Forests and Forestry in Arkansas During the Last Two Centuries

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Bragg DC. 2011. Forests and forestry in Arkansas during the last two centuries. In: Riley LE, Haase DL, Pinto JR, technical coordinators. National Proceedings: Forest and Conservation Nursery Associations—2010. Proc. RMRS-P-65. Fort Collins, CO: USDA Forest Service, Rocky Mountain Research Station: 3-9. Available at: http://www.fs.fed.us/rm/pubs/rmrs_p065.html

Abstract: Arkansas has had a long and storied history related to its forests and forestry. Ever since its acquisition in the Louisiana Purchase, timber has played a large role in the socioeconomic development of this state. In the 1880s, it was estimated that Arkansas had about 13 million ha (32 million ac) of forests and several hundred billion board feet of timber, numbers that fell dramatically as commercial lumbering spread across the state. After reaching historic lows in forest coverage and volume around the end of World War II, better conservation measures and the widespread implementation of sustainable forestry and fire suppression has allowed for some recovery of forested cover (now stabilized at about 7.3 million ha [18 million ac]) and a steady increase in timber volume (currently estimated at over 0.8 billion m^3 [27 billion ft^3]). Over one-third of the timber volume in Arkansas is pine (*Pinus* spp.), a number that is expected to increase as pine plantations continue to replace natural-origin pine and pine-hardwood stands. Recent changes in ownership, increased management intensity, and threats to the health of Arkansas timberlands will continue to challenge foresters well into the future.

Keywords: Crossett Experimental Forest, hardwoods, history, lumbering, pines, USDA Forest Service

Introduction

Arkansas, the self-proclaimed "Natural State," has a long tradition of wood utilization that continues to this day. The state has been blessed with abundant rainfall, good soils, and a temperate climate, all of which encourage luxuriant forests when not constrained by local site conditions or disturbance patterns. These forests have long driven the socioeconomic well-being of the state; at one time, the forest products industry provided 60% to 70% of all manufacturing jobs in Arkansas (Bruner 1930). A more recent study on the economic impacts of forest-related industry noted that over 33,000 Arkansans were employed in this field, with over US$ 1.6 billion in labor income and an estimated economic impact of US$ 2.83 billion (University of Arkansas Division of Agriculture 2009). The addition of other benefits from contributions to tourism, hunting and fishing, water and air quality, and similar goods and services makes Arkansas forestlands a vital resource to the state.

Geographers often subdivide Arkansas into seven physiographic regions (Figure 1). These include the low rolling hills of the timber-covered West Gulf Coastal Plain, where most of the loblolly pine (*Pinus taeda*) is produced; the Mississippi River Alluvial Plain, a broad, flat, agricultural region now largely cleared of its bottomland hardwood and baldcypress (*Taxodium distichum*) forests; Crowley's Ridge, a prominent (low elevation) outlier in northeastern Arkansas covered in hardwood-dominated forests more typical of the Piedmont Plateau further to the east; the Ouachita Mountains, heavily forested with shortleaf pine (*Pinus echinata*) and mixed upland hardwoods; the Arkansas River Valley, a combination of agricultural and forested lands along the Arkansas River; the Boston Mountains' steeply incised slopes covered in oak-hickory forests; and the Ozark Plateau, also dominated by oak-hickory forests, with scattered shortleaf pine. One hundred tree species were encountered in the most recently completed Forest Inventory and Analysis (FIA) survey of

