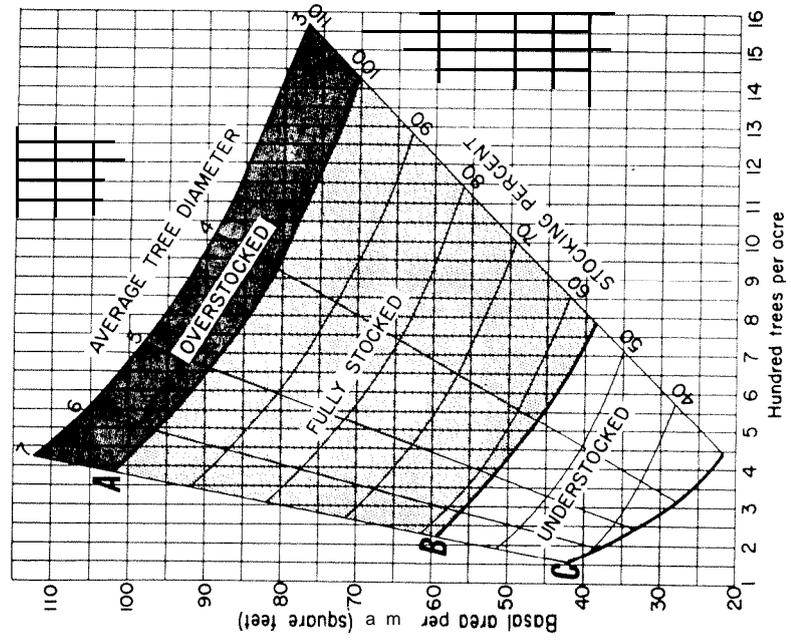


Figure 1 .-Stocking chart for upland central hardwoods. (Gingrich 1967)

Stands with stocking around 100 percent (A-level) are near the average maximum density and are overstocked for timber management purposes. Individual trees grow slowly and natural mortality is high, primarily among small trees. A thinning would benefit such stands, increasing growth on the bigger, higher quality, and more valuable residual trees. A light thinning would reduce the percent stocking to about 80 percent; a moderate thinning to about 60 percent; and a heavy thinning to about 40 percent.

At the B-level, when all trees are uniformly spaced over the area, each tree presumably has all the growing space it can use (fig. 1). So at densities below B-level some growing space is not occupied by timber producing trees and total stand production will be reduced. Moreover, extensive branching may reduce the quality of residual trees, and reproduction and brush develop in a heavy under-story. The B-level (or slightly below) continues to be the recommended thinning level for many upland hardwood stands.

Stands below the C line are understocked. The C line indicates the stocking necessary for a stand to reach the B-level (or full site utilization) within 10 years on site class 55 to 74. On better sites the time interval between C- and B-level stocking is only 5 to 8 years, on poorer sites 12 to 15 years. The C line is thus a reference point useful in predicting how long it will be before a stand efficiently occupies its area. If a stand is much below C-level it is severely understocked and in most cases the general recommendation would be to regenerate that stand now rather than continue to waste growing space for another 15 years or longer.

Stocking charts (or equations) for other species are becoming available. In addition to the chart for the upland oaks, there are now charts for yellow-poplar, black cherry, sugar maple, and the northern hardwood species (maple-beech-birch). However, work continues on the development of stocking charts for the truly mixed-species stands that we encounter in the central hardwood region.

#### Reference

Gingrich, Samuel F. 1967. Measuring and evaluating stocking and stand density in upland hardwood forests in the central states. *Forest Science*. 13: 38-52.

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