



LAND MANAGER'S GUIDE

Shortleaf Pine

NATURAL REGENERATION IN OKLAHOMA





Figure 1: Shortleaf pine – bluestem demonstration area on Pushmataha Wildlife Management Area, Pushmataha County, Oklahoma. Through controlling stand density and applying regular fire, land managers can produce beautiful landscapes with many potential uses. Photographer: Kurt Atkinson, Oklahoma Forestry Services

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Oklahoma Forestry Services

www.forestry.ok.gov



Introduction

In 1897, Charles Mohr wrote, “When maintenance of forest production of timber under a rational system of forestry is to become the rule, this species [shortleaf pine] above all others of southerly distribution will claim attention, for it can be safely asserted that of the coniferous trees adapted to the climatic conditions of the Southern Atlantic forest, no other can be found of better promise for the production of valuable timber in the shortest time.” Although subsequently proven wrong, at the time, shortleaf pine was the most widespread and abundant forest tree in the South and in much of the Mid-Atlantic region. In contrast, loblolly pine, the basis of modern plantation pine management, was a relatively minor species that occurred primarily in wet lowlands.

Many landowners are interested in growing pine forests using natural regeneration of native species and in restoring historical landscapes that include shortleaf pine. Herein, you will find what growth rates you can expect from shortleaf pine, an overview of methods available for the establishment and maintenance of shortleaf pine using natural regeneration, and the kinds of stands that can be managed using shortleaf pine natural regeneration.



Figure 2: Shortleaf pine in an ice storm. Shortleaf pine is known to be an ice-resistant pine species. Its smaller needles and hard wood prevent breakage and compression wood during ice storms. LeFlore County, Oklahoma. Photographer: Caleb Fields, Oklahoma Forestry Services

Sites	Genotypes	Volume (m ³ ha ⁻¹)
Antlers	Loblolly	93.64
	Shortleaf	39.97
Cavanal	Loblolly	82.36
	Shortleaf	15.04
Idabel	Loblolly	79.64
	Shortleaf	38.03
Shinewell	Loblolly	107.12
	Shortleaf	48.52

Table 1: Loblolly pine outperforms shortleaf pine in timber production. Here, across multiple Oklahoma sites, 10-year-old loblolly pines had more than double the volume of 10-year-old shortleaf pines. Adapted from "Comparison of loblolly, shortleaf, and pitch x loblolly pine plantations growing in Oklahoma" by K.C. Dipes, Rodney E. Will, Thomas B. Lynch, Robert Heine- mann, and Randal Holeman, publication in revision.

What You Can Expect From Shortleaf Pine

Even on marginal upland sites north of loblolly pine's natural range, loblolly outperforms shortleaf pine for timber volume production by a large margin (Table 1). Steer landowners interested solely in timber profit away from shortleaf and toward genetically improved loblolly pine. For instance, when measured at age 10, loblolly pine stands planted at four sites in southeastern Oklahoma in 2002 had 1,300 ft³ per acre while shortleaf pine had only 506 ft³ per acre. Given time, shortleaf's growth rate, i.e., current annual increment, may become similar to loblolly, but total stand volume of shortleaf does not tend to catch up due to loblolly's head start. Those interested in native trees and habitats, maintaining more natural forest aesthetics, managing for longer rotations, desiring less expensive starting costs, reducing risks from climate change, or diversifying their timber portfolios may want to consider natural regeneration of shortleaf pine as their management strategy.

The Benefits and Costs of Natural Regeneration

Natural regeneration of shortleaf pine offers numerous potential benefits to fulfill the goals of landowners.

- Less upfront cost
- Opportunities for more frequent periodic revenue
- Diversification of timber sources
- High quality timber
- Greater flexibility in approach
- Native flora and fauna abundance
- Opportunities for agroforestry
- Game species abundance
- Historical forest aesthetic

Natural regeneration is not without drawbacks and tradeoffs, however.

- Lowered timber volume
- Less opportunity to use genetically improved seedlings
- Unpredictability of seed crops
- Greater need for active stand management

Methods for Converting a Site to Shortleaf Pine

If shortleaf pine does not already exist on the site, then it will be necessary to plant shortleaf pine seedlings to convert the site. Site preparation will need to be tailored to the location. Oklahoma Forestry Services (OFS) offers both bare-root and containerized shortleaf pine seedlings for reforestation. Ordering information is available through Forestry Services website. These Oklahoma adapted and genetically improved seedlings are sourced from the OFS seed orchards in Idabel. Shortleaf does best when planted early (December through February).



