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Executive Summary

Arkansas is a diverse state with 33.3 million acres, 56% of which is forested. Arkansas's forests provide a multitude of economic and environmental services. Numerous threats to Arkansas's forest resources exist. Addressing these issues will ensure the ecosystem services provided by our forests will continue for future generations. The primary threats can be summed by the following six issues:

1. **Water quality**—Many things influence water quality and quantity, including the conversion of forest land to non-forest uses including urbanization. Forests and forest cover in and around water channels and bodies buffer those areas from water quality degradation. Management should be tailored to reduce water quality degradation. Opportunities exist to establish buffers in urban and agricultural areas and to improve the implementation of forestry BMP's.
2. **Forest Health/Invasive Species**— Nonnative invasive species are a threat to forest health and productivity and as a result threaten the economic and environmental benefits that forests provide.
   All forests in Arkansas are threatened by nonnative invasive species. Factors exacerbating those threats are the forests proximity to the Wildland Urban Interface, lack of active forest management, and/or proximity to highways that cross state boundaries.
3. **Forest Fragmentation/Parcelization/Changing Ownerships**— Air quality, water quality, forestry related jobs and biodiversity are public benefits that are threatened when forest land is converted to non forest uses. Large amounts of forest lands in Arkansas could be affected by fragmentation. The greatest threats are in the growing areas of central and northwest Arkansas. Properly managed forests ensure that all natural resources are sustained in a manner to provide ecosystem services and benefits while providing forest products.
4. **Increase and Enhance the Benefits of Working Forests**—Forest land ownerships are becoming smaller as a result of ownership changes and management objectives. It is possible that an increasing number of owners lack forest management knowledge. Increasing and enhancing working forests can be accomplished through education and outreach to forestland owners, continued funding of cost share programs, and developing new biomass/fiber markets.
5. **Climate change**—Arkansas forests are potentially affected by climate change. Potential effects to forest resources include the ability of forests to adapt to change, carbon sequestering ability, species distribution, forest regeneration, and forest loss from catastrophic wildfires. Public benefits from forests that could be negatively affected include drinking water quality and quantity, forest products, energy costs and independence as well as bioenergy, climate change and mitigation, air quality, recreation, and wildlife habitats.
6. **Fire Management**—All forests in the state are subject to the effects of wildfire. Forests in the wildland-urban interface are potentially more prone to the effects of wildfire than rural forests. Well managed fire is a factor in growing a diverse, healthy forest that provides many public benefits.

Overview of State Assessments

The 2008 farm bill established a new set of national priorities for federal assistance for private forest conservation. Those priorities are to conserve working forests, protect and restore forests, and enhance public benefits from private forests.

The bill also directs states to conduct a statewide assessment of forest resource conditions, trends and threats in order to receive federal forestry assistance funds. Each state also must prepare a strategy for addressing the identified threats, and describe the resources needed to address those threats.

At a minimum, state forest resource assessments will:

- Provide an analysis of present and future forest conditions, trends, and threats on all ownerships in the state using publicly available information.
- Identify forest related threats, benefits, and services consistent with the S&PF Redesign national objectives.
- Delineate priority rural and urban forest landscape areas to be addressed by the state resource strategy. States can also identify linkages between terrestrial and aquatic habitat, as appropriate.
- Work with neighboring States and governments to identify any multi-state areas that are a regional priority.
- Incorporate existing statewide plans including Wildlife Action Plans, Community Wildfire Protection Plans, and address existing S&PF program planning requirements. States can also utilize relevant national and regional assessments as appropriate.

A state's forest resource strategy will provide a long-term, comprehensive, coordinated strategy for investing state, federal, and leveraged partner resources to address the management and landscape priorities identified in its assessment. The resource strategy should incorporate existing statewide forest and resource management plans and provide the basis for future program, agency, and partner coordination.

At a minimum, state resource strategies should:

- Outline long-term strategies for addressing priority landscapes identified in the state forest resource assessment and the following national themes and associated management:
    - **Conserve Working Forest Lands:** conserving and managing working forest landscapes for multiple values and uses.
        - Identify and conserve high priority forest ecosystems and landscapes.
        - Actively and sustainably manage forests.
    - **Protect Forests from Harm:** protect forests from threats, including

catastrophic storms, flooding, insect or disease outbreak, and invasive species.

- Restore fire-adapted lands and reduce risk of wildfire..
- Identify, manage and reduce threats to forest and ecosystem health.

- **Enhance Public Benefits from Trees and Forests:** including air and water quality, soil conservation, biological diversity, carbon storage, and forest products, forestry-related jobs, production of renewable energy, and wildlife.
  - Protect and enhance water quality and quantity.
  - Improve air quality and conserve energy.
  - Assist communities in planning for and reducing wildfire risks.
  - Maintain and enhance the economic benefits and values of trees and forests.
  - Protect, conserve, and enhance wildlife and fish habitat.
  - Connect people to trees and forests, and engage them in environmental stewardship activities.
  - Manage and restore trees and forests to mitigate and adapt to global climate change.

Forest Resource Conditions

Arkansas Forests: A Brief Historical Perspective—*adapted from Forest Legacy Assessment of Need*

When English naturalist Thomas Nuttall journeyed across Arkansas in 1819, he saw a vast wilderness encompassing tall grass prairies, pine woodlands, and large areas covered with bald cypress and bottomland hardwoods. Early inhabitants of Arkansas enjoyed an area that was roughly 95 percent forested (Ashmore 1978). In the Delta region, the virgin forest consisted of stands of bottomland oaks, gums, ash, other hardwoods, and bald cypress. The Ouachita Mountains were dominated by shortleaf pine, loblolly pine, and mixtures of pine and hardwood stands. Oaks, hickories, gums and other upland hardwoods occupied much of the Ozarks. Land clearing for farming and settlement and limited timber harvesting for the purposes of local building, fire wood, fence post, and even the export of logs in Southern Arkansas to Louisiana had a limited effect on the largely virgin forests.

In the 1880's the state's rail network expanded from 880 to 2,200 miles of track. This provided access to a much area and connected Arkansas to the major lumber markets in Midwestern and eastern cities. According to the first field survey of Arkansas forest conditions in 1929, large lumber companies began large scale liquidation harvesting, which left 20 million acres cut over. Although 85 percent of the harvested area had naturally resprouted or reseeded, 70 percent of these new stands had experienced severe damage by wildfires.

Several factors contributed to the recovery of forests during the 1930's and 1940's. During the 1930's the Civilian Conservation Corps Program established 13 camps to help fight forest fires, build lookout towers, and plant thousands of acres of worn-out highland farmland on the Ouachita and Ozark National Forests, which had been created in 1907 and 1908. The Arkansas Forestry Commission was established in 1931 under a state initiative which also brought all non-federal forestland under state forest fire protection. Also, several forest products companies, including Union Sawmill Company at Huttig, Malvern Lumber Company, Crossett, Dierks, International Paper Company at Camden, and other companies began taking steps to assure a continuing supply of timber from their own lands. These included providing fire protection, selective logging, and reserving seed trees after final harvesting. A sharp decline in building and the shift away from wood as fuel for home heating and cooking also reduced harvesting pressure, which further contributed to the recovery of Arkansas's forests.

A 1953 report conducted by the US Forest Service showed that although 2.5 million acres of forests had been lost since 1929 to other land uses (predominately farm expansion in the Delta) overall forest cover had stabilized. Between 1950 to the mid 1990s, major increases in demand for all forest-related commodities occurred. The half century leading to 1998 was marked by an 86 percent increase in hunting licenses and a 132 percent increase in fishing licenses issued by the Arkansas Game and Fish Commission. By 1996, 4 million recreation days per year were provided by the two National Forests of Arkansas alone.

Current Conditions and Trends- *adapted from Forest Legacy Assessment of Need*

Arkansas is comprised of 33.3 million acres, 56% of which is forested. Over half of Arkansas's 18.8 million forested acres is oak and other hardwoods and 41% are softwoods dominated by pine. Arkansas is an important wood producer, contributing 3.5 percent of the total production of the United States. Apart from economic proceeds, our forests support a diverse system of values beyond scenic beauty and outdoor recreation to encompass critical wildlife and biodiversity concerns and the maintenance of clean air and water. Figure 1 shows a map of Arkansas Ownership.

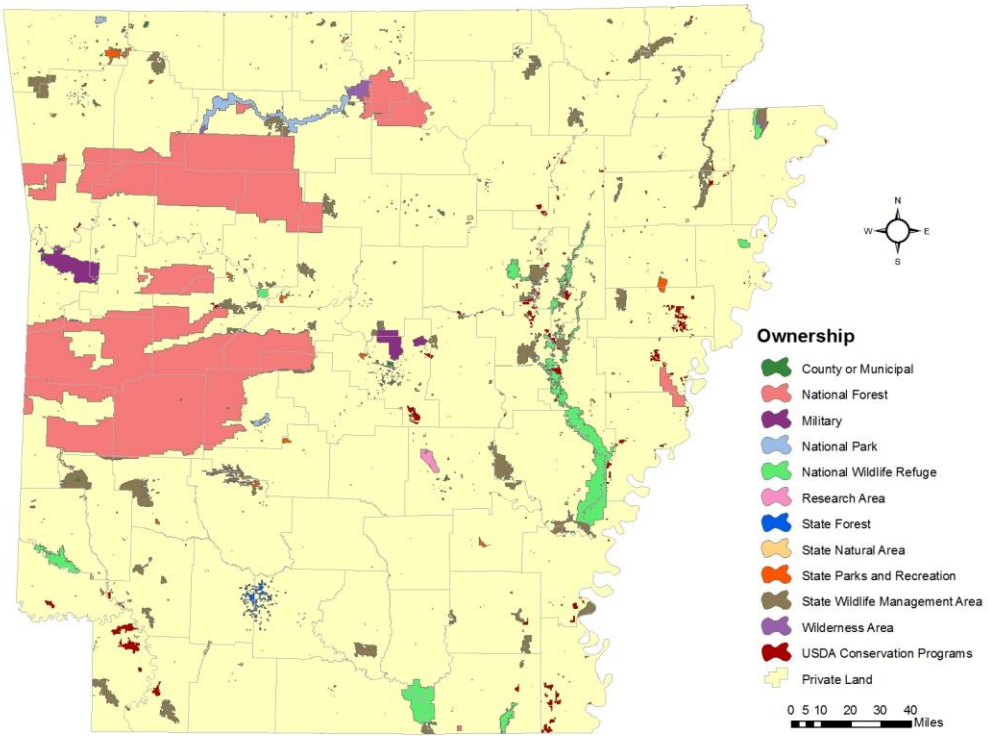


Figure 1. Map of Arkansas Ownership

Changes in ownership, industrial to non-industrial, and forest management, non-intensive to intensive, are trends that brought Arkansas's forest to 1995. Since 1988, timberland acreage has increased by six percent, from 17.2 million acres to 18.2 million acres making Arkansas the ninth highest state in timberland area in the US (Timberland is defined by USFS Forest Inventory and Analysis as "Forest land that is producing or capable of producing in excess of 20 cubic feet per acre per year of wood at culmination of mean annual increment.")

Non-industrial private landowners, most of who live in the Ozarks, own nearly half of Arkansas forests. Forest industry and corporations control nearly one quarter of the Arkansas's forests. Most corporate and industry forests are in the south Arkansas. With combined acreages exceeding three million acres, the Ozark-St Francis and Ouachita National Forest comprise a major portion of publicly owned land. Other public lands include parks, wildlife refuges and management areas, military bases,

state natural area and forests, and county and municipal lands. Table 1 shows forest ownership in Arkansas by area and percentage.

Ownership	Acres	Percentage
National Forest	2,558,827	13.8
National Park Service	66,336	0.4
Fish and Wildlife Service	220,009	1.2
Department of Defense or Energy	111,945	0.6
Other Federal	196,777	1.1
State	437,482	2.4
Local (county, municipal, etc.)	78,676	0.4
Other non federal lands	7,034	0.04
Private	14,842,619	80.1
Total	18,519,705	100.0

Table 1. Ownership of Arkansas by area and percentage (Forest Inventory and Analysis, 2007)

Ecological Regions of the State

This section describes the ecoregions of Arkansas including various levels of detail according to the requirements of use in both funding mechanisms and management-related understanding. As various informational datasets are available at different hierarchical levels (i.e. FIA, gross populations figures, habitat suitability indices) this section includes a description from gross ecosystem level (Figure 2) to the more detailed forest ecosystem similarities as used with the Arkansas Wildlife Action Plan (AWAP) as shown in Figure 3.

Arkansas's ecological diversity is strongly related to regional physiography, geology, soil, climate and land use. Elevated karst plateaus, folded mountains, agricultural valleys, forested uplands, and bottomland forests occur. Fire-maintained prairies were once extensive in several parts of Arkansas. To a significant degree, this diversity can be understood and mapped as ecoregions, which are areas having general similarity in ecosystems and in the type, quality, and quantity of environmental resources. They are designed to serve as a spatial framework for the research, assessment, management, and monitoring of ecosystems and ecosystem components. The AWAP (discussed in more detail later in this assessment) uses ecoregions originally developed by the USEPA and partners (Woods et al., 2004). Figure 3 defines seven level III ecoregions and 32 level IV ecoregions. In this assessment, the seven level III ecoregions have been combined into four ecoregions: the Ozark Mountains, the Ouachita Mountains, the Upper West Gulf Coastal Plain, and the Mississippi Alluvial Plain, as traditionally used to organize forest resource planning (Figure 2). These ecoregions will be correlated and discussed.

Priority of Arkansas Ecoregions as determined by AWAP

The Arkansas Wildlife Action Plan determined which ecoregions have more "species of greatest

conservation need" (SGCN) and/or more greatly imperiled species. Table 2 below shows Ecoregion Scores reported in the Arkansas Wildlife Action Plan equal the sum of all Species Priority Scores within an ecoregion. A higher score implies more species of greatest conservation need and/or species with a greater need for conservation.

AWAP Level III Ecoregion	Total SGCN	Average Priority Score
Ozark Highlands	204	29
Boston Mountains	131	29
Ouachita Mountains	153	27
Arkansas Valley	154	24
Upper West Gulf Coastal Plain	172	25
Mississippi Alluvial plain	149	23
Mississippi Valley Loess Plains	41	17

Table 2. Ecoregion Scores for Species of Greatest Conservation Need.