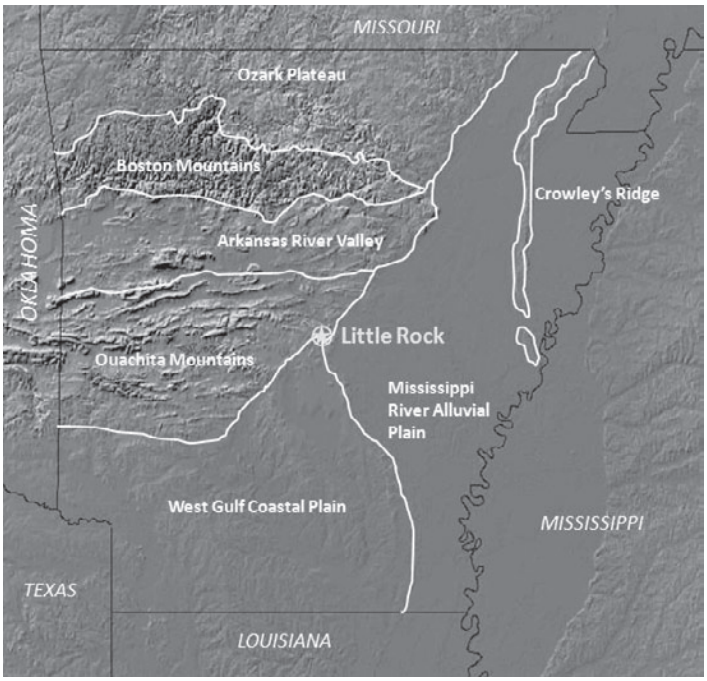

Figure 1. The topography of Arkansas, overlain by the physiographic provinces of the state.

Arkansas, but only a relative handful (Table 1) contributed most of the volume (Rosson and Rose 2010). This paper will summarize the forest conditions of Arkansas over a two-century period, from its initial acquisition by the United States to the present-day, and describe the major events that shaped the development of these timberlands. In addition, some anticipated trends of Arkansas forests will be provided to help suggest the future.

Forest Conditions Prior to 1880

The first persons to enter Arkansas over 12,000 years ago, the Paleoindians, encountered considerably different landscapes than we see today. These lands were still strongly influenced by glacial activity much further north, and supported vegetation assemblages notably different than those that appeared following a climatic stabilization

Table 1. Live tree volume of stems at least 12.7 cm (5-in) dbh reported in the 2005 FIA survey of Arkansas forests (Rosson and Rose 2010).

Tree species	Volume (millions of ft^3)*	Percentage of total	Cumulative total
Loblolly pine (*Pinus taeda*)	6,040.1	22.29	22.29
Shortleaf pine (*Pinus echinata*)	3,467.5	12.80	35.08
White oak (*Quercus alba*)	2,555.4	9.43	44.51
Sweetgum (*Liquidambar styraciflua*)	1,922.2	7.09	51.61
Post oak (*Quercus stellata*)	1,441.5	5.32	56.93
Northern red oak (*Quercus rubra*)	974.3	3.60	60.52
Black oak (*Quercus velutina*)	876.2	3.23	63.75
Southern red oak (*Quercus falcata*)	850.9	3.14	66.89
Black hickory (*Carya texana*)	639.7	2.36	69.25
Water oak (*Quercus phellos*)	612.9	2.26	71.52
All other 90+ species	7,719.3	28.48	100.00
Totals:	27,100	100.00	

*1 ft^3 = 0.03 m^3

approximately 4000 to 5000 years ago (Delcourt and Delcourt 1981; Royall and others 1991). However, dendroecological records suggest that the mild contemporary climate Arkansas enjoys today was punctuated by periodic "megadroughts," with intense, if brief, impacts on forest conditions (Stahle and others 1985; Cleaveland 2000; Stahle and others 2007).

Written records of Arkansas forests at first contact are limited. The dense populations of Native Americans described in the chronicles of Spaniard Hernando de Soto in the early 1540s had drastically declined by the time French missionaries and traders returned to the region 150 years later. Few Europeans remained during the next century; with the notable exception of an occasional hamlet or hunter/trapper, there were almost no white settlers living in Arkansas prior to 1800. Reports of forest conditions during this period are even scarcer, and largely limited to passing mentions in early explorer accounts. American control following the 1803 Louisiana Purchase brought increasing numbers of settlers, especially after the General Land Office public land surveyors began subdividing the territory starting in 1815 (Gill 2004). These early surveyors viewed the lands they worked on as wilderness, with few traces of civilization; the wide expanses of agricultural fields cleared by the prehistoric native peoples encountered by de Soto had long since been replaced by mature forests. The scattered groups of Indians removed from Arkansas Territory by the early 1830s had limited impact on the forests of the region. They (as would the EuroAmerican settlers that followed them) periodically set fires to clear the forest undergrowth, especially in the uplands, and would carve out small patches of timber to build their homes and plant a few crops, but nothing on the scale of the prehistoric cultures.

