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Ecological and Social History of Shortleaf Pine

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Introduction

Shortleaf pine (*Pinus echinata* Mill.) has a complex ecology and social history. It is the most widespread pine species in the Eastern United States, with a current natural range encompassing 22 states and over 440,000 square miles (Fig. 1).[23] Historically, pollen data suggests that the species was even more widespread, with records from Michigan[9]. Additionally, the species has been planted in some of the adjacent states on the northern limit of its current range (J Guldin 2016, pers. comm.). Shortleaf pine is found in a wide diversity of habitats and different natural community types, sometimes in pure shortleaf pine dominated stands in the Ouachita and Ozark Mountains, and elsewhere as a component of mixed pine, pine-oak and oak-pine forests. Throughout its range the species has been an important timber species since European settlement and continues to have significant commercial value.

Yet, even with its wide occurrence and commercial value, the species has not been as highly valued ecologically as the iconic longleaf pine (*Pinus palustris* Mill.) or commercially as loblolly pine (*Pinus taeda* L).[11] This has resulted in a greatly reduced abundance. Shortleaf pine dominated forests currently occur on less than 6 million acres, estimated as less than 10% of its historic acreage.[30,32] The causes of the decline are many. Several centuries of harvesting has greatly reduced the acreage of shortleaf pine, as have land use changes and disease and pests.[23] The preference of planting loblolly pine for industrial roundwood and fiber production, especially where the natural range of the two species overlap, and the lack of experience regenerating shortleaf pine in mixed stands have contributed to this decline.[16,35] The most significant cause of degradation to remaining forests is the lack of fire.[24] Fire plays a critical role in perpetuating the shortleaf pine ecosystem. Without fire, both the extent and condition of shortleaf pine dominated forests have diminished.

The following sections discuss the historic range, ecology, and current condition of shortleaf pine forests and the historic and current human use of the species. The final section presents some lessons learned from the past history of the species.

HISTORIC RANGE OF SHORTLEAF PINE

The geographic range of shortleaf pine includes 440,000 square miles (282 million acres),[23] much of which is composed of forests in which shortleaf pine is either not dominant or entirely absent. The exact acreage of shortleaf pine forests at the time of European settlement is difficult to estimate considering the first measure-