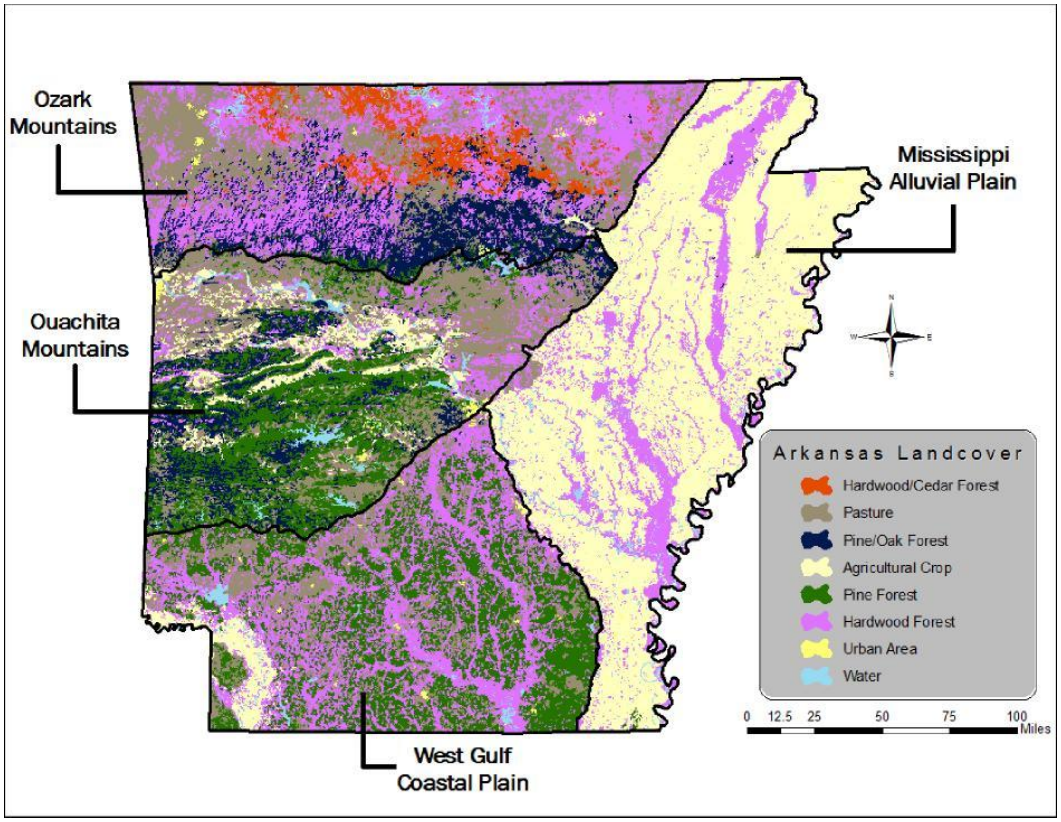


Figure 2. Ecoregions of Arkansas

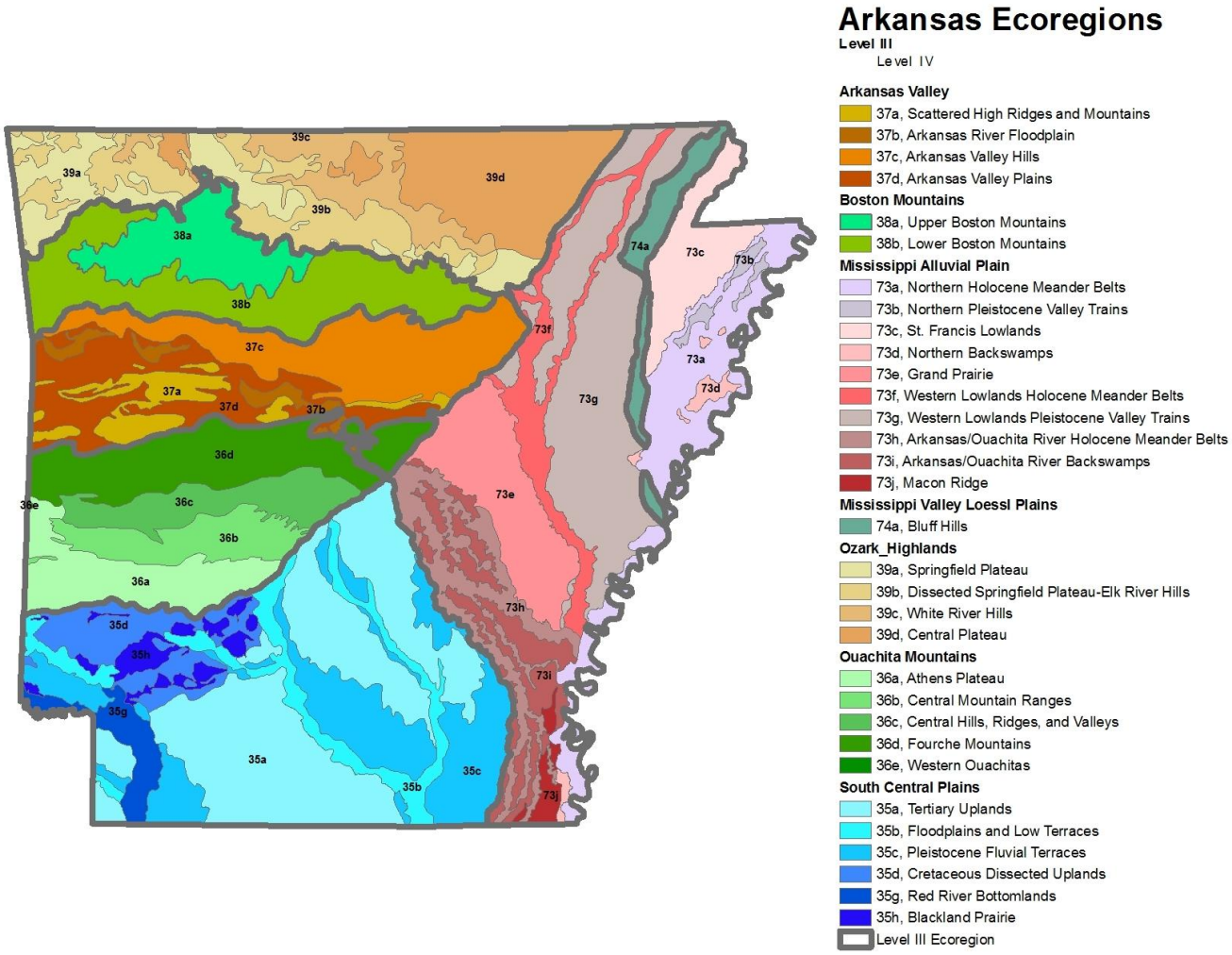


Figure 3. Level III and IV Ecoregions in Arkansas (Woods et al., 2004) used in the Arkansas Wildlife Action Plan (AWAP).

Forest Resource Conditions by Ecoregion

-adapted from Forest Legacy Assessment of Need

1) Ozark Mountain Ecoregion (Ozark Highlands and Boston Mountains Ecoregions)

The Ozarks formed as the Ouachita Mountains weighted-down the edge of the North American continent, flexing the crust of the Arkoma Basin upward. Younger sedimentary layers then eroded away, exposing the older, Paleozoic rocks that dominate this region, which is composed of the Springfield and Salem plateaus and largely underlain by highly soluble and fractured limestone and dolomite.

The Ozark Highlands Ecoregion (Ecoregion 39) is largely underlain by highly soluble and fractured limestone and dolomite. It is level to highly dissected, partly forested and rich in karst features. Caves, sinkholes and underground drainage occur, heavily influencing surface water availability and water temperature. Clear, cold, perennial, spring-fed streams are common and typically have gravelly substrates. Many small dry valleys occur. The Ozark Highlands Ecoregion includes 4 Level IV ecoregions: the Springfield Plateau; the Dissected Springfield Plateau-Elk River Hills; the White River Hills; and the Central Plateau.

The Upper and Lower Boston Mountains are forested and underlain by Pennsylvanian sandstone, shale and siltstone. They are one of the Ozark Plateaus. Some folding and faulting has occurred but, in general, strata are much less deformed than in the Ouachita Mountains. Maximum elevations are higher, soils have a warmer temperature regime and carbonate rocks are much less extensive than in the Ozark Highlands. Upland soils are mostly Ultisols that developed under oak–hickory and oak–hickory–pine forests. Today, forests are still widespread with northern red oak, southern red oak, white oak and hickories usually dominating the uplands. Shortleaf pine grows on drier, south and west-facing slopes underlain by sandstone. Water quality in streams is generally exceptional; biochemical, nutrient and mineral water quality parameter concentrations all tend to be very low.

The Lower Boston Mountains are a mosaic of woodland, forest and savanna that contrasts with the denser, more, moist and closed forests than the Upper Boston Mountains. Shortleaf pine is especially widespread on drier, south and west-facing slopes underlain by sandstone. Both precipitation and forest density decrease toward the west, where oak–pine woodland or savannas become common.

Potential natural vegetation is mostly oak–hickory forest. Open forest dominates rugged areas; pastureland and hayland are common on nearly level sites. Shortleaf pine grows on steep, cherty escarpments and on shallow soils derived from sandstone, which becomes more common in this ecoregion. Glades dominated by grass and eastern red cedar are found on shallow, droughty soils, especially over dolomite.

Primary land uses are logging, housing, recreation and, especially, poultry and livestock farming. Water quality in the Ozarks is different from the other ecoregions in Arkansas and is strongly influenced by lithology and land use practices. Alkalinity, total dissolved solids and total hardness values are relatively high, reflecting the influence of distinctive limestone and dolomite. Fecal coliform and nitrite-nitrate values are elevated downstream of improved pastureland that is intensively grazed by cattle and fields where animal

wastes from confined poultry and hog operations have been applied.

Native Americans used fire as a tool which helped improve the quality of life of the native Americans (Van Lear 2004). Oak is a fire adapted species for several reasons, including resprouting ability (Waldrop and others 1987) and thick bark (Hare 1965). Fire exclusion has affected oak forests by allowing fire-intolerant species to emerge creating more dense conditions.

Density of tress in this ecoregion has doubled since the early 19th century (Foti 2004). Ladd (1991) attributes this increase to fire suppression. Higher densities of trees, combined with biotic and abiotic factors, along with fire exclusion have lead to oak decline in this ecoregion (Ladd 1991).

The Ozark ecoregion encompasses some 9.4 million acres. According to the 2003 Forest Inventory Analysis, 60 percent of this ecoregion is forested. It supports outstanding biodiversity and is covered predominately in oak-hickory upland forests. Two exceptions are an area of increasing population and development in the northwest corner and north central Arkansas. In north central Arkansas, vacation/retirement property development acquisitions are rapidly increasing along waterfronts and where scenic and recreational resources abound.

The history of timber use in the Ozarks spans over one and half centuries. For instance, as railways expanded across the Great Plains in the late 1800's, and as the barrel industry peaked from 1860-1930, white oak timber was targeted throughout this region to supply the staves and cross ties. Throughout the 1940's and 1950's small sawmill operations represented a major economic contribution to the mountain communities.

Only 13 to 18 percent of all hardwood and 5 percent of all pine harvested in Arkansas comes from this ecoregion. Of all the ecoregions, the Ozark Mountains has the least timber harvested. Currently, sawmills remain scattered throughout this region providing crossties and lumber from the oak-dominated forests. Table 3 shows ownership changes for the Ozark Ecoregion.

Ownership Class shown as percent	1988	2003	Change
Public	19.8	18.8	-5
Forest Industry	3.1	2.6	-19
Non-Industrial Private	77.1	78.1	1

Table 3. Ownership Changes in Ozark Ecoregion 1988 - 2003

The population of this ecoregion experienced a growth rate of 24.1 percent from 1990 to 2000 reaching a total population of 641,386. By 2004, population numbers had increased another 7.5 percent for a total population of 693,215.

With regards to wildlife species richness, according to the AWAP, of the 369 Species of Greatest Conservation Need, 204 occur in this ecoregion. Also, of the 45 terrestrial habitats in Arkansas, 21 occur in the Ozark Mountains ecoregion.

A summary of the problems faced by SGCN in the Ozark Mountains is presented below. Each

problem has a score which is a sum of all Species Priority Scores associated with species for which this problem was assigned. A higher score implies a higher quantity of SGCN and/or more greatly imperiled species associated with problems listed here.

Problem Faced	Score
Urban development	3,417
Grazing	3,082
Road construction	1,910
Dam	1,807
Resource extraction	1,632
Forestry activities	1,632
Confined animal operations	1,625
Crop production practices	1,254
Municipal/Industrial point source	924
Recreation	878
Channel alteration	770

Table 4. Problems Faced by Species of Greatest Conservation Need in the Ozark Mountain Ecoregion

2) Upper West Gulf Coastal Plain Ecoregion:

The Upper West Gulf Coastal Plain (UWGCP) (Ecoregion 35) in the AWAP is composed of rolling plains that are broken by nearly flat fluvial terraces, bottomlands, sandy low hills and low cuestas. The terrain is unlike the much more rugged Ouachita Mountains (Ecoregion 36) or the flatter, less dissected Mississippi Alluvial Plain (Ecoregion 73). Uplands are underlain by poorly-consolidated, Tertiary- through Cretaceous-age, coastal plain deposits and marginal marine sediments (laid down as the Gulf of Mexico opened and North America's southern continental margin subsided). Bottomlands and terraces are veneered with Quaternary alluvium or windblown silt deposits (loess). Potential natural vegetation is oak–hickory–pine forest on uplands and southern floodplain forest on bottomlands. Today, more than 75 percent of Ecoregion 35 remains forested. Extensive commercial loblolly pine plantations occur. Lumber and pulpwood production and livestock grazing are major land uses. Cropland dominates the drained bottomlands of the Red River. Turbidity and total suspended solid concentrations are usually low except in the Red River. Summer flow in many small streams is limited or nonexistent but enduring pools may occur. Fish communities typically have a limited proportion of sensitive species. The UWGCP contains six level IV ecoregions; the Tertiary Uplands, the Floodplains and Low Terraces, the Pleistocene Fluvial Terraces, the Cretaceous Dissected Uplands, the Red River Bottomlands and the Blackland Prairie.

The UWGCP ecoregion is located in the southern and western parts of Arkansas

encompassing some 8.3 million acres. Forested watersheds provide moderate to better water quality in the streams and rivers of this ecoregion. The UWGCP has excellent biodiversity, wildlife habitat, soils, and high-growth forests.

Habitat fragmentation caused by urban growth and suburban sprawl occurs throughout the region. Urban and suburban land uses are increasing, though not as intensely as in other ecoregions. Table 5 shows the ownership changes in the UWGCP.

Ownership Class shown as percent	1988	2003	Change
Public	2.6	3.5	26
Forest Industry	50.6	45.3	-12
Non-Industrial Private	46.8	51.1	8

Table 5. Ownership Changes in the West Gulf Coastal Plain Ecoregion 1988-2003.

Currently forest industry owners are selling or have sold lands to the two other sectors making private non-industrial landowners the largest ownership class. For decades the forest products industry has played a large role in the management of the forests in this ecoregion. Most of the 4.5 million acres owned by industry in Arkansas is in this ecoregion where soil is productive and growing seasons are long. From a forest products standpoint, this region represents the "bread basket" of Arkansas.

Between 1990 and 2000, the population growth rate of this region was 6.1%, reaching a total of 522,016. The population in 2004 increased only 0.4%, to 524,204.