For most of the 19th century, the infrastructure to exploit the virgin forests of Arkansas was too limited to support much in the way of commercial lumbering. Limited quantities of timber were felled for local consumption and a relatively small amount of cutting occurred along the major rivers of the state, either to provide fuel wood for steamships or pine or cypress logs to raft to mills in Louisiana. This was soon to change, however; a rapidly growing and wood-hungry nation would soon drive land speculation and commercial lumbering on a massive scale across the entire southern US.

Arkansas Forests During the Exploitive Lumbering Period

Environmental historians consider 1880 a benchmark year for forests in the Arkansas region. By then, railroads had penetrated the region, and lumber companies that had cut out their timberlands in the Lake States and New England were scouring the South for new opportunities (Heyward 1958). Early reports on the forest conditions of the US showed only superficial exploitation of the timber resources of Arkansas in the immediate proximity of the major railroads (for example, Sargent 1884; Mohr 1897). Even though shortleaf and loblolly pine were considered the major commercial species of the period, the majority of wood volume of the virgin forests of Arkansas was mixed hardwood, with large quantities of baldcypress and eastern redcedar (*Juniperus virginiana*) in certain habitats (Record 1910).

By the late 1800s, the initial quantifications of the forests of Arkansas were made. Professor FL Harvey (of what would become the University of Arkansas–Fayetteville) reported that Arkansas had at least 51,800 km^2 (20,000 mi^2) of "pine land" thought to have 0.19 to 0.24 billion m^3 (40 and 50 billion board feet) of lumber (Harvey 1883). Others estimated that the "original" forests of Arkansas had a total of 0.94 to 1.42 billion m^3 (200 to 300 billion board feet) of timber at this time (for example, Bruner 1930). There is no way to confirm these numbers, nor which trees (either by size or species) were included in these assessments; documenting standing timber volume was a challenge prior to the mid-1930s. By this time, the USDA Forest Service (USFS) had begun formal inventories of Arkansas forest conditions, culminating in a series of reports that included the southwestern portion of the state (Cruikshank 1937), the northern Arkansas Delta (Winters 1938), the Ouachita Mountains (Cruikshank 1938), the southern Arkansas Delta (Winters 1939), and finally, the Ozark Mountains (Duerr 1948).

Figure 2 provides the best available estimates of both forest area and volume for Arkansas from about 1880 until 2005. The volumes prior to the forest inventories of the late 1930s represent cubic foot yield estimates based on board foot totals (assuming that a cubic foot of wood, adjusted for kerf and log shape, yields 6 board feet), while those after this point were reported in cubic feet. There was an estimated 1.4 billion m^3 (50 billion ft^3) of live standing sawtimber in Arkansas in 1880 (Bruner 1930). Industrial exploitation peaked in Arkansas in 1909, with over 9.3 million m^3 (2 billion board feet) of lumber cut in this year, most of which was then shipped to markets out of state (Harris and Maxwell 1912). In addition, almost 12 million m^3 (2.6 billion board feet) of timber were cut for firewood and hundreds of millions of board feet were turned into cooperage, lath, shingles, veneer, crossties, and other forest products (Harris and Maxwell 1912).