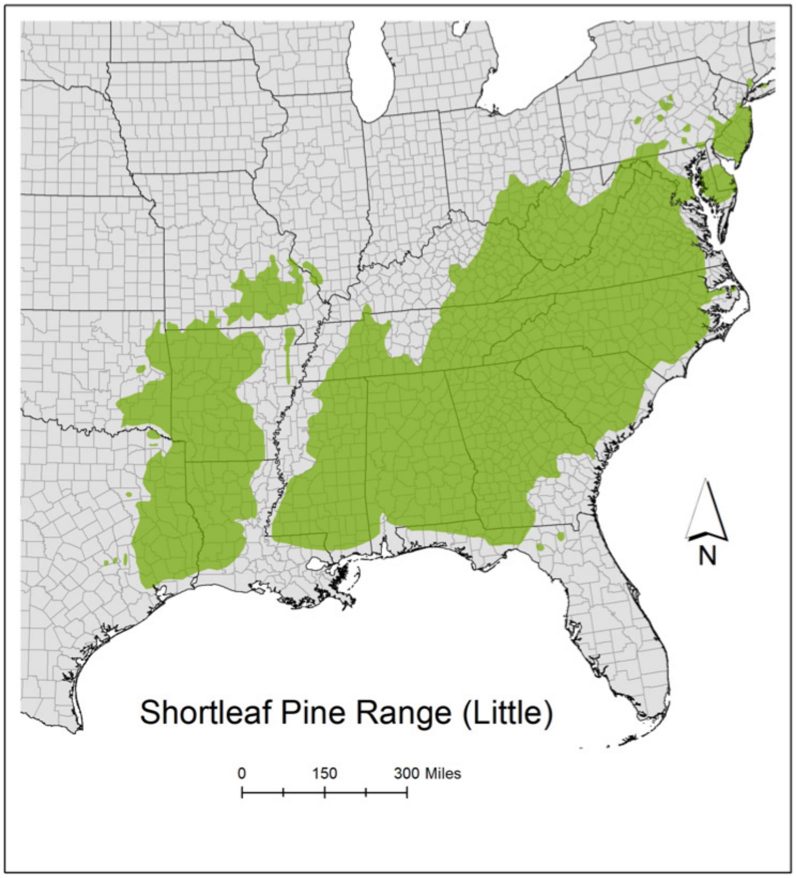

Figure 1. Historic range of shortleaf pine published by E.L. Little, 1971, USDA Forest Service.

ments of timber resources in the eastern U.S. came at the end of the 1800s and the early 1900s,[26,28,31] after nearly 300 years of harvesting shortleaf and extensive land use changes. These estimates from the turn of the last century did not differentiate between shortleaf forest types, some assessing only shortleaf acreage of commercial value and others assessing all forest types that included shortleaf pine. For example, in the early twentieth century, the commercial range of shortleaf pine was estimated at 280 million acres across 14 states, equal to its original geographic range, which included substantial second growth growth forests on abandoned agricultural lands.[26]

Using Mohr and Roth's 1896 assessment of shortleaf-dominated forests for the western part of the range and historical information and a model based on topography and aspect for the eastern part of the range, the Shortleaf Pine Restoration Plan (2016) estimated the historic range of shortleaf-dominated forests as between 70 and 80 million acres at the time of European settlement.[28,32] More recent plot-based data show that only 6 million acres of shortleaf pine dominated forests exist today and that this acreage has declined by more than 53% since 1980 (Fig. 2).[30] Even without exact estimates of historic acreage, it is clear that shortleaf pine has significantly declined as an ecosystem and community component, present now on probably less than 10% of its historic range. The best remaining examples of shortleaf pine forest types are on federal and state lands (J Guldin 2016, pers. comm.).

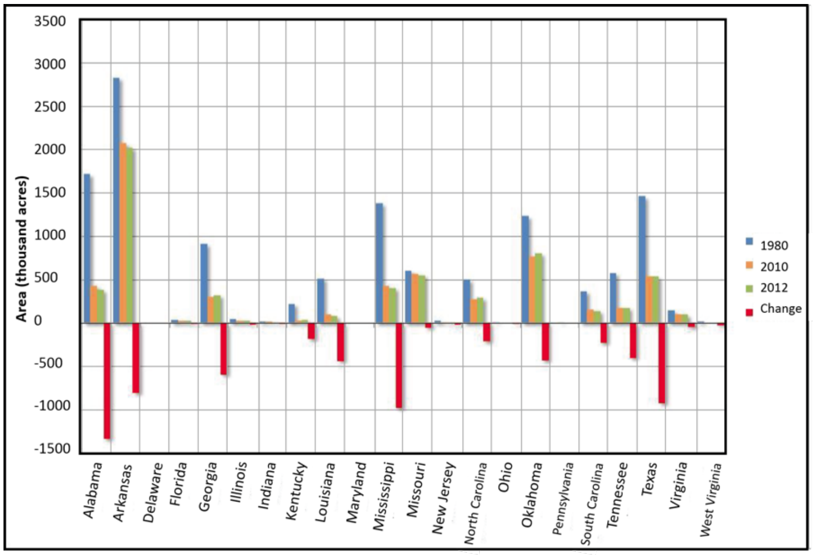

Figure 2. Decline of shortleaf pine-dominated forests.