Figure 3: A forestry worker hand plants shortleaf pine bare-root seedlings. LeFlore County, Oklahoma. Photographer: Craig Marquardt, Oklahoma Forestry Services

Shortleaf pine needs full sun for optimal growth so harvesting merchantable trees is the first step. When it is consistent with landowner objectives, some hardwoods, such as oaks, may be left standing to provide limited cover, a seed source for the future desired species mix, and a source of habitat and food for wildlife. Depending on the size and density, undesired non-merchantable trees can be killed with mechanical methods, fire, or herbicide. Soil ripping can ease planting and improve

shortleaf pine seedling survival, though this can be expensive and cause soil erosion if done improperly.

Prescribed fire will topkill smaller hardwood trees. It also reduces remaining underbrush and debris, to release further nutrients for the seedlings that will be planted, and to reduce competition for water. Fire has potential drawbacks, however. There is always a risk of the fire getting too hot or even out of control, damaging large trees or structures. Smoke causes air quality problems for people downwind of the fire, so in addition to ensuring that moisture levels are right, managers have to account for wind speed and direction and other factors.

Herbicide treatment is alternative or an amendment to prescribed fire. It can be used to specifically control hardwoods or herbaceous vegetation, and it does not carry the same aforementioned risks and smoke as fire. It can be applied by spot spraying or by broadcast spray from ground-based misters or aircraft. Herbicide application (especially if it is by broadcast spray) may have undesired effects on the herbaceous plant population if understory production and diversity is important for wildlife or other objectives. Many landowners will also choose not to use herbicide. Proper licensing for commercially applying chemicals, including herbicides, is necessary.

Methods for Initiating Shortleaf Pine Natural Regeneration

When shortleaf pine is already present on a site, there is little to no need to plant seedlings. Instead, the site can be regenerated using one of several silvicultural systems: seed-tree, shelterwood or uneven-aged management. In each case, timing of harvesting, prescribed burning, or other soil disturbance activities is important. When stand regeneration is desired, expose mineral soil with fire or mechanical methods in advance of good seed crops. Shortleaf pine seeds germinate best when they lay on top of mineral soil in open sun. It is important to leave healthy, good-quality seed-trees when using any of these systems, because their fecundity and genetic quality will determine the quantity and quality of the seedlings. They are also the trees that increase in value the most within additional growth. If merchantable timber is prioritized to the point that inferior trees are left on the site, select seed-trees that have environmentally caused defects to try and minimize poor genetic stock. The size of the seed-trees is also important. Expect seeds to be dispersed by wind to around triple the height of each tree. Larger trees also generate more seed.

The initial cut of a **seed-tree** regeneration system removes most or all non-shortleaf pine as well as all but 2 to 12 large and healthy shortleaf pine seed-trees per acre. The number of trees left on site to provide seed depends on tree size and suitability of the forest floor, i.e. fewer trees

if they are large and if bare mineral soil is exposed. Prescribed fire or herbicide application might be needed to prepare the forest floor for germination and establishment of shortleaf pine. Depending on seed production the first several years after cutting and the aggressiveness of competitors, follow-up treatment of fire, herbicide, or mechanical methods might also be necessary. When an adequate number of saplings are established, the seed-trees are removed, and the stand can grow as an even-aged shortleaf pine stand. Subsequent thinning will provide income and manage density to optimize tree growth. Seed-tree cuts are somewhat traumatic for the landscape. Erosion, risk of encroachment of undesired plants, a disruption of the wildlife regime, and a landscape that most will find unaesthetic are all likely outcomes. On the other hand, the newly regenerated stand provides important early successional habitat for a variety of herbaceous plants and game and nongame wildlife species.



Figure 4: Seed-tree cut with shortleaf pine natural regeneration. The taller shortleaf pines will be removed soon, as the seedlings appear well-established. LeFlore County, Oklahoma. Photographer: Craig Marquardt

The **shelterwood** silvicultural system is similar to the seed-tree system, but it offers the landowner a less drastic alternative to seed-tree cuts. With shelterwood treatments, fewer trees are removed in the first treatment so that the ground is less exposed, and seedlings are afforded some protection. Since the initial cut of a

shelterwood treatment removes less material than that of a seed-tree system, there is less up-front profit, but there is less erosion and other deleterious effects. Shelterwood treatments offer the forester more flexibility moving forward, because subsequent tree removal can be total or partial.



Figure 5: Shelterwood cuts provide good opportunities for shortleaf pine regeneration, giving more flexibility than seed-tree cuts. LeFlore County, Oklahoma. Photographer: Craig Marquardt

Uneven-age stands may be established through periodic removal of merchantable trees in order to create clearings for seedlings to grow. In addition, lower quality individuals of smaller size classes are removed as necessary to balance the age distribution across the stand. This management system results in periodic income from timber, maintenance of existing habitat, and an aesthetic that is often pleasing for the owners. In addition to continued tree removal, maintenance with fire or herbicide will be necessary, especially since the remaining trees will make mechanical treatments difficult. With uneven-age stands, fire can be riskier, since the varying crown heights can act as a ladder for the fire, if it gets out of control. Fire may also eliminate some of the younger shortleaf pine.