Of the 45 terrestrial habitats in Arkansas, 19 occur in the UWGCP. A summary of the problems faced by SGCN in the Upper West Gulf Coastal Plains is presented in Table 6. Each problem has a score which is a sum of all Species Priority Scores associated with species for which this problem was assigned. A higher score implies a higher quantity of SGCN and/or more greatly imperiled species associated with problems listed.

Problem faced	Score
Dam	2,172
Forestry activities	1,726
Grazing	1,711
Crop production practices	1,680
Road construction	1,660
Urban development	1,164
Channel alteration	1,113
Resource extraction	1,112
Channel maintenance	930

Table 6. Problems Faced by Species of Greatest Conservation Need in the Upper West Gulf Coastal Plain Ecoregion.

3) Ouachita Mountains Ecoregion (including the Arkansas River Valley)

The Ouachita Mountains ecoregion is located in the west central part of Arkansas. The Ouachita Mountains are generally comprised of east-west ridges of sandstone, shale and novaculite. However, the Arkansas Valley in the northern part of the region becomes transitional to the Ozarks, having erosional flat-topped mountains as well as the folded ridges characteristic of the southern part of the region. The wide structural valley through which the Arkansas River flows has wide rolling uplands as well as the bottomlands and terraces along the Arkansas River.

Potential natural vegetation is oak–hickory–pine forest with oak-hickory forest in the bottomlands as well as on some ridges and eroded plateaus. Loblolly pine, often in plantations, dominates on intensively managed forest industry lands and shortleaf pine on less intensively managed and US Forest Service lands. Pastureland and hayland are also common, particularly in the valleys. Cattle and broiler chickens are important farm products.

The assessment's Ouachita Mountains Ecoregion (Figure 2) is comprised of two Level III AWAP ecoregions: the Ouachita Mountains and the Arkansas Valley. In turn, each of these is subdivided into several Level IV ecoregions. Their characteristics are briefly summarized here.

Ouachita Mountains Ecoregion (Ecoregion 36) is made up of ridges, hills and valleys formed by the erosion of folded and faulted Paleozoic sandstone, shale and novaculite. They are a continuation of the Appalachians, formed during the late Paleozoic Era when an ocean closed and continents collided, causing marine sediments to be folded, faulted and thrust northward. The Ouachitas are structurally different from the Boston Mountains and Ozark Highlands, in that they are more folded and rugged, with pronounced, generally east-west trending, ridges. Potential natural vegetation is oak–hickory–pine forest. Today, loblolly pine dominates on intensively managed forest industry lands and shortleaf pine on less intensively managed and US Forest

Service lands. Pine plantations are widespread. Pastureland and hayland are also common. Cattle and broiler chickens are important farm products. The Ouachita Mountains Ecoregion includes 5 Level IV ecoregions: the Athens Plateau, the Central Mountain Ranges, the Central Hills, Ridges and Valleys, the Fourche Mountains and the Western Ouachitas.

The Arkansas River Valley (Ecoregion 37) is a synclinal and alluvial valley lying between the Ozark Mountains and the Ouachita Mountains. The Arkansas River Valley is diverse and transitional. It generally coincides with the Arkoma Basin, an oil and gas province, which developed as sand and mud were deposited in a depression north of the rising Ouachita Mountains during the Mississippian and Pennsylvanian eras. It contains plains, hills, floodplains, terraces and scattered mountains. It is largely underlain by interbedded Pennsylvanian sandstone, shale and siltstone. Before the 19th century, uplands were dominated by a mix of forest, woodland, savanna and prairie. Floodplains and lower terraces were covered by bottomland deciduous forest. Today, less rugged upland areas have been cleared for pastureland or hayland. Poultry and livestock farming are important land uses. It is comprised of four Level IV ecoregions, the Scattered High Ridges and Mountains, the Arkansas River Floodplain, the Arkansas Valley Hills, and the Arkansas Valley Plains.

According to the Forest Inventory Analysis of 2003, 74% of the Ouachita Mountains ecoregion is forested. The Ouachita Mountains support the world's most extensive native shortleaf pine woodlands. Also growing with pine in many places are typical upland hardwood species such as oak and hickory.

The largest land holding in this ecoregion is the Ouachita National Forest, which is 1.2 million acres. Forest ownership of this ecoregion is noted in Figure 6 below. This ecoregion exhibits the most stable ownership in all of Arkansas.

Ownership Class shown as percentage	1988	2003	Change
Public	46.7	46.5	0
Forest Industry	22	20.6	-7
Non-Industrial Private	31.2	32.9	5

Table 7. Ownership Changes in Ouachita Mountains Ecoregion 1988 - 2003

This ecoregion is second only to the Upper West Gulf Coastal Plain ecoregion in terms of timber production. Approximately one fourth of all the hardwood harvested and about one third of the pine harvested comes from this ecoregion.

According to the AWAP, of the 45 terrestrial habitats in Arkansas, 22 occur in the Ouachita Mountains ecoregion. A summary of the problems faced by SGCN in the Ouachita Mountains is presented below. Each problem has a score which is a sum of all Species Priority Scores associated with species for which this problem was assigned. A higher score implies a higher quantity of SGCN and/or more greatly imperiled species associated with problems listed.

Problem faced	Score
Forestry activities	2,142
Dam	1,718
Road construction	1,588
Grazing	1,376
Resource extraction	1,262
Crop production practices	1,095
Urban development	847
Confined animal operations	668
Municipal/Industrial point source	600
Channel alteration	587
Channel maintenance	424
Water diversion	420
Fire suppression	386

Table 8. Problems faced by Species of Greatest Conservation Need in the Ouachita Mountains Ecoregion.

4) Mississippi Alluvial Plain Ecoregion (including Mississippi Valley Loess Plains)

The Mississippi Alluvial Plain (MAP) (Ecoregion 73) is a broad, nearly level, agriculturally-dominated alluvial plain. It is veneered by Quaternary alluvium, loess, glacial outwash and lacustrine deposits. River terraces, swales and levees provide limited relief, but overall, the Mississippi Alluvial Plain is flatter than neighboring ecoregions. Clayey, poorly-drained soils are widespread and characteristic. Streams and rivers have very low gradients and fine-grained substrates. Many reaches have ill-defined stream channels. This assessment MAP Ecoregion includes two AWAP Level III Ecoregions, the Mississippi Alluvial Plain and the Mississippi Valley Loess Plains.

The MAP provides important habitat for fish and wildlife and includes the largest continuous system of wetlands in North America. It is also a major bird migration corridor used in fall and spring migrations. Potential natural vegetation is largely southern floodplain forest. The MAP has been widely cleared and drained for cultivation. This reduced wetland habitat and reduced wildlife populations. Agricultural runoff containing fertilizers, herbicides, pesticides and livestock waste have degraded surficial water quality. Concentrations of total suspended solids, total dissolved solids, total phosphorus, ammonia nitrogen, sulfates, turbidity, biological oxygen demand, and fecal coliform are high in the rivers, streams and ditches of the MAP. Man-made flood control levees typically flank the

Mississippi River and, in effect, separate the river and its adjoining habitat from the remainder of its natural hydrologic system. The levees interfere with sediment transfer within the MAP and have reduced available habitat for many species. Between the levees that parallel the Mississippi River is a corridor known as the "batture lands". Batture lands are hydrologically linked to the Mississippi River, flood-prone and contain remnant habitat for "big river" species (e.g., pallid sturgeon) as well as riverfront plant communities. They are too narrow to map as a separate level IV ecoregion. The MAP in Arkansas contains ten Level IV ecoregions: the Northern Holocene Meander Belts, the Northern Pleistocene Valley Trains, the St. Francis Lowlands, the Northern Backswamps, the Grand Prairie, the Western Lowlands Holocene Meander Belts, the Western Lowlands Pleistocene Valley Trains, the Arkansas/Ouachita River Meander Belt, the Arkansas River Meander Belt, the Arkansas/Ouachita River Backswamps and Macon Ridge.

The Mississippi Valley Loess Plains (Ecoregion 74) is part of the assessment's MAP Ecoregion. It extends from Kentucky to Louisiana, usually on the eastern side of the MAP. It is characteristically veneered with windblown silt deposits (loess) and underlain by erosion-prone, unconsolidated coastal plain sediments. Ecoregion 74 has hills, ridges and bluffs. Potential natural vegetation is primarily oak–hickory forest or oak–hickory–pine forest and is unlike the southern floodplain forests of the MAP (Ecoregion 73). Streams tend to have gentle gradients and silty substrates.

Bottomland hardwood forests are the dominant natural plant community in the (MAP). It is maintained by regular floods, including large-scale annual springtime inundation, and localized ponding on poorly drained sites. The diversity of forests and other communities characterizing the historic landscape provide extraordinary habitat for many species. Over 240 fish species, 45 species of reptiles and amphibians, and 37 species of mussels depend on the river and floodplain system found in this ecoregion. Also, 50 species of mammals and approximately 60 percent of all bird species in the contiguous United States currently use the Mississippi River, its tributaries and/or their associated floodplains.

This is the only area in Arkansas that showed an increase in public over private ownership from 1988 to 2003. Most forested blocks have a substantial component of publicly owned land. The Arkansas Game and Fish Commission owns 161,859 acres, and the US Fish and Wildlife Service, the US Forest Service, and the Arkansas Natural Heritage Commission combined own more than 274,000 acres. The forests of Crowley's Ridge, for the most part, are privately owned. Figure 9 below shows recent ownerships changes in the Mississippi Alluvial Plain.

Crowley's Ridge, a portion of Ecoregion 74, is a disjunct series of loess-capped hills surrounded by the lower, flatter Mississippi Alluvial Plain. Crowley's Ridge, with elevations of up to 500 feet, is of sufficient height to have trapped wind-blown silt during the Pleistocene Epoch. It was formed by the aggregation of loess and the subsequent erosion by streams. The loess is subject to vertical sloughing when wet, causing landslides. Spring-fed streams and seep areas occur on the lower slopes and base where Tertiary sands and gravels, never removed by the Mississippi River, are exposed. Soils are generally well-drained. They are generally more loamy than those found in the surrounding

Ecoregion 73. Wooded land and pastureland are common; only limited cropland is found in this area. Post oak–blackjack oak forest, southern red oak–white oak forest and beech–maple forest occur. Undisturbed ravine vegetation can be rich in mesophytes, such as beech and sugar maple. Oaks still dominate most of these mesophytic communities. The forests are usually classified as oak–beech. They are related to the beech–maple cove forests of the Appalachian Mountains. Like the Appalachian cove forests, tulip poplar dominates early successional communities, at least in the southern ridge. In Arkansas, tulip poplar is native only to the Bluff Hills. Shortleaf pine grows on the sandier soils of the northern ridge.

Ownership Class shown as percent	1988	2003	Change
Public	15.3	18.2	16
Forest Industry	12.7	11.3	-12
Non-Industrial Private	72	70.4	-2

Table 9. Ownership Changes in Mississippi Alluvial Plain Ecoregion 1988 - 2003

Of the 45 terrestrial habitats in Arkansas, 13 occur in the Mississippi Alluvial Plain ecoregion. A summary of the problems faced by SGCN in the Mississippi Alluvial Plain is presented in Table 10. A higher score implies a higher quantity of SGCN and/or more greatly imperiled species associated with problems listed.

Problem faced	Score
Crop production practices	2,248
Dam	1,587
Forestry Activities	1,403
Grazing	1,241
Channel alteration	1,160
Resource extraction	1,078
Channel maintenance	1,020
Road construction	848
Water diversion	749

Table 10. Problems faced by Species of Greatest Conservation Need in the Mississippi Alluvial Plain Ecoregion.

Public Benefits from Forest Resources

Arkansas forests provide many ecosystem services. Clean water, scenic beauty, and carbon sequestration, for example, are benefits to the public provided, in part, by forests. Arkansas forests also provide economic benefits. Timber is the third leading forest crop in Arkansas, with payments to landowners of $537 million in 2003. Arkansas forest products industries shipped goods worth $7.4 billion dollars in 2001 and provided employment for 43,371 workers. The total economic impact of forest industries was $12.4 billion dollars of output and 97,183 workers in 2001 (Pelkki 2005).

Clean Water

Water provides many benefits to Arkansas's residents including safe drinking water, recreational places that support outdoor activities such as boating, fishing, hiking, and a diverse range of habitats that support a variety of wildlife (AWPG, 2006). Arkansas's abundant aquatic resources include a myriad of streams and standing-water environments ranging from ponds and large natural lakes to man-made lakes. Within or along Arkansas's borders are found 9,740 miles of streams and 453,868 acres of lakes, with a surface area exceeding 1,100 square miles.

This brings into focus the watershed protection functions and relationships within forests. Clean water is an important resource produced by our forests. Trees and shrubs in watersheds function as filters that trap sediments and absorb nutrients carried by water draining over the land (runoff). Additionally, streamside vegetation provides shade, maintaining water temperatures at levels necessary for certain species of plants and animals. Other important functions include regulation of the exchange of nutrients and woody residue between land and water and soil stabilization by the root systems of trees and shrubs (AWPG, 2006).

Silvicultural practices can cause soil and sediment to move into streams. Forestry Best Management Practices (BMP's) are important practices that prevent and reduce the amount of erosion generated by silviculture. Arkansas forestry BMP's are voluntary and the Arkansas Forestry Commission strongly encourages implementation. BMP's were adopted in response to the Clean Water Act of 1977 and the Water Quality Act of 1987, which protect and improve the quality of America's water.

Jobs and Economic Activity

The timber industry plays an important role in Arkansas's economy and is constantly being transformed as the south, including Arkansas, becomes a more important player in the provision of the nation's supply of timber and timber related products (Walkingstick and others 2001). Table 11 gives detailed information on Economic and Employment Activity related to Arkansas's Forests.

Employment Activity Related to Arkansas's Forests

Sector	Employment	Annual Payroll Income (in millions of dollars)
Forestry and Logging	5,506	$194
Wood Products	13,223	$528
Pulp and Paper	10,881	$758
Total	**29,610**	**$1,480**

Economic Activity Related to Arkansas's Forests

Sector	Number of Facilities	Value of Industry Shipments (in thousands of dollars)
Wood Manufacturing	49	$3,141,663
Paper Manufacturing	75	$4,519,187
Total	**124**	**$7,660,850**

Table 11. Economic and Employment Activity Related to Arkansas's Forests.

Other job and economic activities related to forests include outdoor recreation. Hunting, boating, fishing, camping, hiking, bird watching, and caving are related to forests or benefited by forests in some way. According to the 2003 Statewide Comprehensive Outdoor Recreation Plan, wildlife-related recreation is a $1 billion industry for Arkansas, enjoyed by half of its adult residents. Trends in outdoor recreation suggest trails are becoming more popular, especially those with a smooth, hard-finished surface. Recreation on these trails includes walking, hiking, bicycling, and rollerblading. Also many trails are accessible to wheelchair users interested in enjoying the outdoors. There has been a notable increase in those driving off-highway vehicles to just ride, picnic at favorite locations, or access points of interest for scenery and wildlife (SCORP 2003).