Table 1. Shortleaf Pine Cover Types Recognized by the Society of American Foresters.[7]

Component	Shortleaf Forest Cover Types
Major	Shortleaf Pine (Type 75) Shortleaf Pine-Oak (76) Loblolly Pine-Shortleaf Pine (80)
Minor	Eastern White Pine (21) Post Oak-Blackjack Oak (40) Bear Oak (43) Chestnut Oak (44) Pitch Pine (45) Eastern Redcedar (46) White Pine-Chestnut Oak (51) White Oak-Black Oak-Northern Red Oak (52) Yellow Poplar (57) Longleaf Pine (70) Virginia Pine-Oak (78) Virginia Pine (79) Loblolly Pine (81) Loblolly Pine-Hardwood (82) Black Oak (110)

ECOLOGY OF SHORTLEAF PINE

Across its wide range, shortleaf pine occurs in a variety of habitats, from open woodlands to hardwood forests. This diversity of community structure and composition is the result of geology, soils, aspect, hydrology, and interaction with fire.

Shortleaf pine can grow on a range of soil types, aspects, and geological types, and across a range of hydrologic gradients.[1,3,12,14] It grows on xeric sandhills in Florida; xeric south- and southwest-facing slopes in the Appalachians, Ozarks, and the Ouachitas; and well-drained sandstone hills on the Cumberland Plateau. It also occurs on mesic lowlands and across the rolling uplands separating major and minor stream bottoms in the Piedmont and Coastal Plain.

Within its range, shortleaf pine occurs in a number of different forest types. These forest types vary depending on the classification scheme. Shortleaf pine is associated with 18 forest cover types according to the Society of American Foresters (Table 1),[7] and 60 NatureServe plant communities.[29,32] Of the 47 NatureServe natural community associations in which shortleaf is dominant or co-dominant, the majority (68%) are considered critically imperiled or imperiled.[29,32] The critically imperiled natural communities

Figure 3. Prescribed fire in a shortleaf pine woodland. Ouachita National Forest. Credit: Virginia McDonald, USDA Forest Service.

of shortleaf pine occur throughout the range of the species, including shortleaf-oak woodlands in North Carolina, Tennessee, Georgia, and Mississippi, longleaf-shortleaf woodlands in Georgia, and shortleaf oak woodlands and mesic longleaf-shortleaf woodlands in Louisiana and Texas. Many of these forest types are the focus of conservation efforts.

In the New Jersey Pine Barrens and in the Appalachians, shortleaf pine is a close associate of pitch pine. In the eastern part of its range, shortleaf pine is found mixed with oaks, but today is rarely found in extensive stands of shortleaf pine. Conversely, in the northwestern part of its range (Ozark Highlands and especially the Ouachita Mountains), shortleaf pine is the dominant canopy species either alone or in mixture with oaks, eastern red cedar, and other hardwoods in the region. Along the Atlantic and Gulf Coastal Plains, shortleaf pine is found in varying degrees of mixture with three common southern yellow pine species: loblolly, longleaf, and slash.

Fire plays a critical role in the regeneration, establishment, maintenance, structure, and composition of shortleaf pine ecosystems (Fig. 3).[24] Fire prepares bare soil for regeneration and reduces competition with other tree species. Windstorms and human disturbances also provide conditions for shortleaf pine regeneration. Along with longleaf and ponderosa pine, it is one of the three great frequent fire pine ecosystems in North America.[19]

Shortleaf pine has several fire-adapted traits allowing it to survive fire and colonize burned areas. Seedlings and saplings have the capacity to re-sprout when top-killed by fire due to axillary buds located in a basal J-shaped crook near the ground surface, a unique feature of the species relative to other southern pines (Fig. 4).[25] A thick platy bark and minimal quantities of resin production protect older trees from fire.[11,25] Seed crops and growth of existing seedlings allow the species to establish soon after fire (J Guldin 2016, pers. comm.).[25]

Shortleaf pine evolved in a landscape that had a historic mean fire interval of two to twenty years from both natural (e.g., lightning) and human sources (e.g., Native Americans).[8,13,21] Native Americans commonly used fire for agriculture, enhancing wildlife populations and forage plants and improving travel and defensive conditions.[37] Early settlers continued the use of fire, benefitting shortleaf pine, until extensive fire suppression at the beginning of the 20th century.[8]