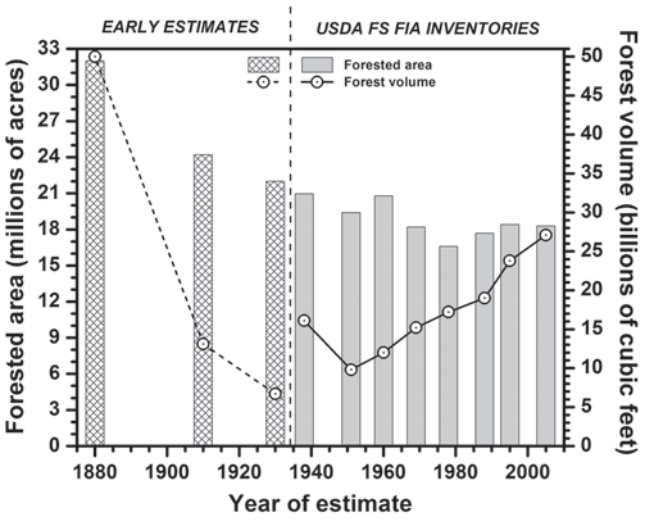

Figure 2. Long-term trends (1880 to 2005) in forest coverage and wood volume for Arkansas. Data before 1935 are based on poorly documented estimates, while data after this date are from the Forest Inventory and Analysis (FIA) program of the USDA Forest Service.

This rate of consumption substantially exceeded the growth of Arkansas forests. By the late 1920s, sawtimber volumes had dropped to about 0.2 billion m^3 (7 billion ft^3) (Bruner 1930), a number that would continue to decline well into the mid-20th century. The apparent spike in volume noted in the late 1930s (Figure 2) probably arises from better inventories rather than a rapid jump in tree growth or stocking. At the lowest reliable estimates, Arkansas probably had less than 0.3 billion m^3 (10 billion ft^3) of live timber by the end of World War II. This decline was then followed by decades of continuous increase until the present-day quantity of 0.8 billion m^3 (27.1 billion ft^3) was reached (Figure 2; Rosson and Rose 2010). Interestingly, during this same period, total forest cover in Arkansas remained largely unchanged. After reaching a historic high of about 13 million ha (32 million ac) prior to 1880, forested land decreased steadily over the next half-century before stabilizing between 7.3 to 8 million ha (18 to 20 million ac) (Figure 2). Fire control, better silvicultural techniques, pine plantations, conservation programs, and the reforestation of former farmlands have all helped to maintain forest cover.

The federal government reserved large parcels of public domain in western and northern Arkansas to establish the Arkansas (now Ouachita) and Ozark National Forests in 1907 and 1908, respectively. While this provided some additional protections to these timberlands, one of the primary management policies of the USFS at this time was to harvest timber and other resources from these lands when possible (Strausberg and Hough 1997). Cutover lands dominated the state by 1930, with most lands sold to farmers or simply abandoned after the valuable timber was removed. These cleared lands, often covered in logging debris, frequently burned and many communities became increasingly destitute as the lumber mills ran out of timber and closed their operations. Public outcry, the promotional efforts of private citizens, and pressure from industry eventually prodded the legislature to establish the Arkansas State Forestry Commission in 1931, but adequate funding for the agency was lacking until well into the 1930s (Lang 1965). Arkansas A&M College (now the University of Arkansas-Monticello) opened the first formal course of study in forestry, offering a 2-year degree starting in 1945 and a 4-year degree in 1950.

Forestry Brings Recovery

By the 1920s, it was obvious that the once extensive virgin forests of Arkansas had been all but exhausted by decades of lumbering, land clearing, and catastrophic events such as fire and tornadoes. A few of the large family-owned timber companies (for example, the Crossett Lumber Company, Dierks Lumber and Coal Company, Long-Bell Lumber Company, and the Fordyce Lumber Company) began to experiment with sustainable forestry practices by the mid-1920s with the notion of engaging in "permanent operations" (Hall 1925a,b; Williams 1925; Woods 1925; Gray 1954). However, very little was known about proper silvicultural techniques during this period; additional technical support was thus needed to ensure the success of these operations. The USFS Southern Forest Experiment Station, headquartered in New Orleans, began providing direct technical assistance to a number of cooperating lumber companies, eventually culminating with the establishment of the Crossett Experimental Forest (CEF) in southeastern Arkansas by late 1933 (Reynolds 1980). The first scientist stationed at the CEF, Russell R Reynolds, helped firms such as the Ozark-Badger Lumber Company and the Crossett Lumber Company evaluate different options in the harvest and delivery of wood and the management of standing timber (including regeneration techniques), laying the groundwork for decades of close cooperation (Reynolds 1980).