Wildlife Habitat and Natural Heritage

Arkansas is world-renowned for its duck and deer hunting opportunities. Other notable game species include turkey, black bear, and elk. For many species, habitat, especially forest habitat, is vital to species survival. The Arkansas Game and Fish Commission (AGFC), under the authority of Amendment 35 of the state constitution provides oversight regarding the regulation and protection of the diversity of all of the state's wildlife and fisheries resources. Through AGFC's direct involvement with the other conservation agencies, including the Arkansas Forestry Commission, forest wildlife habitat issues are being addressed statewide. Through collaborative efforts like this assessment, wildlife habitat needs have been summarized by the agencies and will serve as directing management alternatives in future plans around Arkansas.

Arkansas partners were also instrumental in working with the AGFC in the development of the

Arkansas Wildlife Action Plan (AWAP) which provides an assessment of the populations of "species of greatest conservation need" (SGCN) as well as the condition of the habitats they are associated with. The importance of the AWAP dictated that a later section of this assessment be provided. The section further details the AWAP, its mission and development along with the description of listed SGCN. The section also lists specific forested and woodland habitats and their conditions that jeopardize these identified species.

Arkansas is also home to numerous federally listed threatened or endangered plant and animal species and candidates for listing. Federally listed or candidate species in Arkansas include eleven freshwater mussels, six fish, two cave crayfish, one snail, four mammals, one amphibian, four birds one insect, and five plants. The majority of these species are either forest-dependent or are aquatic indirectly affected by conditions maintained and/or enhanced by forests.

The Arkansas Natural Heritage Commission is responsible for building, maintaining, and refining the Natural Heritage Inventory. The aim of this research is to locate high-quality examples of each type of natural community in the state, determine which species of native plants and animals most need habitat protection, and where the best habitats for these species are located. Through coordination with other state agencies, universities, and resource professionals 11,275 site-specific records of SGCN have been cataloged.

Scenic Beauty

Arkansas offers a variety of experiences ranging from a view from the top of the Ozark and Ouachita mountains to the fragrance of the pine forests in the rolling hills of South Arkansas's Gulf Coastal Plain or the Delta flatlands leveled by the Mississippi River. According to the Arkansas Department of Tourism's *Impact of Travel on Arkansas Counties 1998,* more than 19 million visitors spent $3.4 billion and employed almost 48 thousand people which generated more than $586 million in payroll. A study conducted in 2001 listed sightseeing as the primary attraction in Arkansas. Favorite locations to visit were Petit Jean State Park, DeGray Lake Resort State Park, and Lake Ouachita State Park (SCORP, 2003)

Arkansas's western highways offer some scenic views. Scenic Highway 7 traverses the north-south length of the state from Harrison to Louisiana, offering spectacular views ranging from the Ozark and Ouachita Mountains to the states oil-boom region. The Boston Mountains Scenic Loop consists of two state byways — U.S. 71 and Interstate 540 — both provide scenic experiences of the Boston Mountains, the highest portion of the Ozarks. Other notable scenic byways are the Mount Magazine Scenic Byway and the Talimena Scenic Byway, which cross the states highest and second highest peaks.

Eastern Arkansas is not without its scenery. The Great River Road journeys through the Delta region, passing remnants of the original wetlands and traveling through towns whose histories and economies were influenced by the Mississippi River. From Marianna to Helena the route penetrates the woodlands of the St. Francis National Forest on Crowley's Ridge.

Carbon Sequestration

The level of carbon dioxide (CO2) in the atmosphere is approximately 35% greater than in the pre-industrial revolution (Cason et al. 2006). This is alarming, as carbon dioxide contributes to the normal functioning of our planet by operating as a greenhouse gas and trapping heat from the sun and keeping it from radiating back into space. Too much carbon dioxide, however, is believed to contribute to climate change - specifically global warming - which could alter weather patterns and negatively affect the world's forests (McNulty 2009). The primary man-made source of this greenhouse gas is through the burning of fossil fuels such as oil, coal, and natural gas (Cason et al. 2006).

Forest take up (sequester) carbon dioxide through photosynthesis, storing some carbon as plant biomass and releasing some carbon dioxide back into the atmosphere through respiratory processes (Goward 2008). Disturbances to forest such as fire, pest infestations, and land use change contribute to the release of carbon dioxide into the atmosphere (Depro 2008). Fire, while releasing carbon dioxide, can also make a more vigorous forest which may increase the affected forest's ability to sequester carbon dioxide. Disturbance is a characteristic of US forests and affects up to half of US forest land every ten years (Birdsey and Lewis 2003). However, silvicultural practices such as reforestation, afforestation, and the management of existing forests have enormous potential for sequestering carbon dioxide (Cason et al. 2006). For example, timber harvesting converts standing timber into long lived wood products which continue to store carbon beyond the normal life of the tree. Other forest sector activities that can contribute to increasing sequestration include agroforestry, forest conservation, wood products management, and urban forestry (Birdsey and others 2003). Another important avenue to increase carbon sequestration is to reach out to non-industrial private landowners (NIPLO) who do not actively manage their forests. According to Butler (2010), the majority of NIPLO's in Arkansas do not have a management plan. Improving forest management will likely sequester more carbon.

Public awareness has increased interest in managing forests to sequester carbon to offset human influence on the global climate (Woodbury et al. 2006). Currently, forests in the US occupy about 33% of the land area (Smith and others 2001), and sequester about 10% of the US emission of carbon dioxide from burning fossil fuels (Birdsey and others 2006). The southeast and south-central region (to include Arkansas) accounts for 29% of the total forest area and 40% of the timberland area in the conterminous US and, in 1996, provided 59% of the US timber harvests (Haynes 2003).

The prospective role of forestry in helping stabilize atmospheric carbon dioxide depends on several factors: harvesting and disturbance rates, expectations of future forest productivity, and the ability to deploy technology and forest practices to increase the retention of sequestered carbon dioxide (Birdsey and others 2006). Public forests in the contiguous US are comprised of approximately 228 million acres, which for decades have been managed for multiple uses and ecosystem services including timber, range, wildlife habitat, watershed protection, recreation, and visual amenities (Depro 2008). Carbon sequestration could potentially be an addition to public land management philosophies. Also, emerging markets for carbon offsets have created new opportunities to finance afforestation of agricultural land (Shoch and others 2009). On other private lands, carbon sequestration is a byproduct

of owning forest, but is not likely to be the main goal of land ownership (Birdsey and others 2006), unless emerging markets make carbon storage economically attractive.

Atmospheric carbon dioxide is increasing at a rate that makes forestry practices alone an inadequate means of stabilization, but forests have significant potential for emission mitigation (Cason et al. 2006). Ongoing research is needed to measure and account for carbon sequestration in forest (Birdsey and others 2006). Also, further research to better understand the terrestrial carbon cycle and how it may be affected by land use practices should improve the incentive for landowners to practice forestry (Cason et al. 2006).

Arkansas's Wildlife Action Plan

Introduction

Arkansas constructed its Comprehensive Wildlife Conservation Strategy (CWCS) with key partners who served on the Steering Committee from the beginning. Aiding the AGFC were The Nature Conservancy, Audubon Arkansas, US Fish and Wildlife Service, US Forest Service and Arkansas Natural Heritage Commission. As the work on the CWCS progressed, additional members joined: The Arkansas Academy of Science, the Cooperative Extension Service and USDA Natural Resources Conservation Service.

Through numerous meetings during the development phases, the Steering Committee's role was to make key decisions to direct the cooperative effort that forms the structure of the CWCS.
This first iteration of the CWCS is only the most visible result of our multi-year planning efforts. Of even greater value are the inter-agency and organizational networks and communication bridges that were formed and strengthened through this effort. The ultimate test of the CWCS will be measured through the success of its implementation and the strengthening of collaborative efforts and partnerships.

Guiding Principles

From the outset, Arkansas's CWCS teams chose to focus on developing a living planning tool, rather than a static funding document, that could be useful to professional partners, citizen conservationists and land managers. At the core of Arkansas's plan are teams of scientists who have populated a database which stores and links information and makes possible the calculation of priorities. The result is a database that can be readily updated as data gaps are filled and conservation actions are accomplished. With every update, the status of species of greatest conservation need and the relationships between species, habitats and conservation actions can be reexamined in an efficient manner that will demonstrate progress over time. Science-based decision making relies on making accurate information accessible and usable. In Arkansas, scientific teams, the general public, nonprofit groups, government agencies and land managers will rely on database-managed priorities communicated online at www.wildlifearkansas.com.

Congress identified eight required elements to be addressed in these wildlife conservation plans. Further, the plan must identify and be focused on the "species in greatest need of conservation," (SGCN) yet address the "full array of wildlife" and wildlife-related issues. They must provide while making use of:
(1) Information on the distribution and abundance of species of wildlife, including low and declining populations as the state fish and wildlife agency deems appropriate, that indicate the diversity

and health of the State's wildlife; and,

(2) Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in (1); and,

(3) Descriptions of problems which may adversely affect species identified in (1) or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats; and,

(4) Descriptions of conservation actions proposed to conserve the identified species and habitats and priorities for implementing such actions; and,

(5) Proposed plans for monitoring species identified in (1) and their habitats, for monitoring the effectiveness of the conservation actions proposed in (4), and for adapting these conservation actions to respond appropriately to new information or changing conditions; and,

(6) Descriptions of procedures to review the plan at intervals not to exceed ten years; and,

(7) Plans for coordinating the development, implementation, review, and revision of the plan with Federal, State, and local agencies and Indian tribes that manage significant land and water areas within the State or administer programs that significantly affect the conservation of identified species and habitats.

(8) Congress also affirmed through this legislation, that broad public participation is an essential element of developing and implementing these plans, the projects that are carried out while these plans are developed, and the Species in Greatest Need of Conservation that Congress has indicated such programs and projects are intended to emphasize.

The AWAP has addressed each of these elements in a definitive manner through text, appendices and reports. The volume of data and recommendations for SGCN in Arkansas's Plan prohibits the inclusion of much of the information in this document. It is the aim of this section on the AWAP to highlight the various forested and woodland habitat types throughout Arkansas providing examples of optimal and suitable conditions for those species which occur while lending conservation actions required to obtain the desired habitat conditions. For the complete version of the plan and supportive materials go to the website: www.wildlifearkansas.com

State Wildlife Grants support activities promoting the betterment of Arkansas's designated SGCN. Because there is much more to do to conserve SGCN than can be funded in a given year, Arkansas developed a science-based prioritization process to make the most efficient use of available funds. The process relies on a database framework for organizing, analyzing, storing and retrieving data. Each step in the process receives expert input from the AWAP's partners and stakeholders. Projects funded by State Wildlife Grants each year are chosen from a list of implementation needs that are generated from the database, coarse-filtered by Science Teams, then fine-filtered by the Steering Committee and the Implementation Team.

Given the current limits to available resources, doing our best for SGCN means that funds must be targeted with an eye to optimizing results. The process will rely on the database framework and it will rely on input from biologists, landowners, scientific teams, the general public, researchers, nonprofits, and the many partners whose involvement has contributed so much.

Monitoring

Monitoring and adaptive management are key elements of the conservation effort. Agencies and partners cannot afford to undertake large scale habitat protection, restoration or enhancement endeavors, only to discover after years of management that actions were ineffective or even counterproductive. Monitoring helps evaluate:

- assumptions made in species-habitat models and decision support tools;
- habitat responses to conservation actions;
- population responses to conservation actions; and
- progress toward habitat and population objectives.

New information generated from research and monitoring only becomes useful if it influences future conservation decisions and actions. These benefits are most pronounced when the elements are iterative and ongoing rather, than static or episodic. Thus, habitat conservation strategies are most appropriately viewed as living strategies that are continually developing in response to targeted research and monitoring results. A continuous feedback loop is part of effective implementation. Successful application will depend upon sharing information and incorporating it into the overall body of knowledge held by the CWCS.

Listing SGCN

The CWCS Species Team created a list of species of greatest conservation need for Arkansas. Existing data from agencies and partners was cross-referenced with expert opinion. Some species were chosen for inclusion on the list because they are rare, some because their populations are declining significantly or, in some cases, because they are thought to be rare or declining but uncertainties exist regarding their taxonomic, life history or conservation status. Arkansas's wildlife face many problems and challenges, including the advance of exotic plant and animal species, as well as the fragmenting and destruction of their habitats. The aim of the list is to represent broadly the taxa of Arkansas so that the overall health of ecosystems at a landscape level can be addressed and effectively managed.

Inclusion on the list of SGCN does not confer any special or regulatory status like federal listing as an endangered or threatened species does. The identification of SGCN is part of a process to

identify species and groups of species that will be the focus of programs and projects supported by federal funding under the State Wildlife Grant program and others. Federally-listed species that occur in Arkansas are included on the list of SGCN and addressed by this strategy. However, such species are eligible for funding by sources other than State Wildlife Grants.

The CWCS Species Team assembled a list of potential species from the existing lists of rare, declining or imperiled fauna kept by the AGFC and the Arkansas Natural Heritage Commission. The AGFC list includes Partners-In-Flight priority bird species. These were combined to produce a draft list of species of greatest conservation need.

The CWCS Species team considered all native amphibians, birds, fish, mammals and reptiles for inclusion on the list. Vegetation is specifically excluded from funding. Of the invertebrates, all native crayfish and mussels were considered for the list. Only representative insects and other invertebrates were considered because the team was concerned that the numbers of these species, many with poorly known conservation status, could overwhelm the list.

Strategic Approach to Prioritization and Implementation

The Arkansas Wildlife Action Planning teams developed a comprehensive strategic approach for addressing and prioritizing SGCN using multiple implementation needs for assembling information

Implementation Step 1. As described in the AWAP, the Science Teams (Taxa Association Teams and Habitat Teams) populated the CWCS database with information on 369 “species of greatest conservation need” ranked by species priority score. The teams linked species to ecoregion, ecobasin and habitats and weighted the relative importance of those relationships. The spatial relationships between ecoregion, ecobasins and habitats were then mapped. For each species, Science Teams described problems faced, threats and sources; and data gaps; then recommended conservation actions and monitoring strategies to abate these problems.

Implementation Step 2. The purpose of Step 2 is to use the information gathered and prioritized in Step 1 to promote efficient and scientific evaluation and to prioritize the allocation of resources. Arkansas uses a systematic approach to ranking implementation needs and these needs are categorized into three groups:

- Data Gaps: surveying or determining basic research needs identified during the planning process as requiring attention before further action can be taken. Examples are additional biological information needed for understanding life histories, population ecology or distribution of SGCN prior to developing a conservation action.

- Conservation Actions**:** the protection, management and restoration activities that directly affect SGCN, often at the habitat management level. These are called for in the CWCS.
- Monitoring Needs**:** Measuring how SGCN and habitats change over time. Of particular interest are those changes affected by the implementation of conservation actions. Monitoring drives the adaptive management process, guiding improvements in procedure along with the identification and prioritization of additional data gaps and conservation actions.

