

THE STATE OF MIXED SHORTLEAF PINE-UPLAND OAK MANAGEMENT IN MISSOURI

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ABSTRACT.—Mixed shortleaf pine-upland oak stands allow flexibility in type and timing of regeneration, release, and harvesting treatments for managers; provide unique wildlife and herbaceous community niches; and increase visual diversity. Most of the research to date focused on growing pure pine or oak stands, with little research on today's need to grow pine-oak mixtures. Despite this lack of information, resourceful foresters are using various regeneration treatments in even- and uneven-aged stands to increase the density of shortleaf pine among oaks. In this paper, we discuss past and current regeneration treatments applied by Missouri Department of Conservation and USDA Forest Service foresters.

INTRODUCTION

Mixed species forests are common in the Missouri Ozarks and there is increasing interest in regenerating mixed stands of shortleaf pine (*Pinus echinata* P. Mill.) and upland oak (white oak, *Quercus alba* L.; black oak, *Q. velutina* Lam. and scarlet oak, *Q. coccinea* Muenchh.). Mixed pine-oak stands are used by neotropical migratory birds, game animals and other fauna and may be managed to promote a rich herbaceous layer (Dickson et al. 1995, Nelson 2005). Restoring pine-oak mixes may be an alternative to maintaining oak-dominated stands suffering from chronic oak decline (Law et al. 2004). In declining oak stands, merchantable scarlet and black oaks, which are at high risk of dying, can be harvested, leaving white oak, shortleaf pine and some younger scarlet and black oaks. Much of the land area affected by chronic oak decline is within shortleaf pine's native range (Nigh and Schroeder 2002). These salvage operations can be combined with treatments to regenerate shortleaf pine and restore pine-oak mixes to their historic importance in Missouri's Ozarks.

Little research has been conducted in Missouri on regenerating shortleaf pine under varying levels of understory competition and overstory density/composition that result from salvage cuts in oak decline stands. Hardwood competition reduces pine growth, and the shade-intolerant pine reproduction does poorly in heavy shade from the overstory (Brinkman and Smith 1969). Overstory composition may also affect light quantity and quality, as

well as the presence of shortleaf pine seed sources. The existence of mature pine-oak stands, however, indicates that the two species are not incompatible.

Foresters have begun exploring regeneration methods in pine-oak and oak-pine combinations by modifying regeneration techniques traditionally used for pine or oak. Some foresters have had success, but no one has developed reliably consistent management practices for regenerating pine with hardwoods in natural stands. We surveyed Missouri Department of Conservation (MDC) and U.S. Forest Service (USFS) foresters to get an overview of how they were trying to regenerate shortleaf pine in hardwood dominated stands. The purpose of this paper is: 1) to present variations we observed in how foresters are regenerating a mixture of pine and oak forests; 2) to discuss the need to control hardwood competition in the regeneration layer; and 3) to discuss the need to release shortleaf pine reproduction from the overstory. Results are presented based upon the order of activities in a typical stand.

METHODS

MDC and USFS foresters who had shortleaf pine on their areas or who worked with private landowners to regenerate shortleaf pine were asked to provide examples of mixed pine and oak stands to assess current pine-oak regeneration practices in Missouri. Stand history data were collected to document the management activities. Examples of recent reproduction (0- to 25-years-old) were easy to come by in some areas and non-existent in others. Where examples of recent regeneration were available, the regeneration techniques and release treatments were recorded. Then the foresters were asked what they would prescribe next. Mature stands provided an opportunity to discuss regeneration cuts and options for seedling establishment.

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RESULTS

Pine and Oak Mixtures

Pine-oak mixtures generally occur as even-aged stands or as two-aged stands where oaks grew into a pine stand. In some stands, pines grew into large gaps within oak stands. The ridges and sideslopes near Buzzards' Roost Cave on the Big Piney River in northern Texas County are examples of variation in spatial distribution. Pines and oaks occur as small groups of single species and as more even mixtures (Fig. 1).