Once silvicultural techniques for the most productive forest types were developed, the timber industry quickly returned to southern states (Heyward 1958). The favorable growing conditions and valued timber species, coupled with relatively inexpensive land, existing infrastructure, and a capable workforce, helped encourage corporations such as International Paper Company, Georgia-Pacific, Weyerhaeuser, and Potlatch to acquire large tracts of Arkansas timberland during the middle decades of the 20th century, especially in the West Gulf Coastal Plain and Ouachita Mountains. Georgia-Pacific, for example, entered the picture by purchasing the lands of the Fordyce Lumber Company and Crossett Lumber Company. A number of the original family-owned lumber firms, such as Anthony Timberlands and Deltic Farm and Timber also transitioned into sustainable forestry operations.

These large companies sought to increase the productivity of their lands, typically favoring even-aged approaches over the uneven-aged silviculture that had initially dominated second-growth forests. Seed tree- and shelterwood-based systems soon rose to prominence, with prescribed fire a common technique for controlling competing vegetation. Growing international competition, changes to tax and investment laws, and continuing improvement in both genetics and stand density management, however, increasingly prompted timber companies to use even more productive loblolly pine plantations, especially after 1980.

By the late 1990s, most of the vertically integrated timber companies began to divest themselves of their forests, choosing instead to focus on their core business of manufacturing and purchasing their raw materials on the open market. During the last 20 years, most of the industrial timberlands in Arkansas were transferred to a variety of real estate investment trusts (REITs) or timberland investment management organizations (TIMOs). Major firms such as Georgia-Pacific and International Paper Company left the land management business entirely, and were replaced by operations such as Plum Creek Timber Company, Hancock Timber Resources Group, Resource Management Service, and The Campbell Group. A few of these timber companies reorganized their timberlands, converting them into separate investment operations (examples of this include Potlatch and Weyerhaeuser).

During this period of rapid ownership change, a number of large parcels were also acquired for conservation purposes by government agencies and non-governmental organizations, such as The Nature Conservancy. This occurred while public land management in Arkansas became less intensive, with federal lands shifting away from clearcutting and planting and more towards ecosystem restoration (Guldin and Lowenstein 1999). In particular, large-scale commercial harvesting on the Ouachita National Forest in the latter decades of the 20th century triggered considerable public pressure to

modify how national forest lands were managed. By the early 1990s, ecosystem management research and demonstration programs were installed by the Ouachita National Forest and the USFS Southern Forest Experiment Station (now the Southern Research Station). As a part of this program, a 62,725-ha (155,000-ac) block of the Ouachita National Forest has been dedicated towards restoration of an open, mature shortleaf pine-bluestem community (Bukenhofer and Hedrick nd). Extensive controlled burning, in conjunction with the targeted removal of midstory hardwoods and other habitat manipulations, have been installed to aid in the recovery of a number of sensitive or endangered species, including the red-cockaded woodpecker (*Picoides borealis*) and the pale purple coneflower (*Echinacea pallida*) (USFS 1999; Bukenhofer and Hedrick nd). Similar pine-bluestem restoration efforts are being implemented on the Ozark National Forest, which is also interested with the return of naturally regenerating shortleaf pine back to its historical distribution on the forest.

Private non-industrial ownerships have remained the least consistently managed forestlands within Arkansas, with large tracts harvested with little concern for future stand conditions. It is not unusual, for example, for a logger to contact small private landowners and cut their timber without specific plans to regenerate the forest. Estate-related issues are also a major concern for private landowners; many feel forced into cutting the timbered properties they inherited in order to pay the taxes arising from their acquisition. Forestry consultations are available to most private landowners, often at little to no expense, via the Arkansas Forestry Commission or major timber companies. For-profit forestry consultants often steer private landowners towards intensively managed pine plantations, although many such landowners place wood fiber production as relatively low on their list of ownership objectives (Rosson and Rose 2010).

