COMPARISON OF NE-TWIGS AND ZELIG ON ACTUAL GROWTH OF TWO SITES IN KENTUCKY

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Abstract—Two individual-tree growth simulators are used to predict the growth and mortality on a 30-year-old forest site and an 80-year-old forest site in eastern Kentucky. An empirical growth and yield model (NE-TWIGS, Hilt and Teck 1989) was developed to simulate short-term (< 50 year) forest growth from an industrial perspective. The gap model (ZELIG, Urban 1990) is based on the theory of growth processes and was designed to simulate long-term (100 years and greater) forest succession. Based on comparisons of species specific diameter distributions, biomass, and board-foot and cubic-foot volumes, NE-TWIGS performed better for the 80-year-old site than did ZELIG. Neither simulator provided acceptable predictions for the 30-year-old site.

The ZELIG model over predicted the number of stems for the 30-year-old site, but under predicted the biomass and volumes. This implies that the model does not grow the white oaks fast enough. The red maples, on the other hand, grew too fast and the white oaks incurred too much mortality on the ZELIG simulations of the 80-year-old site.

The NE-TWIGS model cannot be easily altered to obtain better predictions for specific areas. One could annually adjust the site-index value based on seasonal temperatures and precipitation rates being above or below local averages. NE-TWIGS was designed to work in the time frame and region used in this comparison; however, it is a generalized model, not developed, specifically for an even-aged, upland oak stand.

The species parameters in the gap models can be modified, which might produce comparable growth predictions. An adjustment of site specific and species parameters was investigated for white oak on these data sets. White oak made up more than 75 percent of the stems at each site, and any improvement in prediction of the growth for this species would improve the overall predictions immensely. Soil fertility was the site parameter in which I had the least confidence. Whittaker (1975) reports net primary productivity for temperate deciduous forests ranges from 6 to 25 Mg/ha/yr averaging 12 Mg/ha/yr, much higher than was calculated for these sites. Another parameter which might be altered is the species growth constant which changes the age at which a tree of that species puts on most of its diameter growth. A larger constant implies that trees of this species grow quickly early in their life and growth tapers as the tree ages. A lower constant allows trees of the species to grow in diameter evenly as they age. The maximum age and diameter that a tree species can attain are parameters which determine many aspects of growth and mortality within the ZELIG model.

Systematic combinations of values within the ranges of the soil fertility parameter (2-24 Mg/ha/yr) and the white oak growth constant parameter (50-300) were tested within the ZELIG framework seeking a combination that would improve the simulations of both stands. Graphs of the relationships between these parameters and average dbh, number of trees per hectare, and the volume measures showed that the volume measures and average dbh were not sensitive to soil fertility values above 10 Mg/ha/yr. Number of stems on each site was quite sensitive to both parameters. Parameters were found for the 30-year-old site which satisfactorily predicted number of stems, average dbh, biomass, and cubic foot volumes; however the diameter distribution was such that the board foot estimates were still quite low (not enough large trees). These parameters simulated reasonable volume measures for the 80-year-old site, but the estimated average dbh and number of trees were not close to those of the actual site. No combination of parameters tested could produce enough trees for the eighty-year-old stand. Reasonable average dbh estimates for the 80-year-old site could be attained, but never with the proper number of trees to produce the right combination of biomass, cubic-foot volume or board-foot volume.

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Citation for proceedings: Stringer, Jeffrey W.; Loftis, David L., eds. 1999. Proceedings, 12th central hardwood forest conference; 1999 February 28-March 1-2; Lexington, KY. Gen. Tech. Rep. SRS-24. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 293 p. [Poster abstract].