The following articles will appear in the February 2016 edition of Forest Science.

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RESEARCH IN REVIEW

The authors studied five species of endemic red oaks (Section Erythrobalanus) in hardwood bottomlands of the Mississippi Alluvial Valley (MAV), including cherry-bark, Nuttall, pin, water, and willow oaks. Ecologists and managers need reliable estimates of acorn yield and masting traits to assess potential forest regeneration and estimate foraging carrying capacity of these habitats for waterfowl and other wildlife. The authors designed a study to reliably estimate red oak acorn yield in five states in the Mississippi Alluvial Valley over 4 consecutive years (2009–2013) and evaluate the components of masting (i.e., synchrony and temporal variability). The mean annual individual tree yield was 424 kg (dry)/ha (35.1 acorns/m² crown area) across all sites and years. The authors’ yield estimates provide heretofore unreported estimates of average seed yield (seeds/m² canopy) and mass (kg/ha) from red oaks for five of the largest contiguous bottomland hardwood forests remaining in the MAV. In the authors’ study, red oaks yielded more acorns on average and showed less annual variability than studies of other red oaks in North America. The authors found no evidence that annual population-level red oak acorn yield was synchronized at sites across the scale of the MAV. However, synchrony increased with decreasing distance between sites, and the authors found a large degree of interspecific synchronicity within four of five sites. The authors believe that local scale influences such as edaphic resources, weather, and genetics drive within-site yearly patterns in acorn yield. Managers have a greater likelihood of lessening the effect of periodic seed failures in the MAV if they manage for a diversity of site-adapted red oak species as opposed to favoring monocultures or few species.

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FUNDAMENTAL RESEARCH

Forest ecology

Acorn Yield and Masting Traits of Red Oaks in the Lower Mississippi River Alluvial Valley

J.N. Strauss, R.M. Kaminiski, A.G. Leach, A.W. Ezell, and T. Leininger

The authors studied five species of endemic red oaks (Section Erythrobalanus) in hardwood bottomlands of the Mississippi Alluvial Valley (MAV), including cherry-bark, Nuttall, pin, water, and willow oaks. Ecologists and managers need reliable estimates of acorn yield and masting traits to assess potential forest regeneration and estimate foraging carrying capacity of these habitats for waterfowl and other wildlife. The authors designed a study to reliably estimate red oak acorn yield in five states in the Mississippi Alluvial Valley over 4 consecutive years (2009–2013) and evaluate the components of masting (i.e., synchrony and temporal variability). The mean annual individual tree yield was 424 kg (dry)/ha (35.1 acorns/m² crown area) across all sites and years. The authors’ yield estimates provide heretofore unreported estimates of average seed yield (seeds/m² canopy) and mass (kg/ha) from red oaks for five of the largest contiguous bottomland hardwood forests remaining in the MAV. In the authors’ study, red oaks yielded more acorns on average and showed less annual variability than studies of other red oaks in North America. The authors found no evidence that annual population-level red oak acorn yield was synchronized at sites across the scale of the MAV. However, synchrony increased with decreasing distance between sites, and the authors found a large degree of interspecific synchronicity within four of five sites. The authors believe that local scale influences such as edaphic resources, weather, and genetics drive within-site yearly patterns in acorn yield. Managers have a greater likelihood of lessening the effect of periodic seed failures in the MAV if they manage for a diversity of site-adapted red oak species as opposed to favoring monocultures or few species.

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Applied research

Stem Taper Equations for Estimating Merchantable Volume of Lebanon Cedar Trees in the Taurus Mountains, Southern Turkey

B. Ozcelik and F. Ceyucuo-Campos

Taper models are one of several necessary components in modern forest inventory and/or management planning systems, giving information on diameter at any point along the tree stem. This information can be used to estimate stem volume and to classify the structure of the tree. This study aimed to assess the performance of different types of taper equations for predicting tree diameter at a specific height, height to a specific diameter, and merchantable volume for Lebanon cedar (Cedrus libani A. Rich.). Ten commonly used and well-known taper functions were evaluated. Appropriate statistical procedures were used in model fitting to account for the problems of autocorrelation and multicollinearity in the hierarchical data that are associated with the construction of taper models. The compatible segmented model of Clark et al. (US For. Serv., Res. Pap. SE-282, Southern Research Station, Asheville, NC, 1991) was superior to the other equations in describing the stem profile, estimating height to a specific diameter, and estimating merchantable volume for Lebanon cedar when upper stem diameter measurements were available, whereas the taper equation of Fang et al. (For. Sci. 46:1–12, 2000) performed well when those measurements were unavailable. The equation of Kozak (For. Chron. 80:507–515, 2004) had lowest Rs² and higher root mean square error and Akaike information criterion values compared with those for the other taper equations. In general, segmented taper equations provided more accurate predictions than variable-form models. The equations developed in this study are fundamental tools for use in forestry practices and can help forest managers in the area of study.

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Genetics & tree improvement

White Oak Growth after 23 Years in a Three-Site Provenance/Progeny Trial on a Latitudinal Gradient in Indiana


To increase the availability of improved, adapted white oak (Quercus alba L.) for midwestern United States landowners, the authors analyzed data from three 23-year-old provenance/progeny tests of 70 open-pollinated progenies from 17 provenances. The authors’ goal was to estimate the heritability of height growth and range of adaptation and ultimately to determine the value of converting the sites to seed orchards. Tree growth was marked by positive spatial autocorrelation (SA) for height in all three test sites despite differences in management and mortality. Microsites with the highest SA changed little from age 10 to age 23. Nearest neighbor and iterative spatial or kriging analyses were used to remove effects of SA from the data, resulting in little change in heritability estimates but important changes in family means and rank. Within sites, provenances were a relatively unimportant source of variation (mostly < 2%), and there was no evidence local sources grew best. Genetic correlation was 0.81 for height between ages 10 and 23. Considering heritability estimates, significant differences among families, and large predicted breeding zones, the sites are thinned, seedlings produced from the progeny tests should grow well above average on suitable sites in Indiana and would probably be acceptable in nearby states as well.

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Designing Skid-Trail Networks to Reduce Skidding Cost and Soil Disturbance for Ground-Based Timber Harvesting Operations

M.A. Contreras, D.L. Parrott, and W. Chung

Skid-trail locations directly influence the economics and environmental impacts of harvesting operations. Typically, field managers design skid-trail networks manually based on field observations of vegetation and terrain conditions. The authors designed a model to automatically design skid-trail networks to reduce skidding costs and soil disturbances. The model simulates tree-bunch locations, creates a feasible skid-trail location, and sets the network design that connects each tree bunch to landings while reducing skidding and soil recovery costs. The model was applied to a 24-ha hypothetical harvest unit to test its ability to design optimal networks under different scenarios representing conditions commonly found in timber harvesting operations (e.g., skidding pattern, uneven volume distribution, skidding obstacles, and different weights given to skidding and soil recovery costs). It was also applied to an actual 124-ha harvest unit to evaluate its ability to design skid-trail networks considering more realistic conditions with multiple design factors. The model successfully created optimized skid-trail networks for all scenarios considered, and results suggest that it provides a useful tool to help forest engineers and field managers design economically efficient and environmentally sound ground-based timber harvesting operations.

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