Current Silvicultural Trends

The abundance of naturally regenerated pine and bottomland hardwood forests in Arkansas has declined steadily since the early 1960s, although they still comprise 84% of current forests (Rosson and Rose 2010). During this same period, upland hardwoods coverage has remained relatively constant, and both oak-pine forests and pine plantations have increased significantly (Conner and Hartsell 2002). Pine plantations (primarily loblolly pine) have increased most dramatically (Figure 3), from approximately 22,260 ha (55,000 ac) in 1952 to just over 1.19 million ha (2.94 million ac) in 2005 (Conner and Hartsell 2002; Rosson and Rose 2010). Most of the increase has occurred since the early 1980s; the 2005 total represents 675% more land in pine plantations than the 1982 FIA estimate of 176,500 ha (436,000 ac). To meet the demand for plantations, Arkansas currently has three major tree nurseries that supply the majority of the planting stock: ArborGen Fred C Gragg SuperTree Nursery (near Bluff City), the Weyerhaeuser nursery near Magnolia, and the State of Arkansas Baucum Nursery in North Little Rock. These facilities are capable of producing over 100 million pine seedlings and 10 million hardwood seedlings every year.

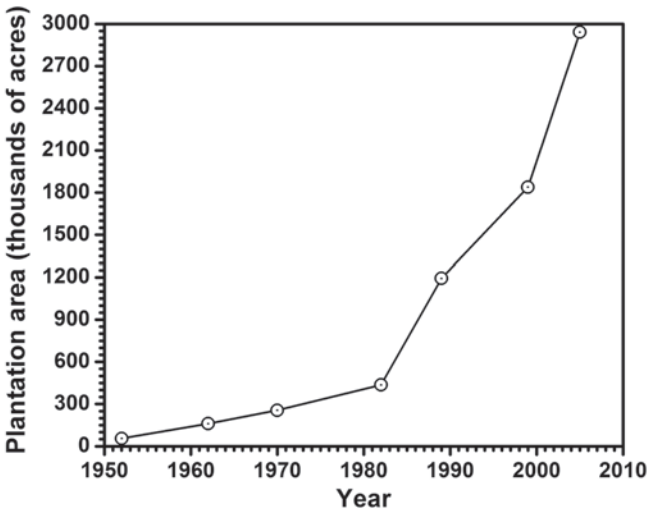

Figure 3. Change in plantation acreage in Arkansas from FIA data from 1952 until 2005 (1 ac = 0.4 ha).

Silvicultural practices have intensified over the last 20 years. During this period, many landscapes once dominated by naturally regenerated, even-aged stands have become short rotation (< 30 year) pine plantations, often with intensive site preparation, mid-rotation thinnings, and competition control. Many stands in southern Arkansas receive significant site preparation treatments immediately following harvest, including ripping and bedding. Genetic improvements and density management have been identified as particularly important in maximizing fiber yield while shortening rotation length (Stanturf and others 2003). For these reasons, foresters often plant improved pine seedlings at lower densities and conduct precommercial thinnings in more heavily stocked pine plantations (often to remove naturally seeded "volunteer" pines). A variety of herbicide treatments have been developed to control undesired vegetation, both prior to and after planting, and landowners often employ mid-rotation herbicides to further reduce competition. Arkansas forest owners generally do not use large quantities of fertilizer on their properties, as is commonly done in other parts of the southeastern US. Most plantations, however, receive one or two commercial thinnings before the stand is cleared and a new one established, often on a rotation length of 25 to 35 years.