Implementation Step 3**.** Each team will develop a ten-year implementation instrument to be used as a coarse-scale tool to help teams sort priorities and facilitate the creation of subsequent finer-scale priority action lists.

Implementation Step 4. Every two years, the continuously-updated CWCS database will provide Science Teams with an updated version of the following lists within each area of expertise:

- Ranked list of Data Gaps
- Ranked list of Conservation Actions
- Ranked list of Monitoring needs

After comparing the ranked lists with the existing ten-year implementation plan, and taking into account new information that warrants consideration, each team will identify a top ten in each category.

Implementation Step 5. Each year, the Steering Committee reviews the Hot Lists provided from each Science Team. At this time, the Steering Committee considers any new information or opportunities to develop a set of Annual Action Items

Implementation Step 6. With this list of needs selected, the State Wildlife Action Plan Coordinator will issue a Request for Pre-proposals, i.e. project descriptions including preliminary budgets, non-federal funding match opportunities and monitoring elements. Pre-proposals should address the implementation priorities selected by the Steering Committee.

Implementation Step 7**.** Each January, the Implementation Team will select from the pre-proposals that were solicited in Implementation Step 6. After the projects are selected, the budget will be presented to the Commission Budget Committee for review and approval. Those projects that make the final cut will have agreements and contracts drawn up. The projects will be submitted to the U. S. Fish and Wildlife Service for approval.

Implementation Step 8. Monitoring is essential to making effective management decisions and evaluating the outcomes of those decisions. Arkansas is approaching the challenge of developing

quality performance measures by participating in the Natural Resource Monitoring Partnership (http://www.nbii.gov/portal/server.pt/community/nbii_partners/413) This is a collaborative effort of the natural resource management community to improve monitoring efforts.

Implementation Step 9. The steps of the implementation process incorporate consistency in managing changing priorities from 2006 to 2015. CWCS teams and the Wildlife Action Plan staff will continually update the CWCS database and communicate priorities with partners and stakeholders. The AGFC commits to working with partners in completing a comprehensive review and revision of the CWCS process and the AWAP by October 1, 2015.

The AWAP and the associated needs of SGCN were assembled from this comprehensive evaluation of the state's terrestrial and aquatic habitats and through collaboration with specialists in the area of species providing the needed connections to suitable habitat types. It is our intent to focus upon actions that foster suitable habitat conditions for the given guild of SGCNs that inhabit each type.

Currently, implementation of conservation strategies is taking place through partnership in the development of terrestrial and aquatic management plans and prescriptions on most public lands in Arkansas. It is also the intent of the members of the steering committee and agencies and organizations involved with delivery of conservation actions to also propose management recommendations to private landowners throughout the state involved in various technical assistance programs.

Threats

Although the important forested and woodland habitat types identified in the AWAP are susceptible to many current threats identified elsewhere in the Assessment like parcelization, urbanization and invasive and exotic invasions, their overall sustainability is also threatened from the removal of ecological processes that provide function. If part of the ecological ingredient is absent from the landscape, whether fire, floods, or migration, sustainable conditions cannot be maintained for the populations of SGCN under this plan. Most of these terrestrial wooded habitat types identified in the plan have been subject to periodic disturbance through centuries by both natural as well as anthropogenic processes. Those forest and woodland types in upland locations throughout Arkansas have been subject to periodic fires, windstorms and ice as the ecological forces that sustained quality habitat conditions for the listed species. The bottomland areas were affected by flooding regimes and fluctuations in moisture that managed the types of forest communities present. Although current changes in land use, invasions by noxious plant species and increased urbanization are very real threats, wise management of Arkansas's forests and woodlands is crucial to their sustainability and the associated species through time.

Additionally, there are threats to habitat types from invasive animal species. For example, illegal feral hog stocking in many areas of Arkansas have created severe competition for food to native species. Feral hogs have also been associated with excessive damage to terrestrial habitats. As a result, eradication of feral hogs on public property is becoming more of a management focus.

Global climate change research has provided predictions regarding potential changes in species compositions of flora and fauna and that more southern latitude conditions could be experienced in Arkansas in the future. Although solutions to global climate change must be continental and sub-regional in scale, offsetting efforts rely upon reducing carbon footprints at the state level. The recent report from the Arkansas Governor's Commission on Global Warming recommendations (www.arclimatechange.us) has outlined many ways our state can make reduction in greenhouse gas (GHG) emissions as well as ways to increase carbon sequestration statewide. In forested landscapes, from which Arkansas is fortunate to have more than 50% cover, the retention of atmospheric carbon can be greatly increased through the proper management of these resources. As closed canopy forests are thinned to more healthy and ecological conditions, tree growth is increased along with the sequestration of carbon. Additionally as stated above, fire management through the proper use of prescribed burning is also beneficial in ultimately reducing GHG emissions by reducing the threat of stand-replacement wildfires, as well as reducing forest fuels thereby allowing more herbaceous cover on the forest floor. It is therefore through conservation actions proposed in the AWAP that will best assist in our state's contribution towards offsetting global warming.

Conservation Actions

In order to address conservation actions contained within the AWAP and incorporate them into this forest assessment, data was obtained from the plan regarding both problems faced and management needed for many of the priority terrestrial SGCN as well as data from the forested and woodland habitat reports concerning indicators of condition. The primary conservation action that covers over 80% of the terrestrial communities involves implementing some type of disturbance and less upon strict protection. A vast majority of the upland terrestrial habitat types are fire dependent plant communities (forests, woodlands, glades) and historically were managed by both natural and cultural fires. It was the more consistent human-set fires by previous inhabitants that served to manage the native vegetative landscapes and the associated fauna. This disturbance along with the use of wood and forest thinning maintained these communities in more open conditions allowing a two-tiered ecosystem of overstory trees and a diversity of herbaceous plants underneath. Most of the SGCN in Arkansas's uplands are dependent upon the conditions brought about by periodic fires and efforts are being made to increase prescribed burning on these landscapes.

In the lower, more mesic communities dominated by bottomland hardwoods, the natural disturbances were flood, windthrow from storms and hydrologic changes. The perpetuation of the species composition of these historic forest ecosystems require wise forest management that takes into account the incredible diversity of biota these forests contain. With canopies dominated by shade-intolerant tree species (primarily oak) sustainability is dependent upon reducing canopy closure and controlling invasive woody species in the understory. The management of these systems for diverse wildlife species is best contained in the Lower Mississippi Valley Joint Venture document, *Restoration, Management, and Monitoring of Forest Resources in the Mississippi Alluvial Valley: Recommendations for Enhancing Wildlife Habitat* (aka. Desired Forest Conditions).

The AWAP differentiated between broader categories of conservation actions as defined in the table below:

Habitat Restoration/	Involves the improvement or restoration of habitat or Improvement habitat components
Habitat Protection	Involves the protection of existing habitat or habitat components
Fire Management	Management of fire regime
Land Acquisition	Purchase of land or conservation easements critical to species of concern
Population Management	Direct manipulation of populations of species of concern, including
	restocking, harvest management, and translocation efforts
Threat Abatement	Mitigation of an existing threat, such as predation, pollution, or
	competing species
Data Gap	Not enough information is known at this time to formulate
	conservation actions
Public Relations/	Public outreach and education involving species of concern or Education key habitats
Other	Other conservation actions not covered by these categories

Provided in Appendix D are 28 terrestrial forest and woodland habitat reports from the 45 terrestrial habitats identified in the AWAP. The decision to not include the aquatic portions of the AWAP in this

forest assessment was simply based upon limited space for the necessary volume and complexity of addressing aquatic species, ecobasins and habitats. Refer to the AWAP website for listed aquatic information (www.wildlifearkansas.com). However, the terrestrial reports do take into account riparian conservation actions that safeguard water quality and stream bank protection. Also, all management actions incorporated in the forest assessment carry with them the expectation of being conducted within the state's BMPs. The terrestrial habitat reports included provided a brief description; examples of the SGCN listed under each habitat type from the action plan; what ecoregions each habitat occurs; problems faced by SGCN; and conservation actions required for abating threats.

Threats to Forest Resources

Threats to Arkansas's forests include fragmentation, parcelization, urbanization, insects, diseases, non-native plants, wildfire, and climate change. Addressing these threats now could save or at least minimize the effect they have on the states forest resources in the future. Fragmentation, parcelization, and urbanization are interrelated and all lead to conversion to non-forest uses.

Fragmentation, Parcelization, and Urbanization

Forest fragmentation is the breaking up of large, continuous forested areas into smaller, more isolated patches (Meneguzzo and others 2009). Local fragmentation effects are dependent on circumstances, but any discontinuity in forest cover can potentially influence ecological processes over most of the forest (Ritters and others 2002). Effects of forest fragmentation include the introduction of barriers to the movement of native animal (Harris 1998) and plant species, degradation of native habitats (Belisle and others 2001; Burke 2000; Cam and others 2000; Herrmann and others 2005; Rosenburg and others 2003), degradation of water quality[9], and the introduction of non-native plant and animal species (Harris 1988). Barriers to the movement of plant species typically result from forest fragmentation as non forest uses override and exclude regeneration of forest species out of forested areas. Wildlife movement is affected as forest patches typically have no corridors linking other patches which impede wildlife movement due to cover. Water quality is impaired as there is a reduction in the filter area before water is introduced into waterways, increasing flow which increases sedimentation and turbidity. The potential for non-native plant and animal species introductions increase as changes in light, wind, and moisture microclimates occur along with the disturbance that created the fragment in the forest (Belisle and others 2001).

Parcelization is the division of large forested tracts into smaller parcels, which are in greater danger of conversion to non-forest uses. A factor driving parcelization is urban out-migration. Increases in real incomes cause increased demand for larger homes and home sites which use more forestland to house fewer people. Also, land is cheaper in more rural areas furthering the reduction of continuous forested landscapes.

Urbanization is the process of increasing urban development to include the loss of forest land to developed land uses (Riemann and others 2009). Urban development is typically more scattered than other land uses, and most of the increase in urban land comes at the expense of forestland (Harris 1988; Riemann and others 2008). Forested land is more valuable for development than for growing timber (LaGro and others 1992). As more and more people live in and closer to the wildland-urban interface it becomes a political arena where people of different values for the forest interact (Lubka 1982). This can result in vocal opposition to traditional forest management practices (Vaux 1982). Timber management is sharply curtailed in areas prone to urbanization and as land on the urban fringe is converted

to urban uses, the nontimber amenity value of remaining forestland increases, resulting in less timber management (Shands 1991). Many researchers and natural resource professionals agree that increasing development and other human influence on forested landscapes harms forest ecosystems (Riemann and others 2008). Urbanization decreases water quality. Urbanization typically brings with it impervious surfaces which increase runoff and add, rather than filter, pollutants to streams (Barlow and others 1998).

Native and Non-native plants and insects

Non-native invasive plants, insects, and diseases are serious potential threats that are priority areas of concern. Native vegetation has no natural defenses for non-native threats and as such are completely vulnerable. Initial infestations, if not diagnosed quickly, have the potential to cause enormous damage. Natural resource personnel and the public in general must be informed of probable threats and identification of those threats, so early detection is possible and eradication cheaper and possibly more effective. Current knowledge suggests the major threats from non-natives are cogongrass, gypsy moth, emerald ash borer, and Asian longhorned beetle. Additionally, southern pine beetle is a native insect that is a major threat in south Arkansas.

Cogongrass

Cogongrass is an invasive grass species and Federally listed noxious weed that is widely regarded as the worst invasive threat in the Southern US States where cogongrass is present include Alabama, Georgia, Louisiana, Mississippi, South Carolina, and Texas. Entry into Arkansas, North Carolina, and Tennessee is imminent (Miller 2007a). It was inadvertently introduced as a packing material in a shipment from Japan to Mobile, Alabama in 1912 (Tabor 1949; Tabor 1952; Dickens 1974). It was also been introduced as forage, and later deemed unacceptable, in Mississippi, Florida, Alabama, and Texas in 1921 (Hubbard 1944; Dickens and Moore 1974). It was not acceptable as forage because of poor nitrogen content, poor digestibility, and accumulation of silica in the mature leaf tissue (MacDonald 2007).

Cogongrass spreads by both rhizomes (root like structures) and seed. Windblown seed can move several miles and seed and rhizomes can move even farther when contaminated soil is present on equipment, mulch, and fill materials (Moorhead and others 2007). It can produce more than 3,000 seeds per plant which can move long distances, but generally movement is limited to 15 meters (MacDonald 2007). Flowering time, in the US, is generally in the late winter/early spring (Shilling and others 1997; Willard 1988); but disturbances such as burning, mowing, grazing, frost, or the addition of nitrogen can also stimulate flowering (Holm and others 1977; Soerjani 1970; Sajise 1972).

Establishment is favored in areas of limited competition such as disturbed sites (Dozier and others 1998). Therefore, natural disasters (hurricanes) and human disturbance (logging, road construction, etc.) will create suitable areas for cogongrass establishment. It also persists through adaptation to poor soils and drought and the ability to withstand and thrive in a fire-based ecosystem

(Hubbard 1944; Holm and others 1977; Dozier and others 1998; Brook 1989). Fires from cogongrass are typically 15 to 20% hotter and more intense than fires in pine-based ecosystems found in the Southern US (MacDonald 2007). This kills most above ground vegetation and limits natural secondary succession (Eussen and Wirjahardja 1973; Seavoy 1975; Eussen 1980; Lippencott 2000). Once established, congongrass out-competes native vegetation. It forms large solid stands with low species diversity and low species richness (MacDonald 2007). Figure 5 shows known infestations as of April 2009.

Cogongrass Distribution—Southern U.S.

