

**Learning Objective:** Following this lab students will be able to demonstrate understanding of basic quantitative silvicultural concepts by creating their own modified Gingrich style stocking guide and by using both Gingrich stocking guides and stand density management diagrams to compare different thinning regimes for a stand.

**Introduction**

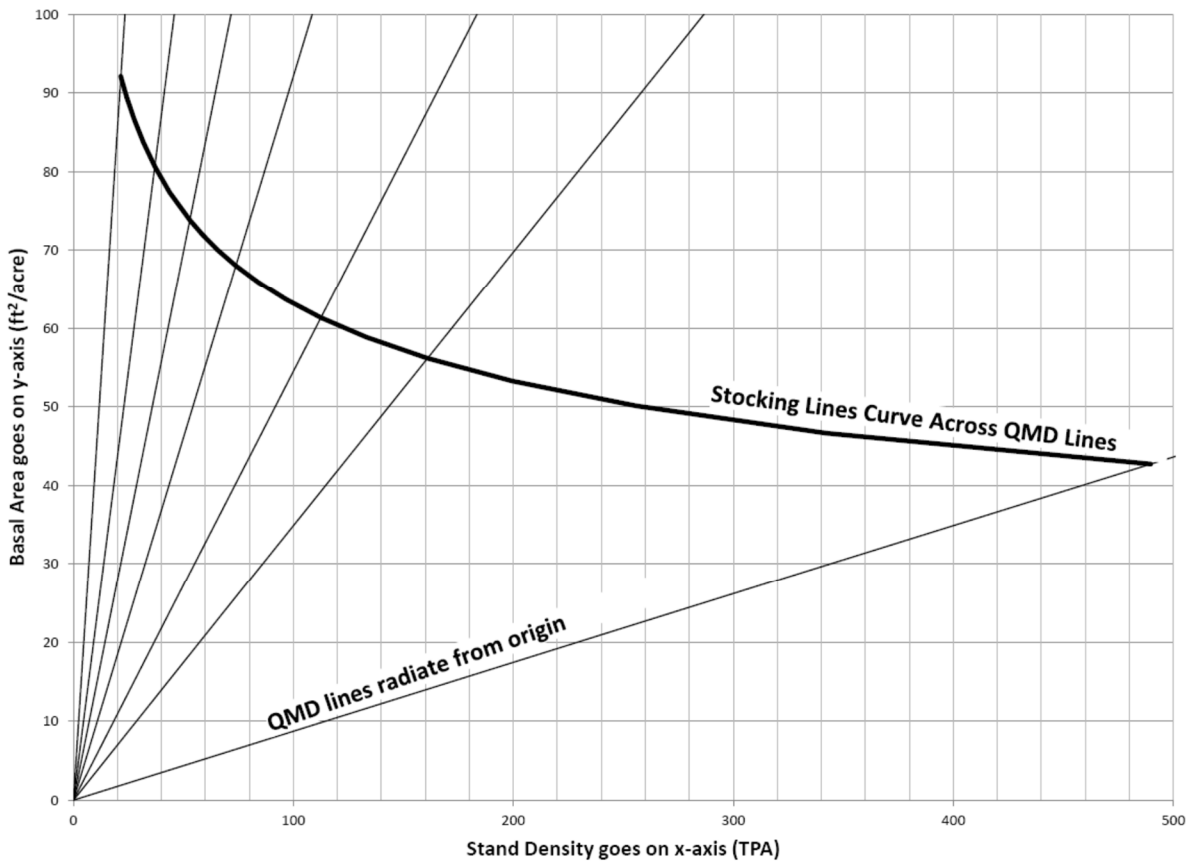
Please read Chapter 6 of *The Ecology and Silviculture of Oaks* on self-thinning and stand density (Johnson et al. 2009), and review your lecture notes on stocking guides and stand density management diagrams.

**Procedure**

**ASSIGNMENT PART 1: GINGRICH STOCKING GUIDE**

Creating a modified Gingrich style stocking guide for Douglas-fir (max SDI = 587).

You'll use the provided grid to create a stocking guide by adding QMD lines and stocking lines. Your stocking guide should look roughly like this when completed:



**Figure 1.** An example modified Gingrich style stocking guide with only one stocking line, rather than the usual three.