Public landowners in Arkansas vary considerably in their silviculture practices. Federally owned timberlands (primarily national forests and national wildlife refuges) have reduced most of their fiber production efforts and now focus more on ecosystem restoration, especially to help endangered species. Some state agencies still manage their lands primarily for timber or natural gas production, while private landowners engage in a range of activities. Extensive forest conversions to non-timber activities (for example, farming) have largely ceased in recent years, helping stabilize Arkansas forest cover at about 7.3 million ha (18 million ac) over the last decade (Figure 2). Residential development in parts of the state, especially the northwestern corner between Fayetteville and

Bentonville and central Arkansas just west of Little Rock, have consumed large tracts of forests during this period, but this loss has largely been offset by the afforestation of former agricultural lands (Wear and Greis 2002).

Forest Health

Forest health issues represent an increasing concern for Arkansas landowners. Many invasive species are present in the state, although few are at crisis levels. Kudzu (*Pueraria montana* var. *lobata*), for example, is locally abundant but is generally not considered a major forest management concern in Arkansas. A number of other invasive plant species, however, are poised to increasingly challenge the state's forests. Japanese climbing fern (*Lygodium japonicum*) and Chinese tallowtree (*Triadica sebifera*) have just started to invade forests in extreme southern Arkansas, and cogongrass (*Imperata cylindrica*) is found in the adjoining states of Louisiana, Mississippi, and Texas, and is expected to eventually reach Arkansas (Miller 2004). Numerous exotic insects and diseases also threaten the state's forests, including emerald ash borer (*Agrilus planipennis*) and laurel wilt disease (*Raffaelea lauricola*).

Native pests, such as the southern pine beetle (*Dendroctonus frontalis*), have been a widespread problem in the past, but are largely of local concern today. A major exception to this trend is a recent outbreak of the red oak borer (*Enaphalodes rufulus*) in parts of the Interior Highlands of Arkansas, Missouri, and Oklahoma. A combination of drought, poor quality hardwood sites, and an aging forest produced very favorable conditions for the borer, which reached unprecedented levels and contributed to the widespread decline and death of various red oaks (*Quercus* spp.) over the last decade (Stephen and others 2003; Fierke and others 2007).

The Future of Arkansas Forests

The future of Arkansas forests depends heavily upon commodity demands and land use practices, both of which can be simulated. Models generally predict increased demand for forest products well into the 21st century (for example, Prestemon and Abt 2002). The Midsouth region of the US, which includes Arkansas and most of its adjoining states, is also predicted to increase in forest cover and overall timber volume, largely because of slower population growth and the continued reforestation of former agricultural lands (Wear 2002). It also seems likely that long-term declines in the coverage of naturally regenerated pine and hardwood forests (Conner and Hartsell 2002) should continue, supplanted in most cases by loblolly pine plantations and housing/commercial developments. Given recent trends, eastern redcedar-dominated forests are also likely to increase significantly into the future (for example, Rosson and Rose 2010).

Much uncertainty remains regarding the impact of climate change upon the forests of Arkansas. The region is predicted under most scenarios to be getting warmer and somewhat wetter, although the magnitude and nature of these trends is still far from certain. Some projections have a number of more southerly tree species moving into the state, while other species are greatly reduced or vanish completely (for example, Iverson and others 2008). For instance, slash pine (*Pinus elliottii*), not currently native to the state, is predicted to arrive under most climate scenarios, while sugar maple (*Acer saccharum*), an uncommon hardwood found primarily in sheltered coves in the Ozark Plateau, is forecast to all but disappear from Arkansas (Iverson and others 2008).

Arkansas forestlands have always been in a state of change, whether responding to species biogeography, large-scale climatic patterns, human influences, or any of a number of other factors. Many of these changes are predictable, others are not; some of these drivers have yet to even appear in the region. We know, for example, that our forests will continue to be altered by invasive species. In fact, the only seemingly certain future for Arkansas forests is one where demands will continue to be placed upon this resource for timber, water, recreation, wildlife, and air quality at the same time a series of challenges threaten its ability to meet these needs.

Acknowledgments

I would like to thank the following for their contributions to this work: OH "Doogie" Darling (retired Georgia-Pacific forester); Jim Guldin, Mike Shelton, Mike Chain, and Kirby Sneed (all from the USDA Forest Service Southern Research Station); and the Southern Forest Nursery Association.

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