

# HARDWOOD REGENERATION RELATED TO OVERSTORY SHORTLEAF PINE BASAL AREA AND SITE INDEX IN ARKANSAS AND EASTERN OKLAHOMA

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## EXTENDED ABSTRACT

Shortleaf pine (*Pinus echinata* Mill.) grows in association with many other woody species, particularly understory hardwoods, which compete with it, limiting its productivity. Along with other species, sweet-gum (*Liquidambar styraciflua* L.) is a major competitor on better-quality sites but decreases rapidly in importance as pine site index (SI) decreases and pine overstory increases.

Over 200 fixed-radius 0.2-acre plots were permanently established in naturally-occurring shortleaf pine stands located in the Ozark and Ouachita National Forests during the period 1985 to 1987 as part of a forest growth study. Five trees per plot were sampled using increment borers to determine age. Height measurements were made on two trees in each one-inch diameter class on each plot and diameter at breast height (DBH) was measured on all trees. SI was calculated using Graney and Burkhardt's (1973) equation for each SI sample tree and averaging the result for each plot.

Initially plots were thinned to assigned basal area levels and hardwoods were treated with chemical herbicide. During the 1995-1997 re-measurement of these plots, two 0.005-acre subplots were established within each of the shortleaf growth plots to assess shortleaf regeneration and abundance of understory hardwoods. During the 2000-2001 re-measurement, an additional two 0.005-acre subplots were added. At each re-measurement, saplings over 4.5 feet tall were tallied by plot and species.

Each plot was an observation. Shortleaf pine basal area (square feet per acre) and SI (50-year basis) were used as environmental (dependent) variables. Seedling counts by plot were used as species (independent) variables. Thinning treatment was used as a co-variable (dummy variable). There were 52 sapling species in the sample.

Analysis was carried out using partial Canonical Correspondence Analysis (pCCA) as described by Leps and Smilauer (2003). Analysis indicates that most associated

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hardwood species are sensitive to pine site quality as determined by SI and shade under shortleaf pine canopies using overstory basal area as a proxy for shade.

SI and basal area explained 12.9 percent of total variation in species composition. The first pCCA axis accounted for 4.5 percent of variation, the second for an additional 3.1 percent and the third for another 2.4 percent. Species vs. SI and basal area correlation was 0.551, 0.554 and 0.445 for the first, second and third axes, respectively.

Sweet-gum was the major hardwood species on the SI scale on sites above SI 85. Green ash (*Fraxinus pennsylvanica* Marsh.), red maple (*Acer rubrum* L.), dogwood (*Cornus* spp. L.), winged elm (*Ulmus alata* Michx.) and black oak (*Quercus velutina* Lam.) were common species on sites above 60 SI. Dogwood was the most common species on sites between 65 and 75 SI. Red maple was common throughout all sites but was the predominant hardwood species on sites below 65 SI.

All species responded along a decay curve related to pine basal area. Sweet-gum and black-gum (*Nyssa sylvatica* Marsh.) were the most-common species with almost identical curves. Both were strongly influenced by pine basal area. Mockernut hickory (*Carya tomentosa* Nutt.) was the species least affected by basal area, occurring at low levels on all sites.

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