Fire also plays an important role in maintaining the structure and composition of shortleaf pine forests. More frequent fires result in an open woodland structure, a habitat that is among some of the most imperiled in eastern North America. The more open woodlands, called savannas by some references, have a very sparse overstory and a well-developed herbaceous understory including grasses, wildflowers, and occasional understory shrubs.[20] The increased light levels encourage the development of a native grass-herbaceous vegetative ground layer often dominated by little and big bluestem. The open structure provides habitat for a range of rare and restricted plant species. Woodlands with a higher density of trees may have understories that consist of lower grass cover and higher cover of woody plants.[20] Fire limits the encroachment of fire-intolerant hardwoods and less fire-tolerant conifers (especially seedling and sapling loblolly and slash pine, as well as eastern redcedar). Even in closed canopy forests, canopy gaps formed from small-scale disturbances and infrequent fires would have maintained shortleaf pine forest types in mixed pine stands. Thus, the amount of shortleaf pine regeneration in Shortleaf Pine–Oak forests decreases when the time between fire events increase.[2]

The reduction or removal of fire from ecosystems containing shortleaf pine threatens future pine regeneration, maintenance, structure, and composition. Altered fire regimes, both in intensity, frequency, and season of burn, have drastically changed the shortleaf pine forest ecosystems.[15,21,22,34] Fire suppression allows the establishment of less fire-tolerant conifers and fire-intolerant hardwood species such as oaks, sweetgum, tulip poplar, and red maple.[4,5,15] Shortleaf pine recruitment

Figure 4. Shortleaf pine basal crook. Ouachita National Forest.

is reduced due to a lack of fire.[10] In the southern Appalachians, where fire has been reintroduced, recruitment of shortleaf pine is lacking due to the absence of a seed source from mature trees.[22] In the absence of fire at the landscape scale, shortleaf pine communities succeed, over time, into hardwood-dominated forests.

Figure 5. Historic wood utilization of shortleaf pine. Shortleaf pine pulpwood bolts, Camden, AR, circa 1928.

HUMAN USE OF SHORTLEAF PINE

Commercially, shortleaf pine has a long history as a valued timber commodity (Fig. 5).[18,26,36] In the 1700s and the early 1800s, shortleaf pine was one of the dominant raw materials used for building construction in the Mid-Atlantic region, used in framing, finish work, and flooring. Furniture was commonly made of shortleaf pine. Shortleaf pine timber was valued for the shipping industry and used in dockyards of port cities of New York, Philadelphia, and Baltimore and for boat building in coastal areas. Some shortleaf pine lumber was exported to Britain and the West Indies from the earliest days of colonization.[40] With this extensive harvesting, shortleaf pine forests decreased dramatically along the east coast, and by the mid-1800s, the resource was nearly eliminated.[26]

In the latter half of the 1800s, after harvest levels declined and regeneration increased on abandoned farm fields, shortleaf pine acreage dramatically increased in the east, so much that Mattoon stated, "shortleaf pine is the only commercial conifer on more than 100,000 square miles of upland region between Virginia and northern Alabama and Mississippi."[26] The species, along with other pines, was used for buildings, furniture, and in the early construction of automobiles.[26] The early 1900s harvest of the species and the expansion of farming again greatly reduced the acreage of the species.

West of the Mississippi River, in the upland areas of northern Louisiana and Arkansas, southern Missouri, northeastern Texas, and eastern Oklahoma, shortleaf pine was mixed with loblolly or found in pure stands. In this part of the species' range, shortleaf pine dominated the forest industry from the late 1800s through the first half of the 1900s in the Ozark Mountains of Missouri and Arkansas, and Ouachita Mountains of Arkansas and Oklahoma.[2,33,36] In 1899, timber production peaked in the western part of shortleaf pine range, and by 1920 the resource had been almost entirely harvested except for several remnant virgin stands in the Ozarks and Ouachita Mountains.[6,33] Larger tracts of uncut forests remained in Oklahoma until the 1940s, and some have persisted to the current time in the McCurtain County Wilderness Area (K Atkinson 2016, pers. comm.).