1. Calculate paired TPA-BA points to construct lines for the following QMD's: 4, 6, 8, 10, 12, 14, 16, 20, and 28 inches.
  - a. Each line will originate at (0,0), so by plotting one other paired (TPA, BA) point, you can connect the points to form a line.
  - b. These lines will be based on the mathematical relationship relating BA, TPA, and QMD, which is represented by the equation:

$$QMD = \sqrt{\frac{BA/TPA}{0.005454}}$$

- c. You'll need to solve this equation algebraically for both BA and TPA to help you plot the QMD lines.
    - i. For QMD's 8-28 inches, calculate TPA for BA = **300** ft<sup>2</sup>/acre
    - ii. For QMD's 4-6 inches calculate the BA for TPA = **1500**
    - iii. In theory you could calculate any of these points by either method. In practice, however, you'd end up calculating some points that were off your grid, making it impractical to plot them conveniently.
2. Next you'll add three relative density lines.
  - a. These lines will describe the following stand conditions:
    - i. A-Line: **55% RD**. This line represents the onset of density dependent mortality. This will be used to reflect full stocking. Maintaining a stand below the A-Line will allow us to maximize value by capturing mortality in various thinning operations.
    - ii. B-Line: **30% RD**. This represents a stocking level where site resources are being fully utilized. Below B-Line stocking, site resources are not being fully utilized, and production is less than the site's potential. On a typical Gingrich stocking guide this represents the onset of crown closure. Using our modified SDI based approach, we have increased our B-Line stocking to reflect the lower limits of the management zone, which occurs after crown closure.
    - iii. C-Line: **15% RD**. On a typical Gingrich stocking guide this represents a condition where a stand will require 10-years to return to B-Level stocking. On our guide, we are using the C-Line to reflect a condition of crown closure. At this point, the stand is nearing full stocking, but is not fully utilizing all site resources. This reflects an understocked condition.
  - b. Use the SDI equation to plot the stocking lines based on the mathematical relationship between SDI, TPA, and QMD reflected by Reineke's equation:

$$SDI = TPA * [(QMD/10)^{1.605}]$$

- i. Solve the equation algebraically for TPA.
    - ii. Determine the maximum SDI for your species.
    - iii. Multiply this maximum by your RD for the A-Line, and use this value for SDI in the equation.
    - iv. Now that you know SDI, solve that equation for the 4-inch QMD line on your stocking guide.

- v. Plot the point where the TPA value from the solved equation intersects the 4-inch QMD line.
  - vi. Repeat steps 4-5 for each QMD line on your diagram.
  - vii. Connect all the points you plotted and label this as the A-Line.
  - viii. Repeat steps 3-7 for both the B-Line and the C-Line.
3. You'll turn in a copy of your stocking guide for this lab. Be sure your name is on it somewhere, and that your axes and all lines are correctly labeled. Include units where possible.

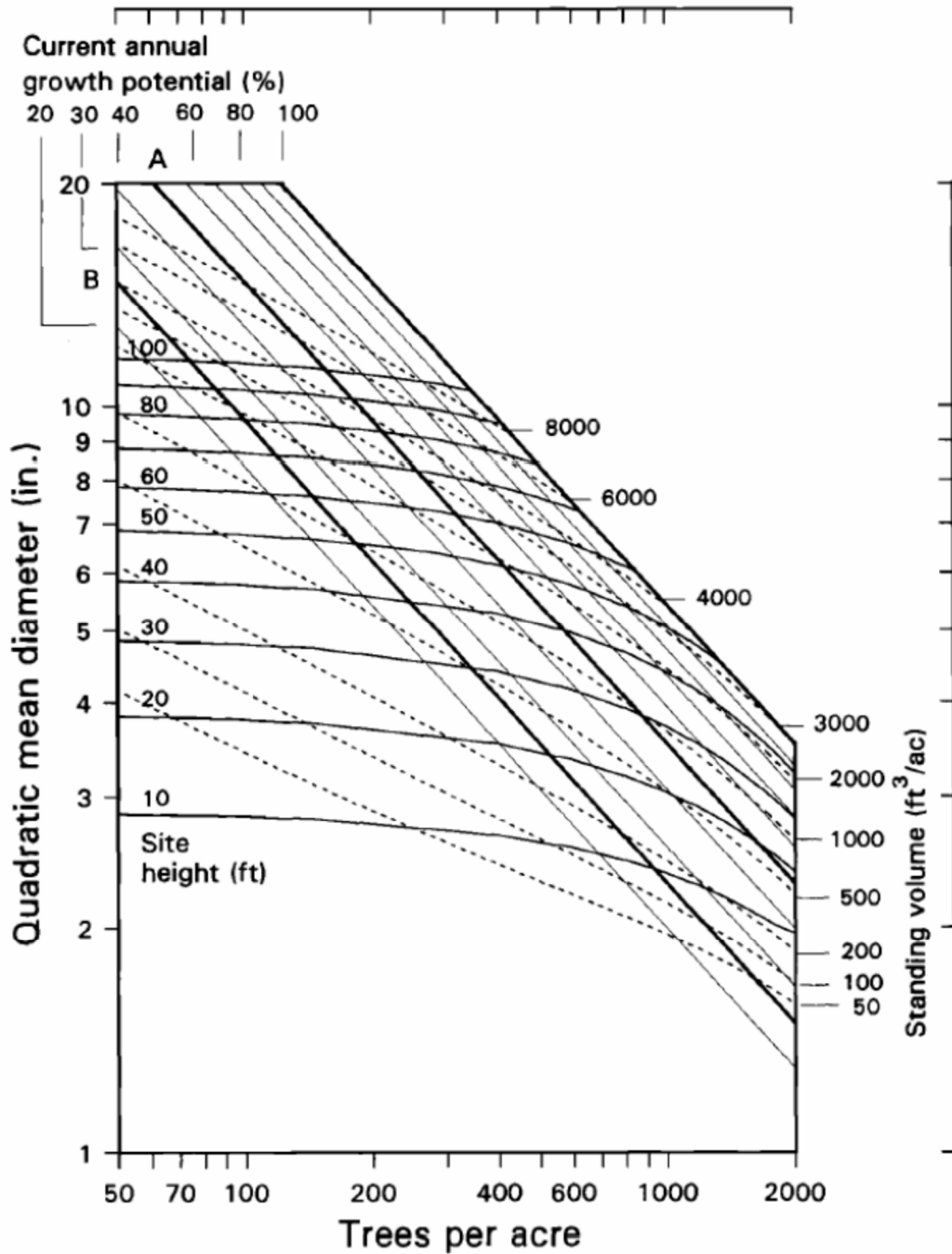
Use your diagram to answer the following questions (no memo format needed, just your name).