Regeneration Cuts

Regeneration cuts applied to regenerate shortleaf pine-oak combinations include both even- and uneven-aged methods. The cuts include clearcut, typically with reserves; seedtree; shelterwood; and group selection. The range of regeneration cuts reflects the variation in owner objectives and the impact of oak decline. The interest in maintaining continuous canopy cover in tourism corridors and centers and the extensiveness of oak decline are causing some foresters to use uneven-aged methods in pine-oak stands. Some research on uneven-aged management has taken place in the Ouachita Mountains of Arkansas. However, the sites differ greatly in geology and climate, and the stands are generally fire-maintained woodlands with few oaks. Oaks are important economically and ecologically; therefore, research should be done to help foresters meet their goals of managing pine-oak combinations in uneven-aged cycles.

Site Preparation

Site preparation for pine-oak stands is not much different from that for pine stands as practiced in Missouri. Chainsaw felling is the most common site preparation practice. All stems above a given height, such as 4.5 ft, are removed to help prevent shading of the next generation. Burning and scarifying are used to allow pine seeds access to mineral

soil. Burning removes most or all of the duff layer prior to seedfall. Scarifying disturbs the leaf and duff layers sufficiently to incorporate fallen seed with bare mineral soil; thus, it is applied in the fall or winter after seedfall. Foliar herbicide is sometimes applied to retard hardwoods and other plants.

Shortleaf Pine Seedling Sources

Shortleaf pine seedlings come from three basic sources: on-site seedtrees, direct seeding, and planting. Ideally seedtrees are the best phenotype and genotype that grew in the previous generation on that site. Short of hand-pollinating the cones, there is little room for introduction of more disease-resistant trees. Seed for both direct seeding and planting came from superior trees located throughout what is now the Mark Twain National Forest (Fig. 2; Gwaze et al. 2005, Studyvin and Gwaze this volume). Some foresters prefer direct seeding, especially in very rocky soils. It can be expensive at over \$100 per pound and often results in dense stands. Mixing the pine seed with native grass seed helps avoid overstocking the stands and provides additional habitat for early successional wildlife. Pine planting in mixed stands is commonly practiced at wider spacings than in a pure pine plantation, and like direct seeding, it is a way to restore genetic diversity to a stand. Both direct seeding and planting may be used to augment natural regeneration and speed up the process.

Release from Understory

Foresters regenerating pine-oak stands face the challenge caused by the rapid early growth of oak sprouts and the slower early growth of shortleaf pine. Competition from non-pine reproduction can dramatically slow growth of pine reproduction, thereby shifting the species mixture (Fig. 3). Most foresters follow regeneration cuts with chainsaw felling of residual trees, including understory stems. Some foresters also release clearcuts 3 to 5 years after



Figure 1.—Variations in spatial distribution of pines and oaks on a ridge near Buzzards' Roost Cave on the Big Piney River in northern Texas County. Pines and oaks occur both as single-species groups and as mixtures. Fall foliage helps to distinguish the hardwoods (light-colored foliage) and pines (dark-colored foliage).



Figure 2.—Superior trees once used for genetic improvement of Missouri's shortleaf pine. Stands of planted and tagged superior trees like this one in the Willow Springs Ranger District can still be found on the Mark Twain National Forest.

regeneration, even in their pine-oak stands. Unfortunately, most foresters interviewed did not plan a second release treatment in canopy gaps. During this investigation we found that understory competition had unexpectedly overshadowed the pine seedlings in canopy gaps. An operational study by Doyle Henken (silviculturist, Mark Twain National Forest) confirms that understory competition plays an important role in slowing pine growth (Blizzard et al. this volume). Canopy openings allow hardwood sprouts and other understory vegetation to take advantage of the direct sunlight and compete for growing space with pine reproduction. Foresters should consider releasing pines from competitors in the reproduction cohort at 3-5 years after regeneration, just as they do in clearcuts.

Release from Retained Overstory

Shortleaf pine has been known to remain in the midstory/understory for over 50 years. For instance, Stambaugh (2001) found a live, 55-year-old stem that was approximately 3 inches DBH. While this discovery shows that shortleaf pine can be somewhat persistent in the understory, this slow diameter growth may not be commercially sustainable. Studies are needed to determine how long pine reproduction can remain in the understory and still grow well after release from the overstory.