Today, shortleaf timber is selected for its strong straight grain, lumber with a higher specific gravity relative to plantation-grown trees, and weather resilient wood. The species is resilient to drought and performs well on very dry sites.[14, 23, 39] Shortleaf pine woodlands are being actively managed for their wildlife value, specifically for hunting game such as deer, turkey, and quail, and for maintaining biodiversity.[17,24] Managed shortleaf pine forests and woodlands also increase the wildfire resilience of landscapes.[27,38]

CURRENT CONDITION

Recent analysis from Forest Inventory and Analysis Program (FIA) data show a continuing decline for shortleaf-dominated forests (Fig. 6 and 7).[30] The analysis focuses on two shortleaf pine-dominant forest types as defined by FIA, Shortleaf Pine (in which shortleaf pine is a dominant species sometimes mixed with other pines) and Shortleaf Pine–Oak (in which shortleaf shares dominance with one or several species of oak). The first is estimated to occur over 3,234,622 acres, while the latter is found on over 2,795,599 acres. Most shortleaf-dominated forests (68%) occur in states west of the Mississippi River (Arkansas, Missouri, Oklahoma, Texas), and are especially prevalent in Arkansas (33%).[30]

The data show a 53% decline in shortleaf-dominated forest acreage since 1980. The greatest losses in acreage over the last thirty years are in Alabama, Arkansas, Georgia, Mississippi, and Texas. The data also show that shortleaf pine is disappearing from the coastal and piedmont regions in Virginia, the Atlantic Coastal Plain of North Carolina, South Carolina, and Georgia, and the Cumberland Plateau of Tennessee and Kentucky at particularly alarming rates.

The data also foreshadow future challenges to sustaining shortleaf pine across the range. The majority of shortleaf-dominated forests (both Shortleaf Pine and Shortleaf Pine– Oak forests as defined by FIA) occur in larger diameter size classes.[30] While this is an excellent condition for these forests and for maximizing timber and wildlife values, the relative lack of smaller diameter trees (implying younger forests) is a cause for concern. Outside of the western part of its range, shortleaf seedlings are found in only a minority of the FIA plots. Without regeneration, this suggests that shortleaf will continue to decline in the eastern part of its range in the absence of future restoration efforts.[30]

While some 62% of shortleaf-dominated forests are found on private lands at present, some trends are disturbing. In recent years (2005-2012), shortleaf removal through harvesting and land clearing in the eastern US have exceeded growth and has reduced shortleaf pine volume by nearly 5%.[30] Meanwhile, volume is increasing on public lands.

LEARNING FROM THE PAST

The status of the nation's shortleaf resource today stands in sharp contrast to its earlier abundance. Recent data estimate that only 6 million acres of shortleaf pine dominated forests exist today and that this acreage has declined by more than 50% since 1980. Much of the remaining shortleaf is found west of the Mississippi, while it is considerably reduced in the east. It is clear that shortleaf pine and associated habitats have significantly declined in the United States, present on less than 10% of the historic range, constituting one of the nation's most threatened legacy forests.

The Shortleaf Pine Restoration Plan is focused on restoring this forest for its unique ecological and economic values. Working throughout the range of the species, the plan will develop and maintain regional partnerships, establish shortleaf pine restoration areas on public lands, support restoration on private lands, identify and communicate the economic opportunities for shortleaf timber products, increase the use of fire to restore, improve, and maintain shortleaf ecosystems, and educate public and private entities about shortleaf pine. The ultimate goal of the plan is to maintain and restore this legacy forest across its native range.