1. For a stand with BA = 125 ft<sup>2</sup>/ac and density = 1400 TPA, what is QMD, and what would you prescribe this year?
2. For a stand with QMD = 14 inches and density = 100 TPA, what is BA, and what would you recommend as the next management action for this stand. Justify your answer.
3. For a stand with BA = 40 ft<sup>2</sup>/ac and QMD = 6 inches, what is the density, and how would you describe the stocking of this stand?
4. On your diagram, draw a line that describes the following series of events, labeling each point with the corresponding letter.
  - a. You acquire a stand and cruise it, finding that BA = 80 ft<sup>2</sup>/ac and density = 840 TPA.
  - b. Your stand grows with no mortality until BA = 165 ft<sup>2</sup>/ac.
  - c. You prescribe and oversee a corridor thinning that removes 10-foot-wide corridors spaced every 30 feet on center.
  - d. The stand grows for a time. You cruise it, observing some trees that died due to density dependent mortality, and find that QMD = 10 inches and BA = 175 ft<sup>2</sup>/ac.
  - e. You prescribe and oversee a typical grade C low thinning that reduces the BA to 105 ft<sup>2</sup>/ac.
  - f. Continue following the stand to a final clearcut harvest. What is your QMD at harvest?

**ASSIGNMENT PART 2: STAND DENSITY MANAGEMENT DIAGRAM**

Using a Stand Density Management Diagram

You will use the provided stand density management diagram for slash pine plantations in the lower coastal plain to learn how to use these graphical tools to make decisions on thinning regimes.



**Figure 2.** A density-management diagram for slash pine plantations in the lower Coastal Plain. Reproduced from Dean and Jokela (1992).

We will compare and contrast three thinning regimes on a slash pine plantation planted at a density of 600 TPA on a site of average quality. You know from past experience on this site that density dependent mortality occurs at 50% RD. Use the provided stand density management diagram on the previous page to answer the following questions.

5. Draw a line on the diagram from stand establishment to where density dependent mortality will first begin.
6. Draw a line on the diagram from the onset of density dependent mortality to a point where the stand allowed to grow unthinned to a QMD of 10 inches, and is then clearcut.
7. Draw a line on the diagram from the onset of density dependent mortality to a point where the stand allowed to grow to a QMD of 7 inches, and is then fourth row thinned. Also draw a line from this point to the same end point as in number 6 (as the stand would grow, not a straight line connecting these two points).
8. Draw a line on the diagram from the end of the row thin to a point where the stand is allowed to grow to a QMD of 9 inches, and is then grade C low thinned removing 40% of the trees per acre. Also draw a line from this point to the end of the rotation, which is when the QMD reaches 12 inches.
9. Given these three scenarios, which would you recommend to maximize timber production? Justify your answer with your data.

### Written Assignment:

There is no formal lab report due this week, and grading of written answers will not be based on formatting. **Turn in 1) your Gingrich-style stocking guide including answers to questions 1-4 AND 2) your stand density management diagram with questions 5-8 drawn and clearly labeled and an answer to question 9.** When you write your answers, be sure to include UNITS, and be sure to number them like they are on this handout, so I know which question the answers correspond to.

### Literature Cited:

- Dean, T. J. and E. J. Jokela. 1992. A Density-Management Diagram for Slash Pine Plantations in the Lower Coastal Plain. *Southern Journal of Applied Forestry* **16**:178-185.
- Johnson, P. S., S. R. Shifley, and R. Rogers. 2009. Self-thinning and Stand Density. Pages 250-279 *The Ecology and Silviculture of Oaks*. CABI, Cambridge, MA.

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