ESTIMATION OF REINEKE AND VOLUME-BASED MAXIMUM SIZE-DENSITY LINES FOR SHORTLEAF PINE

Thomas B. Lynch, Robert F. Wittwer, and Douglas J. Stevenson[1]

POSTER SUMMARY

Maximum size-density relationships for Reineke's stand density index as well as for a relationship based on average tree volume were fitted to data from more than a decade of annual remeasurements of plots in unthinned naturally occurring shortleaf pine in southeastern Oklahoma. Reineke's stand density index is based on a maximum line of the form log(N) = a + b(log(D)) where N is trees per acre, D is quadratic mean diameter, and a and b are constants. Reineke (1933) proposed a value of b = -1.6 for many tree species. However, he obtained a steeper slope for shortleaf pine (b = -1.8). The -3/2 power law is based on a maximum line in the form log(V) = a' + b'log(N), where V is mean tree volume and a' and b' are constants. A value of -3/2 has been postulated for the slope parameter b' for many plant species (Yoda and others 1963). Drew and Flewelling (1977) applied this equation to forest populations and noted the relationship to Reineke's maximum size-density equation. Intercept values a and a' for each of the approaches are species dependent. The two maximum size-density lines were fitted to the shortleaf pine plot data from unthinned plots in shortleaf pine natural stands. These lines can be used to calculate Reineke's stand density index and to evaluate the likelihood of competition-induced mortality for shortleaf pine forests.

Unthinned plot data are from two study sites located in naturally occurring shortleaf pine forests in the Ouachita Mountains of Pushmataha County, OK. Site One is about 25 miles east of the western limit of the natural range of shortleaf pine, whereas Site Two is located an additional 35 miles to the southeast. A thinning study that included the unthinned control plots used here was installed on Site One during the winter of 1989 in stands aged 25 to 30 years and on Site Two during the winter of 1990 in stands aged 30 to 37 years. Fourteen annual measurements have been made at Site One and 13 at Site Two. Annual measurements from three unthinned control plots located at each site provided data for examination of maximum size-density relationships. Thinned plots were not used in the current analysis. Measurement plots from Site One were 0.1 acre in size whereas plots on Site Two were 0.2 acre.

The Durban-Watson test indicated autocorrelation in these data, which was not unexpected because plots were measured annually. Therefore, a first difference model was used to estimate the slope parameter for a Reineke-type maximum size-density relationship. The intercept was obtained by constraining the relationship to pass between the means of the dependent and independent variables. Then the standard error of the residuals was calculated. The following maximum line was obtained by adding two standard errors (standard error of the residuals) to the intercept

$$\log(N) = 4.3275 - 1.7197[\log(D)]$$

where log(N) is the common (base 10) logarithm of number of trees per acre and log(D) is the common logarithm of quadratic mean d.b.h. This yields a maximum Stand Density Index (SDI) of 405 trees per acre where SDI is the expected maximum density for a stand having a quadratic mean d.b.h. of 10 inches. Preliminary analysis of the relationship between mean volume and maximum density indicated that the slope was not substantially different than the theoretical value of –3/2 for these data. An intercept was obtained for this line using methods similar to those described for the Reineke-type line.

LITERATURE CITED

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[1]Professor, Professor, and Senior Research Specialist, Department of Forestry, Oklahoma State University, Stillwater, OK 74078-6013, respectively.

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