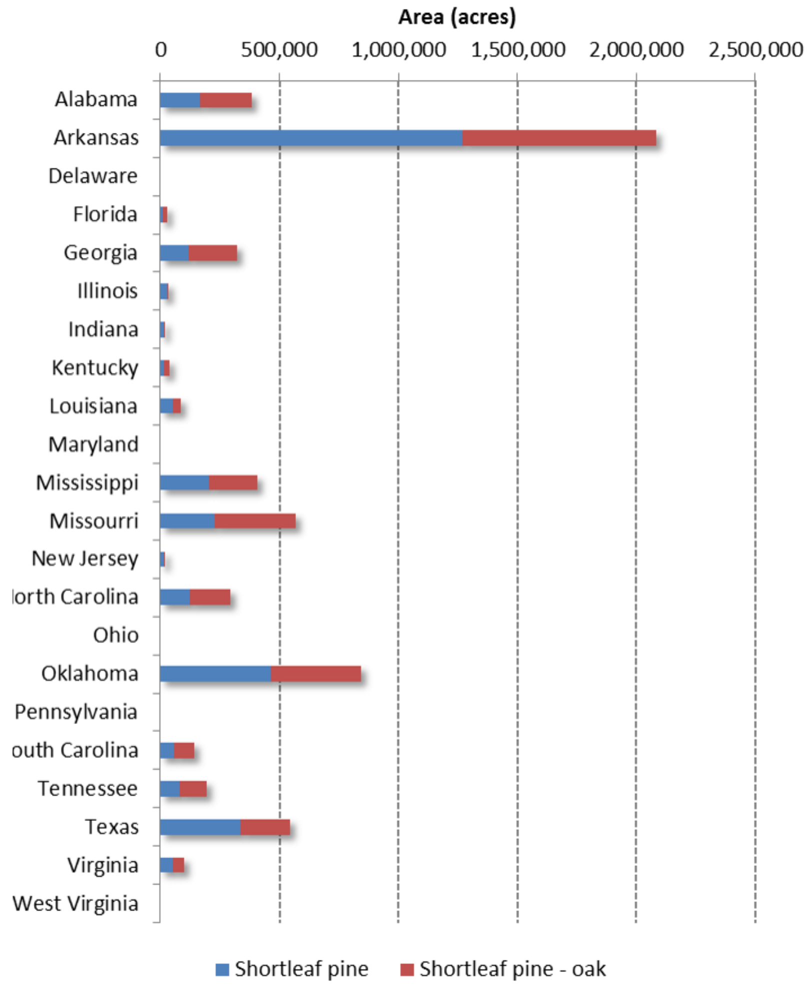

Figure 6. Acreage of Shortleaf Pine and Shortleaf Pine–Oak Forest types in each state from FIA data.

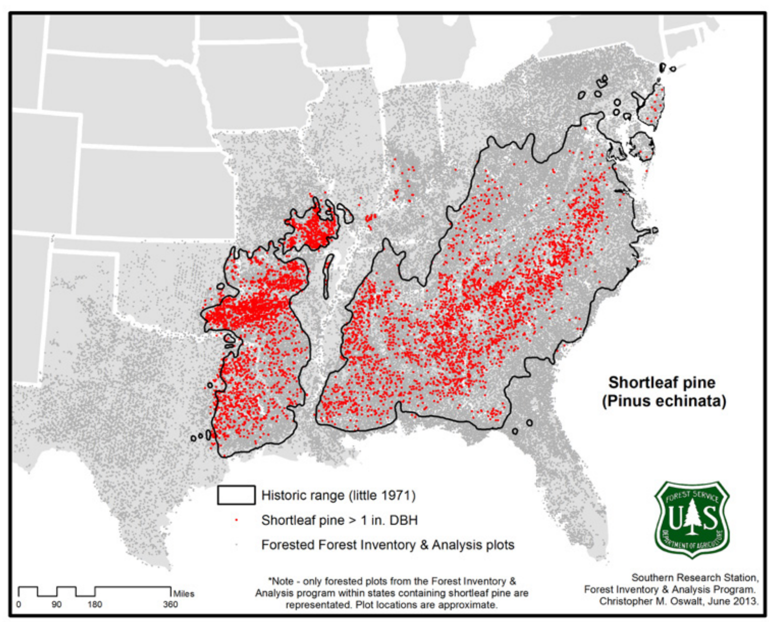

Figure 7. Distribution of shortleaf pine on FIA forest plots within historic shortleaf pine range, 2012.

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