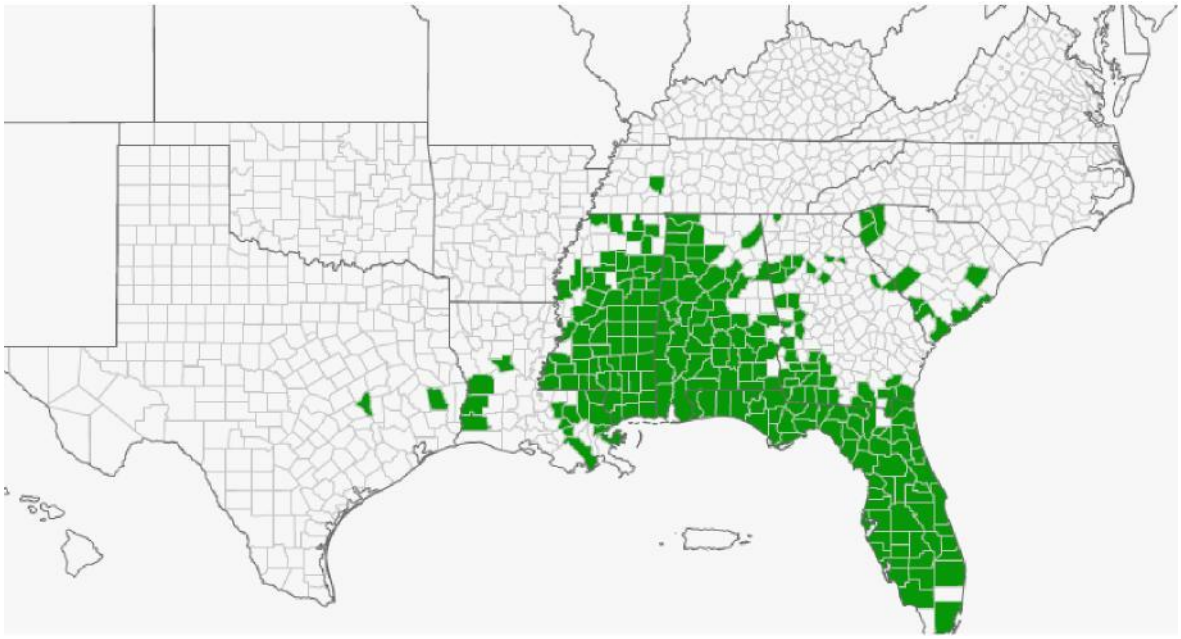


Figure 4. County Level Infestations of Cogongrass. April 2009. EDDMaps—Bugwood Network.

Cogongrass will continue to spread and suppress or eliminate natural ecosystems unless concerted programs are created to contain and combat it. Eradication of this invasive species is necessary, but federal programs and responsible agencies are under-funded to effectively aid in the process (Miller 2007b). Steps to effectively combat congongrass include education, making political arenas aware of the threat and gaining their support, stopping vectors of spread, and improving or creating cooperative networks among regional, state, multi-county and county levels (Miller 2007; Johnson 2007).

Natural resource professionals, as well as the public, across the southern region must be educated on the identification, biology, and threat to natural resources cogongrass poses. Early detection and treatment of new infested sites is crucial to the containment of this noxious weed. Political support will make available grants to contain and eradicate congongrass to individuals and entities who

may otherwise be unable to effectively combat it. Also, the creation of cooperative networks among regional, state, multi-county, and county levels will provide much needed technical support through information sharing to areas with new cogongrass infestations needing to combat it.

Emerald Ash Borer

Emerald Ash Borer was first discovered in Detroit, Michigan and neighboring Ontario, Canada in June 2002. This beetle is identified as the causal agent of widespread ash tree decline and mortality in the Detroit metropolitan area (USDA APHIS 2008). This native to Asia has since become one of the most devastating forest pests in the United States (McCollough 2008). It is responsible for the death or decline of tens of millions of ash trees in thirteen states including Illinois, Indiana, Kentucky, Minnesota, Michigan, Ohio, Pennsylvania, Maryland, Missouri, Virginia, West Virginia, New York, and Wisconsin (USDA Program Aid 769).

The emerald ash borer probably arrived in North America hidden in wood packing materials used to ship consumer goods, auto parts, and other such products. The scientific community believes the beetle may have been present for 12 years before being detected (USDA Program Aid 769). Larvae from the beetle feed on the tissue between the bark and the sapwood which disrupts the transport of nutrients and water in the tree, eventually causing branches an the entire tree to die (USDA 2008). There are about 60 species of ash worldwide, including 16 in North America, all of which are at risk of infestation (Haack et al 2002).

Trees outside of its normal range in China and southeast Asia are particularly vulnerable as emerald ash borers do not have natural population controls such as parasites, predators, or diseases and trees have not had time to adapt and develop effective defenses against them. This non-native pest poses an enormous threat to our urban and rural forests because it kills stressed and healthy trees (USDA APHIS 2008). Ash is an important timber species and landscape tree, which also provides food for wildlife (Haack et al 2002). Ash is also vital to natural forest succession as it is one of the few species that will out-compete weeds that prevent most other tree species from becoming established. They are also very desirable for urban tree planting as they grow well under difficult conditions (USDA APHIS 2008).

Artificial (human assisted) spread of the Emerald Ash Borer is accomplished through the movement of common ash tree products such as firewood, nursery stock, green lumber, branches, logs, and chips (USDA Program Aid 769). In order to effectively stop the spread of infested wood the USDA quarantines areas where Emerald Ash Borer is known to exist. Other strategies to manage the pest include using detection traps and public awareness campaigns such as “Don’t Move Firewood”, as firewood movement is a primary method of spread (USDA APHIS 2008). Figure 6 shows know infestation sites for the emerald ash borer.

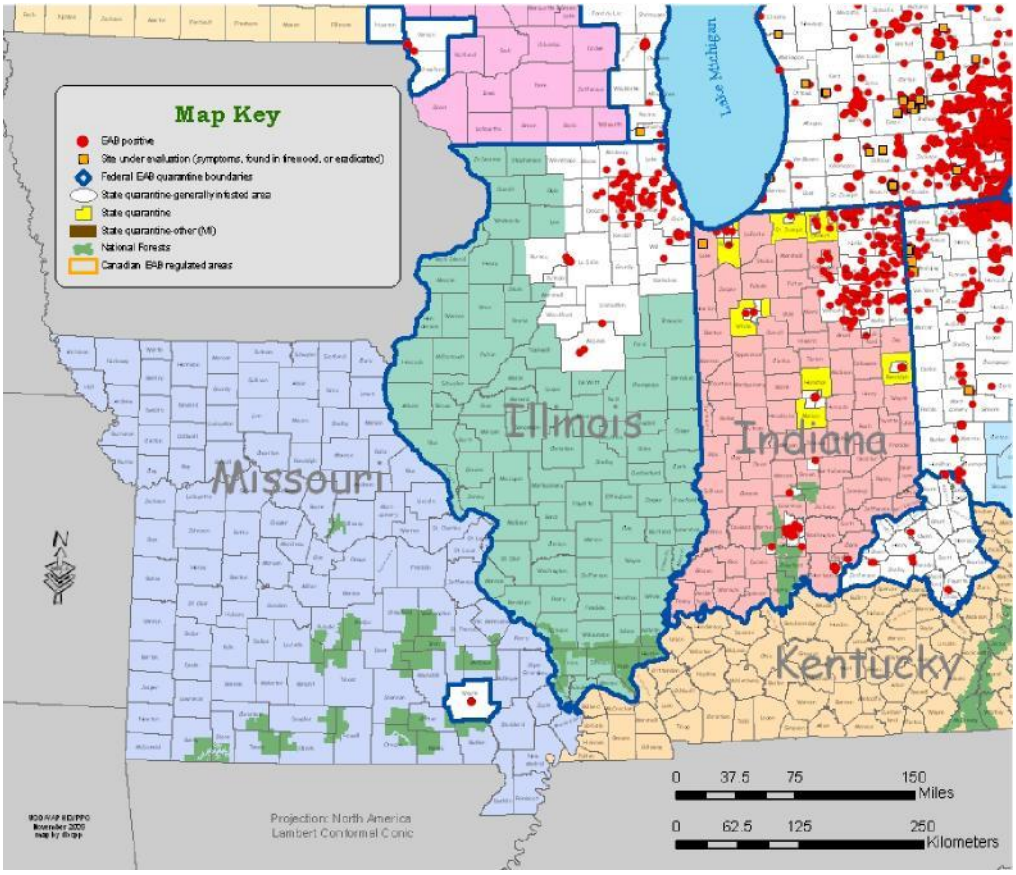


Figure 5. Known Infestation Sites of the Emerald Ash Borer

Asian longhorned beetle

The Asian longhorned beetle was first discovered in the US in New York City in 1996 (Sawyer 2007). The beetle is endemic to China and North Korea and was most likely introduced through wood shipping crates packed from China (Moltzan 2002); as most colonization events have occurred near an importer of goods from Asia (Sawyer 2007). It has now been found in the urban forests of Long Island, Chicago, New Jersey, and Toronto (Roden et al. 2008).

In its native environment, the Asian longhorned beetle attacks 24 species of living hardwoods (Roden et al. 2008). In the United States it primarily feeds on maple species, but has been found on horse chestnut, chinaberry, mulberry, poplar, cherry, pear, locust, willow, elm, birch, ash and citrus (USDA 2001). A complete list of host trees in the United States is yet to be determined (USDA 2008). The beetle has one generation per year, which usually stays on the trees from which they emerge or they may disperse for short distances to a new host to feed and reproduce. The

larvae feed under the bark of a tree, then bore deep into the wood; adults emerge from the tree by boring a tunnel in the wood and emerging from a round exit hole in the tree (Haack 2003). Early detection is difficult because the exit hole is generally high in the tree were it is easily overlooked (Moltzan 2002). One positive finding is that in areas with abundant host trees the beetle does not spread rapidly. The population, instead, multiplies steadily in a number of trees for a number of years, then expands rapidly as the condition of the host tree deteriorates.

The primary damage caused by the larvae of Asian longhorned beetle is the main stem and branches of trees are girdled (Cavey and others 1998). If repeated attacks occur, the crown will dieback and the tree will eventually die (Moltzan 2002). The only effective means to eliminate the beetle is to remove infested trees and destroy them by chipping and burning them (USDA 2008). Damage from infestations in New York and Illinois resulted in over $80 million in removal costs to State and Federal governments. The beetle has the potential to damage trees nationwide, adversely affecting lumber, maple syrup, nursery, commercial fruit, and tourism industries and accumulating over $650 billion in losses (Moltzan 2002).

A federal quarantine was implemented by the US Department of Agriculture, Animal and Plant Health Inspection Service (APHIS) in March 1997. It regulates the artificial movement of host material that could contain life stages of the Asian longhorned beetle (Haack 2003). APHIS is also working with Chinese authorities to prevent future infestations of the beetle including restrictions on softwood packing material from China and the imposition of treatment requirements for these materials before they arrive in the United States (Moltzan 2002).

Gypsy Moth

There are two species of gypsy moths, the European Gypsy Moth (Lymnatria dispar) and the Asian Gypsy Moth (Lymantria dispar dispar), both of which have been introduced to the United States. The Asian Gypsy Moth has been found in Washington and California. Eradication efforts in Washington have proved successful and eradication efforts are currently being employed in California (USDA AHPIS). This discussion will focus on the European Gypsy Moth as it poses a much more immediate threat to the state of Arkansas.

The gypsy moth, Lymantria dispar, was originally introduced to North American in 1868 or 1869, near Boston, Massachusetts (Liebhold et al 2004). Egg clusters of the moth were brought from France by amateur entomologist Etienne Leopold Trouvelot. It is believed he was conducting laboratory experiments to evaluate the gypsy moth as an alternative to the native silkworm, *Antheraea polyphemus* (Tobin et al. 2007). It is unclear how the moth escaped his laboratory, but the infestation of the local area was first noticed by residents around 1880 (Leibhold and Tobin 2006). Efforts to eradicate the species began immediately but by 1900 it was clear the efforts had failed and the species was permanently established in North America (Liebhold 2003).

The gypsy moth has over 300 species of deciduous and coniferous hosts (Elkinton and Leibhold 1990). The host species for gypsy moth caterpillars are oaks, but apple, sweetgum,

basswood, gray and white birch, poplar, willow, and many other trees serve as hosts. Older larvae feed on pines, hemlock, spruces and southern white cedar (Pest Alert 2001). Natural forms of dispersal include adult male flight and ballooning early instars (Whitmire and Tobin, 2006). Without intervention, the gypsy moth has historically spread approximately 13 miles per year (Pest Alert 2001). The movement beyond infested zones is largely thought to be the result of inadvertent transportation of life stages by humans (Schawlbe 1981; Mason and McManus 1981; Liebhold et al. 1992). Current range of the gypsy moth includes the entire Northeastern United States and portions of Virginia, West Virginia, North Carolina, Ohio, and Michigan (Leibhold and others 1992, 1997). Since 1924, over 34.6 million hectares of forest in the US have been partially or completely defoliated by the gypsy moth (Gypsy Moth Digest 2004).

The first Federal quarantine against the gypsy moth was enacted in 1912 (Weber 1930). Despite efforts by federal and state agencies the moth has continued to spread since that time (Liebhold et al. 1992). In 2000, Congress funded the Slow the Spread (STS) Program which is dedicated entirely to the gypsy moth. STS cost $76.35 million from 2000 to 2007, but reduced spread by 70% to 3 miles per year (STS 2008). A conservative total net present value (after subtracting costs) of the STS program for 2007 over a 20 year span is estimated to be between $184 and $348 million (STS 2009).

Southern Pine Beetle

The southern pine beetle (*Dendroctonus frontalis*) is one of pine's most destructive insect enemies in the Southern United States (Thatcher and Barry 1982). In pre-settlement forests, the southern pine beetle (SPB) was responsible for periodic perturbations that maintained uneven-aged forests and a diversity of plant species. These outbreaks were beneficial events in the normal functioning southern pine beetle ecosystems (Nebeker 2004). Although all southern pines may serve as hosts for SPB, loblolly pine (*Pinus taeda*) and shortleaf pine (*Pinus echinata*) are considered the most susceptible (Thatcher and Barry 1982, Clark and Nowak 2008). SPB is now considered a pest due to the economic value placed on pine and because intensive management of pine forests has caused beetle populations to interfere with management objectives (Nebeker 2003). In the South, adults emerge and begin to attack uninfested trees in early spring. Depending on latitude and elevation, there may be upwards of three to seven generations per year. Under ideal conditions the number of beetles may increase tenfold in a single generation causing sparse populations to reach epidemic proportions within a summer (Thatcher and Barry 1982). Forester and entomologists have long relied on ground observations, aerial surveys, and aerial photography to locate infestations. Global positioning systems (GPS) have increased the efficiency with which SPB spots can be located on the ground (Nebeker 2004). Once located the primary objectives of suppression are to reduce beetle populations to a low level as rapidly as possible (Thatcher and Barry 1982).

Forest health managers and forest health specialists commonly believe that the most

effective method of managing SPBs is through preventing outbreak populations through creating conditions which lessen outbreaks when they do occur (Thatcher et al. 1980, Belanger et al. 1993, Clarke 2003). Prevention principles include matching tree species to the right site; controlling stand density; promptly salvaging lightning-struck, logging damaged, diseased, and high risk trees; planting trees only in their natural range; minimizing site and stand disturbances; and harvesting all mature trees at or near rotation age (Nebeker and Hedden 1984).

Wildfire

Fire was a regular part of the landscape of Arkansas during pre-settlement times. Native Americans and early European settlers frequently used fire to protect themselves from wildfire, improve wildlife habitat, and clear land for cultivation. The vegetation in some parts of the state are even adapted to fire, with many species requiring fire for regeneration. A basic premise of fire ecology is that wildland fire is not necessarily destructive or constructive; it simply causes change. Change is biologically necessary to maintain healthy ecosystems. Benefits of fire include reduction in hazardous fuels and logging debris, improvement of wildlife habitat, control of insects and disease, enhanced aesthetics, improved access, and the perpetuation of fire dependent species. Land managers generally determine the timing and frequency of fire (Wayne and Cunsford 1989). When fire exclusion occurs, fuels build; thereby creating hazardous conditions that can result in catastrophic wildfires.