A study under way on MDC's Piedmont District by Jason Jensen examines underplanting (Jensen this volume). Figure 4a shows a stand underplanted in 1998 and then clearcut less than a year later; and Fig. 4b shows a stand also planted in 1998, but under C-level stocking. The reproduction in the clearcut stand appears to have grown roughly twice as tall as the reproduction in the stand thinned to C-level stocking. This difference shows the dynamic impact of a partial canopy on shortleaf pine seedling growth.



Figure 3.—Shade slows height growth of shortleaf pine.

Timber Stand Improvement

Release from competition continues in even-aged stands through the first 20-25 years after regeneration. Chainsaw fellers are given decision rules to rank stems by species, form and spacing for target stand conditions. This thinning may shift the balance toward pine or retain more of a mixture of pine and oak. A typical species ranking is: shortleaf pine, white oaks and then red oaks. This ranking is used particularly in declining red oak stands that have a component of shortleaf pine, and shifts the mix towards the longer-lived shortleaf pine and white oak group.

CONCLUSION

All studies on shortleaf pine-upland oak must be evaluated based upon the starting condition of the stand as well as the moisture regimes, desired fire regimes, and soils to determine how the stands and treatments fit the conditions in a local area. Not all potential pine-oak sites are the same. Some pine-oak sites are currently fire-maintained as early successional open woodlands, while others have not been burned recently, receive more rain, or have a higher proportion of non-oak hardwood sprouts. Both even- and uneven-aged regeneration cuts are being applied due to oak

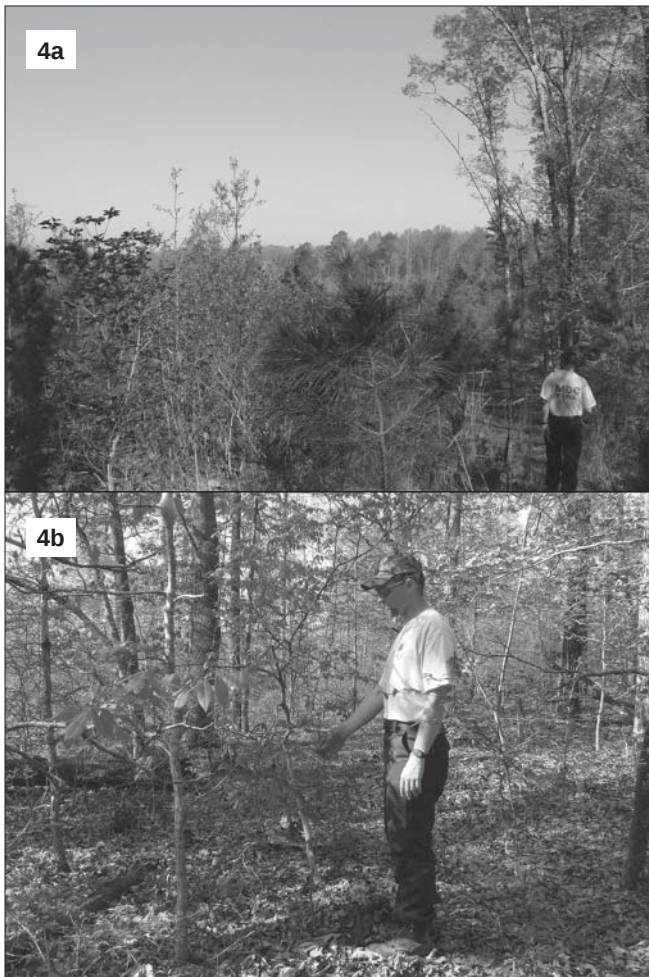


Figure 4.—Positive impact of overstory release on shortleaf pine growth underplanted in 1998 and clearcut within 1 year (a). Shortleaf pines appear to be over twice as tall as those planted under a C-level stocking (b). Both pictures were taken in late spring 2006.

decline and increased tourism. There are examples of 20- to 25-year-old even-aged pine-oak stands in the Missouri Ozarks. Examples of 20-25 year-old uneven-aged pine-oak stands are less common, owing to past management trends and lack of information about the timing of applicable regeneration and release treatments.

While shortleaf pine can remain alive in shade, the species is generally considered intolerant of shade and grows more vigorously in full sunlight. Release from both the overstory and the understory may be required to provide sufficient sunlight. Studies are being developed and are underway to further understand the role that overstory and understory shade combinations play in shortleaf pine growth in mixed pine-oak stands.

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