Methods for Maintaining Shortleaf Pine Natural Regeneration

Shortleaf pine is not a climax species, and if a site goes unmanaged and undisturbed, it will eventually convert to dense hardwood forest with only large established shortleaf pine individuals remaining. Historically, shortleaf pine was maintained by regular fire set by indigenous people, but the absence of fire over the last century has dramatically changed Oklahoma forests. In order to perpetuate a shortleaf pine forest, fire or another frequent disturbance will be required for shortleaf pine regeneration and for keeping hardwood trees from crowding out the pines.



Figure 6: Fire as a management strategy. Low-intensity fire provides an ecologically friendly way to manage underbrush and increase soil fertility. LeFlore County, Oklahoma. Photographer: Craig Marquardt

Fire is the most ecologically sound means of maintaining a shortleaf pine forest. The species itself has fire adaptations, and new evidence suggests that fire can prevent the establishment of shortleaf pine x loblolly pine hybrid seedlings, thereby maintaining species integrity. Low intensity, early growing season (March through May) fire every 3 years is recommended. Shortleaf pine seedlings will lose their stems in such fires, but they can resprout, and they will eventually grow large enough to avoid topkill. Many herbaceous species benefit from fire, and landowners may be pleasantly surprised with the beauty of wildflowers that bloom afterward. Fire, however, has its drawbacks. There is the risk of wildfires or escape of prescribed fires, and the air quality concerns of neighbors have to be taken into account. Oklahoma Forestry Services offers help for prescribed burning and offers special assistance to non-industrial forest landowners.

Mechanical treatments can substitute for fire to a degree. Treatments that cut or shear undesirable vegetation will set back competition, but will not kill the roots allowing resprouting. Treatments that uproot vegetation will eliminate undesirable plants, but may result in soil erosion. In all cases, mechanical treatments are expensive, will not encourage fire-dependent species, and may be limited by site accessibility.

Herbicides can be used to control hardwoods to maintain a shortleaf pine stand. Spot application with a backpack sprayer or stem injection will remove specific plants, though broadcast spray will likely work better for maintenance of existing stands. Applications should be made every 8 to 10 years. Herbicides are relatively inexpensive, but they will kill many plants that may be desirable, will not control against shortleaf pine x loblolly pine hybrids, and many landowners interested in natural regeneration will oppose their use. They are potentially toxic and require proper licensing to deploy commercially.

Stand Density. With natural regeneration, stand density is not dependent on the spacing of initial planting, and landowner goals are not likely centered on maximizing timber profits. Land managers need to be aware of other possible goals and how managing density can achieve them. Density can range from closed canopy forests to semi-open canopy woodlands to open canopy savanna.

A productive **closed canopy forest** has a basal area between 70 and 120 ft²/acre. Because of shading, undergrowth is somewhat limited, though to keep a walkable landscape and prevent eventual domination by hardwoods and infill of eastern redcedar in the midstory, fire or herbicides should be applied. Occasional thinning will be necessary in order to maximize productivity, just as in a plantation setting.

Pine-bluestem woodlands are a historical landscape that once dominated a large portion of eastern Oklahoma. These semi-open canopy systems have basal areas between 60 and 75 ft²/acre. Herbaceous plants, especially bluestem grasses, can grow underneath the canopy. The wide spacing of the trees and the grasses give pine-bluestem woodlands a park-like atmosphere and can host abundant wildlife, much of which does not occur in closed canopy forests. The red-cockaded woodpecker is one such species, and if the forester is interested in encouraging this species, then special considerations can be made. Currently, the U.S. Forest Service is pioneering efforts to restore this ecosystem in the Ouachita Mountains. This system is very good for promoting game species including white-tail deer, turkeys, and quail. Agroforestry using cattle is also a possible land use. Fire is necessary to topkill hardwoods and prevents them from creating a closed canopy.



Figure 7: Shortleaf pine-bluestem woodland. The semi-open canopy allows grasses and other herbaceous plants to thrive. Scott County, Arkansas. Photographer: Rodney Will

Pine savannas are open canopy woodlands that combine the forest and the prairie. A typical pine savanna (also called a pine barren) has a basal area between 20 and 40 ft²/acre. As with pine-bluestem woodlands, pine savannas support numerous flora and fauna and encourage popular game species. Landowners can also graze livestock, however they produce relatively little timber after establishment.

Conclusion

Shortleaf pine natural regeneration offers a great alternative to traditional plantation systems, and many landowners will be interested in maintaining some of their property in these historical landscape forms. Oklahoma Forestry Services offers state residents information and support for transitioning land into shortleaf pine regeneration.

Links of Interest

Additional resources are available on these websites:

Oklahoma Forestry Services
www.forestry.ok.gov/shortleaf-pine

The Shortleaf Pine Initiative
www.shortleafpine.net

For more information, contact:

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