Fire suppression programs were instituted in the 1930s to protect regenerating forests. Campaigns such as “Only You Can Prevent Wildfires” were successful to the extent that many people view any wildland fire as harmful. Fire exclusion resulted and increasing fuel loads has left some areas at risk for damaging wildfire. Compounding the situation is increasing neighborhoods and homes on the fringes of forested area (the wildland-urban interface).

Land management agencies now use prescribed fires and other fuel reduction techniques to reduce fuel loads on many acres of forestland each year. Vegetation grows back quickly in the South with its long growing seasons and mild climate, so regular treatment is necessary to maintain the benefits of fuel reduction treatments. However, rapid development in the wildland urban interface has increased the challenges and reduced the ability of forestry agencies from using prescribed fire treatments to maintain safe fuel loads in many areas of the state. Compounding the issue is public health concerns from smoke and private property owner concerns for the safety of their assets.

Climate Change

Climate change affects our forests and will continue to do so (McNulty 2009). Complex models of weather patterns suggest that as the planet increases in overall temperature, global patterns of circulation in the atmosphere and in the oceans change as well. These changes in large-scale patterns can influence local precipitation, the timing of bud break and frosts, and extreme weather event frequency (Smith 2009). In the Southeast US climate change has begun to alter our weather by warming our winters and drying our summers (Solomon et al. 2009).

"Greenhouse warming" distinguishes global change caused by human activity from that of long-term climate cycles that are independent of human activity. Concern for greenhouse warming has been associated with greenhouse gases especially carbon dioxide (Smith 2009). Carbon dioxide is necessary for normal atmospheric processes but too much of it is a bad thing. The current greenhouse warming problem stems from the burning of fossil fuels as well as other gases from animal agriculture and other industrial sources. This increased production of greenhouse gases is coupled with the decreased capture of carbon dioxide and reduced storage of carbon in trees and soil due to deforestation, forest fires, and other changes in land use (Smith 2009). Continued greenhouse gas emissions could result in average air temperatures increasing, changing precipitation patterns across the landscape, and thereby having significant effect on our nations forest (McNulty 2009).

Increased global temperatures will continue to have an effect on our nation's forest including increased potential for wildfire and insect outbreaks. A combination of reduced national forest timber harvesting and fire prevention have increased fire risk by increasing fuel loading. Also, tighter regulations of clean air and visibility standards have reduced opportunities for controlled burning, which help to reduce fuel buildup, and thereby reduce incidence and occurrence of large catastrophic wildfires. Climate change may also affect some species of insect's outbreak potential. Higher temperatures mean longer insect seasons. However, continued management practices used to control insect populations will continue to work under changing climate. Early detection, removal, and decreased forest stocking through thinning will continue to effectively reduce and minimize insect outbreaks (McNulty 2009).

Critical Issues Affecting Arkansas's Forests

There are many issues affecting the health of Arkansas's forests. Critical issues to be addressed in this assessment include water quality and quantity, forest health/invasive species, forest fragmentation/parcelization, increasing and enhancing the benefits of working forests, climate change, and fire management. Addressing these issues will improve Arkansas's forests and the benefits they provide.

Issue 1. Water Quality and Quantity

Forests influence the overland flow of water, water temperature, and stream flow and discharge, and as a result, affect water quality and quantity. These attributes of forests require managers/landowners to consider water quality and quantity when making forest management decisions to meet social, economic, or personal goals and objectives. With respect to water, forests are needed to protect water recharge areas, public drinking water supplies, extraordinary waters, priority watersheds, national and state designated scenic areas, and to secure habitat for endangered aquatic species.

Forests act as both filters and buffers to water bodies both of which are critical for maintaining healthy aquatic systems. Forests act as filters as trees take up nitrogen, phosphorus, and other mineral nutrients which in high amounts can lead to water pollution. Forests also act as buffers by increasing the distance between sources of pollution and the waters that could potentially be polluted. Healthy aquatic systems provide habitat for aquatic vertebrates, invertebrates, and plant communities, many of which are endangered or threatened. They also ensure public drinking water is adequate and meets drinking water standards.

Specific threats to water quality and abundance in Arkansas include land conversion, urbanization, fragmentation, and parcelization. Conversion of forested areas to non-forest can introduce excess nutrients, chemicals, and even animal waste into water affecting terrestrial and aquatic life and even human health. Urbanization of forested areas can lead to sediment being introduced into water from construction. Also excess runoff will result from impermeable surfaces of the transportation network required to facilitate the movement of increased traffic in the area. Fragmentation and parcelization threaten water quality when forest land is converted to non-forest uses because of economic pressure.

Opportunities exist to conserve and expand forests along waterways. These opportunities include protecting forested karst recharge watersheds from development, forested riparian zones from conversion to non-forested uses, and forested watersheds critical to public drinking water supplies and aquatic life. Methods for accomplishment include prioritizing the purchase of conservation easements within riparian corridors of priority areas and lands that contain known cave structures, sinkholes, and other openings to groundwater recharge. Conservation easements will ensure protection against forestland conversion.

Priority areas in Arkansas to benefit from forested waterways include the Buffalo River, Saline River, Lake Maumelle watershed, Arkansas River, Mississippi River, and the karst features associated with

the landscape of the Ozark Mountains. The defining features of the karst area is that it is underlain by calcareous limestone which is dissolved by acid water, forming solution caves under ground and solution features at the surface such as sinkholes and disappearing streams. Caves contain significant resources related to biology, geology, hydrology, archeology, paleontology, recreation, and scenery. Cave environments, by their very nature, provide unique, closed systems that are valuable for scientific study and environmental education of underground resources and the interrelationship between surface and subsurface (AR SNG). Water moves from the sinkholes and disappearing streams into the caves which may harbor endangered species and/or serve as water sources for rural populations. The Cave Springs karst area, an ecologically important karst area, comprises 44,000 acres west of Springdale that includes extensive subterranean aquatic habitats and many globally rare species. Almost all of this area is in private ownership, and much of the upland recharge area for the Cave Springs karst system is grazed pasture and developing rural residential neighborhoods that threaten underground water quality.

The Saline River has been designated by the Arkansas Department of Environmental Quality as an Extraordinary Resource Water and an Ecologically Sensitive Waterbody. It contains the last and largest stand of Loblolly/Shortleaf pine dominated flatwoods (a very unique plant community). The Audubon Society has identified much of the area as an Important Bird Area as Red-Cockaded Woodpeckers occur within and use the area. The Nature Conservancy has also identified part of this area as a key conservation area. Both the Saline and Ouachita Rivers support ten globally imperiled mussels, including the Ouachita rock-pocketbook (*Arkansia wheeleri*), Arkansas fatmucket (*Lampsilis abrupta*), and winged mapleleaf (*Quadrula frangosa*), as well as some 25 other mussel taxa. Eight globally imperiled fishes including crystal darter (*Crystallaria asprella*) and western sand darter (*Ammocrypta clara*) occur in the Saline and Ouachita Rivers. Combined, the two rivers support 120 species of fish and 40 species of mussel.

There are many areas in the state where opportunities exist to establish and restore forest cover to riparian areas. Two primary areas are in the urban areas of the state and along agricultural fields. The restoration of forest cover along these areas will provide many benefits not only to the sources of human drinking water but also to aquatic and terrestrial fauna that depend of the riparian areas for cover, concealment, and life itself.

There are opportunities for improvement of BMP implementation on all ownerships, especially non-industrial private landowners which scored the lowest on the 2008 BMP Implementation Survey conducted by the Arkansas Forestry Commission. The increase of cost shares made available to private landowners to assist in the cost of implementing Arkansas State BMP's could improve the chances of implementation.

Figure 7 on page 84 shows Water Quality for Developing Populations. Figure 8 on page 85 shows critical areas of Rural Water Quality.

Water Quality for Developing Populations

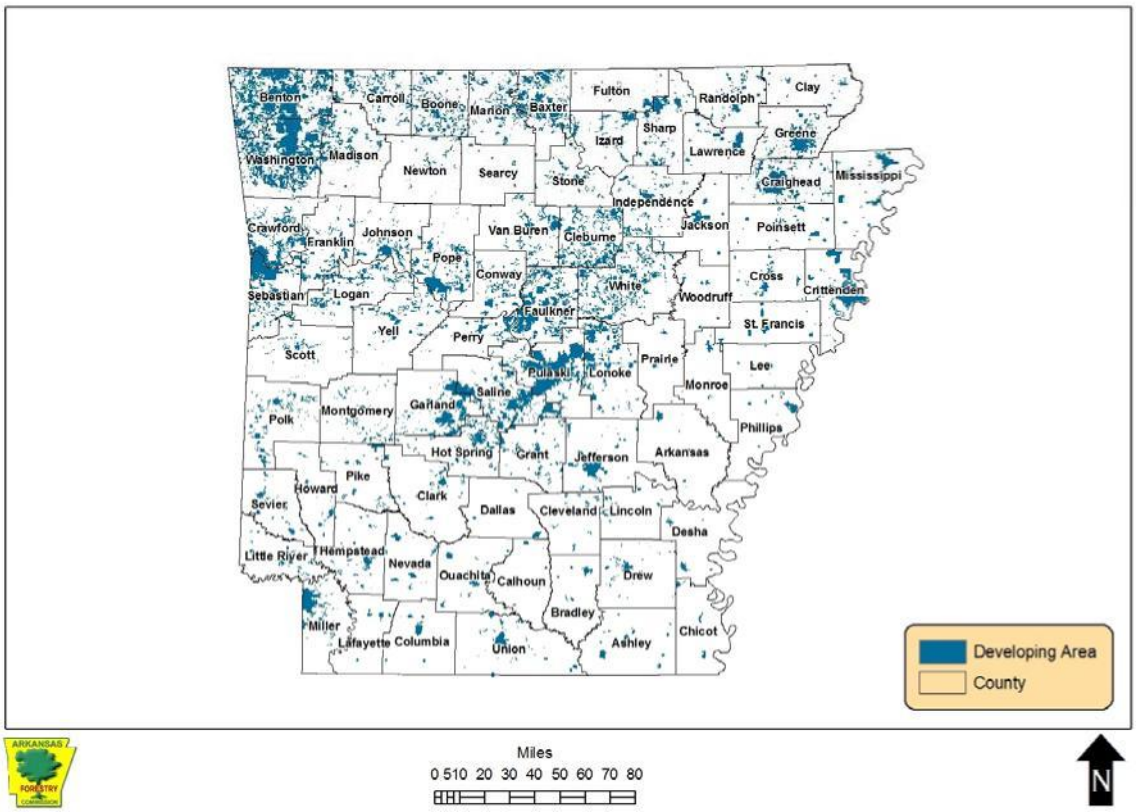


Figure 6. Water Quality for Developing Populations

National Priority: Enhance public benefits from Trees and Forests

Strategic Objectives:

- 3.1. Protect and enhance water quality and quantity
- 3.4. Maintain and enhance the economic benefits and values of trees and forests
- 3.5. Protect, conserve, and enhance wildlife and fish habitat

National Direction: Assessments should identify watersheds where continued forest conservation and management is important to the future supply of clean municipal drinking water, or where restoration or protection activities will improve or restore a critical water source.

Source Layers: *Development Level* - Southern Forest Land Assessment, 2008; *City Limits* - Arkansas Highway and Transportation Department, August 29, 2006

Rural Water Quality

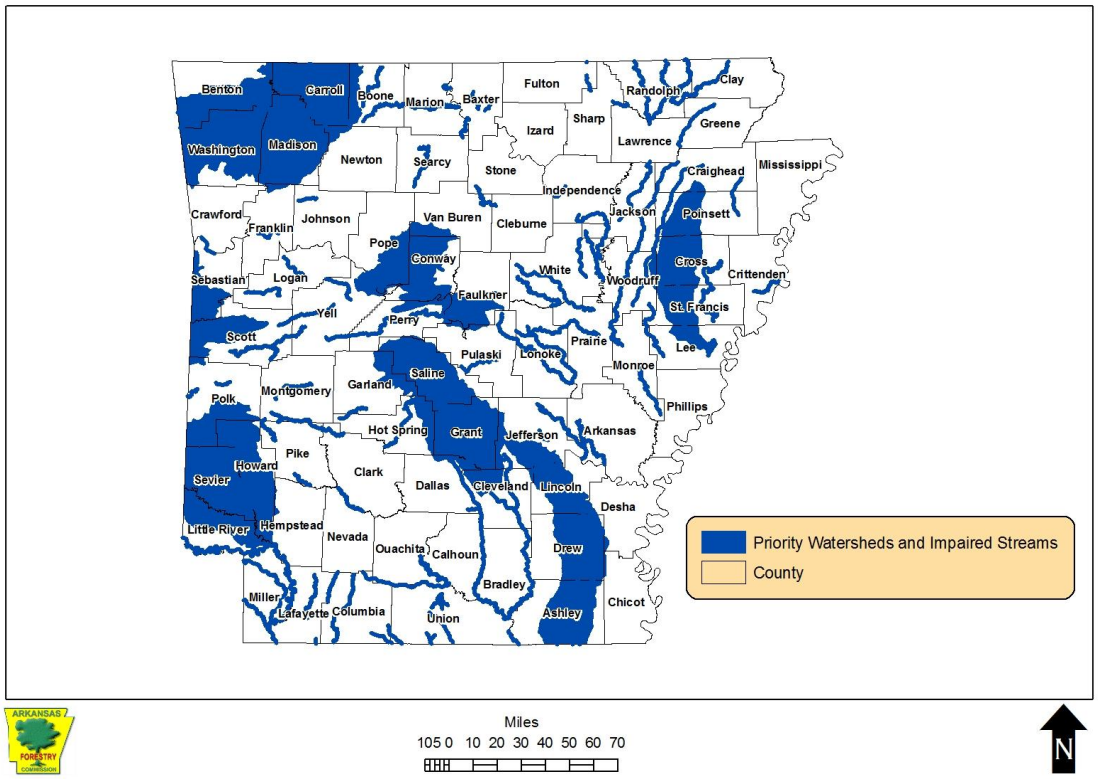


Figure 7. Rural Water Quality

National Priority: Enhance public benefits from Trees and Forests

Strategic Objectives:

- 3.1. Protect and enhance water quality and quantity
- 3.4. Maintain and enhance the economic benefits and values of trees and forests
- 3.5. Protect, conserve, and enhance wildlife and fish habitat

National Direction: Assessments should identify watersheds where continued forest conservation and management is important to the future supply of clean municipal drinking water, or where restoration or protection activities will improve or restore a critical water source.

Source Layers: *Priority Watersheds* - Arkansas Non-point Source Pollution Management - Arkansas Natural Resources Commission, 2010; *303d Streams* - Arkansas Department of Environmental Quality, 2009

Issue 2. Forest Health

The health of Arkansas forests are obviously important considering the economic, recreational, and aesthetic opportunities they provide. Both native and non native invasive insects and diseases can harm forests and reduce their ability to provide environmental benefits. The introduction to Arkansas of non native invasive species is a particular concern, because of the potential catastrophic effects they may have on the landscape. Invasive species introduced to Arkansas in the 1990's included the gypsy moth, which required the treatment of many thousands of acres to contain. There is continual monitoring of invasive species through the Arkansas State Plant Board. Currently the invasive species of most concern are cogongrass, the emerald ash borer, the Asian long horned beetle, and the gypsy moth. Of course, native pests are also a concern. Generally, good forest management is the best tool for landowners to use in defense of native insects. The southern pine beetle and red oak borer are two examples of native pests that have a killed pine timber and killed and/or damaged oaks, respectively.

While cogongrass does not normally disperse more than a mile from reproductive populations, it is already in counties in Mississippi that border Arkansas. Any accidental movement from human means would present Arkansas forests and agricultural lands alike with yet one more invasive species to contend with. The emerald ash borer has already been confirmed in Southeast Missouri and spread to Arkansas is potentially next. The Asian long horned beetle's proximity is much farther away but accidental artificial movement is likely. Arkansas's tourism could very well invite both the emerald ash borer and the Asian long horned beetle to gain a foothold in the state as they have been known to infest firewood, which many tourists carry when visiting the recreation areas.

Factors that contribute to forest health threats are developmental patterns, land use changes, lack of active forest management, and quarantine/eradication policies in neighboring states. These threats are enhanced by the forests proximity to the Wildland-Urban Interface, lack of active forest management, and transportation networks that cross state lines.

Opportunities are available to diminish or decrease the potential effect of an invasive species infestation in the state. Public education on the importance of active forest management, identification of potential invasive species, and communication with neighboring states regarding locations and potential treatments of new invasive species should all be at the forefront of state natural resource managers objectives, provided necessary funds are available to educate, identify, and eradicate new infestations.

Priority areas in Arkansas threatened by forest health/invasive species are along the Mississippi River as cogongrass is just across the border and the northeastern portion of the state as emerald ash borer has been confirmed in southeastern Missouri. Also, the Ozark region is the most likely point of reentry for the next gypsy moth outbreak due to tourism, human migration from the north, and vast quantity of host type forests. Liebhold and others (2004) concluded that the Ouachita/Ozark Highland's has one of the highest concentrations in the conterminous US of forests that are highly susceptible to the gypsy moth. Figures 9 and 10 on pages 87 and 88, respectively, show Nonnative Invasive Species Entry Potential and Forest Health Risk from Southern Pine Beetle.

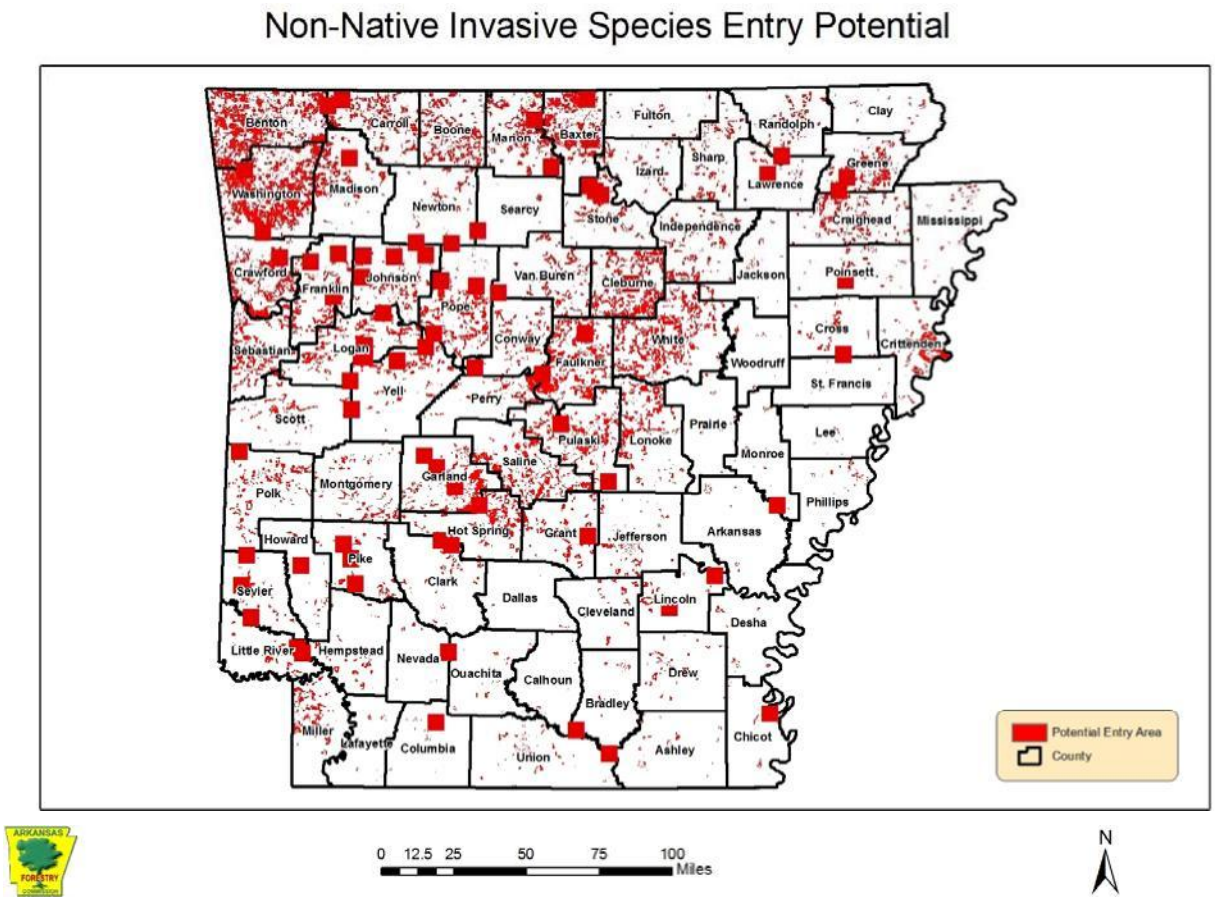


Figure 8. Non-Native Invasive Species Entry Potential

National Priority: Protect forests from harm.

Strategic Objectives:

- 1.1. Identify and conserve high priority forest ecosystems and landscapes
- 1.2. Actively and sustainably manage forests
- 2.2. Identify, manage, and reduce threats to forest and ecosystems and landscapes

National Direction: Assessments should identify high value forest landscape areas that are especially vulnerable to existing or potential forest health risk factors where management practices are most likely to prevent and mitigate effects. Assessments should also identify areas where management could successfully restore forests.

Source Layers: *Development Level* - Southern Forest Land Assessment, 2008; *Arkansas Campgrounds* (State and Federal) - Arkansas Department of Tourism, 2010 website http://www.arkansas.com/outdoors/camping/

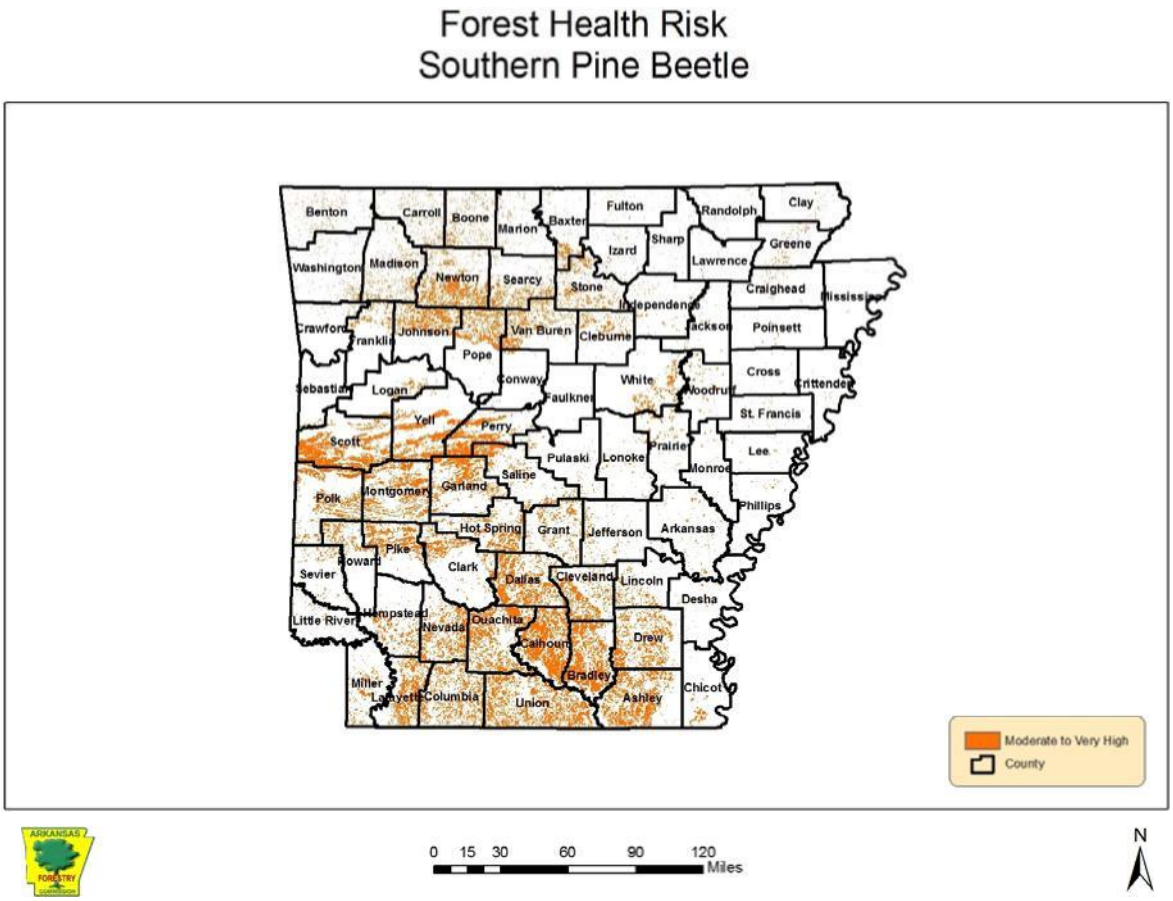


Figure 9. Forest Health Risk - Southern Pine Beetle

National Priority: Protect forests from harm.

Strategic Objectives:

- 1.1. Identify and conserve high priority forest ecosystems and landscapes
- 1.2. Actively and sustainably manage forests
- 2.2. Identify, manage, and reduce threats to forest and ecosystems and landscapes

National Direction: Assessments should identify high value forest landscape areas that are especially vulnerable to existing or potential forest health risk factors where management practices are most likely to prevent and mitigate effects. Assessments should also identify areas where management could successfully restore forests.

Source Layers: *Development Level* - Southern Forest Land Assessment, 2008; *Arkansas Campgrounds* (State and Federal) - Arkansas Department of Tourism, 2010 website http://www.arkansas.com/outdoors/camping/

Issue 3. Forest Fragmentation/Parcelization/Changing Ownerships

Large amounts of forest lands in Arkansas could be affected by fragmentation and parcelization due to changing ownerships. The greatest threats to contiguous forested landscapes are in the growing areas of central and northwest Arkansas. Air quality, water quality, forestry related jobs and biodiversity are public benefits that are threatened when forest land is converted to non forest and impervious surfaces and/or fragmented. Other threats include degradation to forest health from insects such as the southern pine beetle, wildfire, and the introduction of nonnative invasive species. These threats are caused by and/or exacerbated by a lack of active management and different management objectives.

Fragmentation threatens forest land in three ways. 1.) Fragmentation breaks up the connectivity of forest land. 2.) Loss of forest canopy creates barriers for wildlife, isolating species to even smaller habitats and eventually causing population density to decrease. 3.) Fragmentation also causes loss of continuity and interrupts landscape-scale ecosystems. As 58% of the forestland in Arkansas is held by private landowners, and the divestitures of land holdings by large timberland owners, new, often numerous, landowners have their own management strategies. Urban and ex-urban sprawl is another factor that threatens Arkansas's forests. The states population grew from 1.92 million in 1970 to 2.75 million in 2004. This growth was concentrated in central and northwestern Arkansas. Those regions are experiencing dramatic increases in human population and related infrastructure, commercial and residential development, threaten forestland. This trend is forecasted to accelerate with the addition of increased industrial development and interstate transportation routes.

Conversion to non-forest uses is a major threat across the Arkansas landscape. Northwest and North Central Arkansas is especially vulnerable to urban and exurban sprawl as land outside major communities are being targeted. This area of the state is in the path of a planned interstate highway connecting New Orleans and Kansas City. Northwest and North Central Arkansas are also very attractive areas for retirement. By 2025, Arkansas is projected to have the 5th highest proportion of elderly. Nine out of 15 or the projected Retirement Destination Counties are in the Ozarks. North Arkansas is also the poultry hub for the state with large processing facilities and a high density of poultry and egg production houses. Arkansas also ranks 17th among the beef producing states, and eight of the state's top ten beef cattle producing counties are also in this ecoregion. Conversion of forestlands to pasture is a constant threat in North Arkansas. While available forest products markets can be viewed as having a positive benefit for improving the quality of these forests, many landowners are electing to utilize the markets to convert their forestlands into pastureland and poultry production.

The UWGCP is also threatened for similar reasons. Both corporate and non-corporate land owners are selling forest lands as they become more valuable for development. Industrial lands located near active real estate markets are especially vulnerable as companies take opportunities to maximize profits (Luloff, 2000). Timber Investment Management Organizations (TIMOs), who's interests are primarily financially based (Sampson, 2000), are buying and managing timberland for pension and investment funds with a high rate of turnover of property. Additionally, small private investors are

purchasing industry lands in blocks of a few hundred to a few thousand acres, and reselling them in parcels of 10 to 20 acres to exurban owners. These parcels are then converted to pasture, small crop farms, and home-sites, which are all land use practices leading to sedimentation, runoff, and non-point source pollution.

Major threats in the Ouachita region forests are conversion to urban/suburban development especially around population centers and reservoir watersheds. Parcelization of industrial holdings through the sale of higher and better use properties breaks large tracts of forestland leading to suburban and exurban development. Water quality of many upland streams is also threatened by extensive development of formerly forested hillsides.

Northwest and central/north central Arkansas currently have the most potential for developmental risk. Fragmentation, parcelization, and changing ownerships are directly tied to development. As fragmented and parcelized properties become more valuable large continuous blocks in these areas will cease to exist. In turn, natural resource managers will have a more difficult time utilizing all available management techniques when attempting to mange these areas. Fire risk, water quality, species diversity, and a host of other issues will become more problematic in these areas. Figure 11 on page 91 shows forest parcelization in Arkansas.

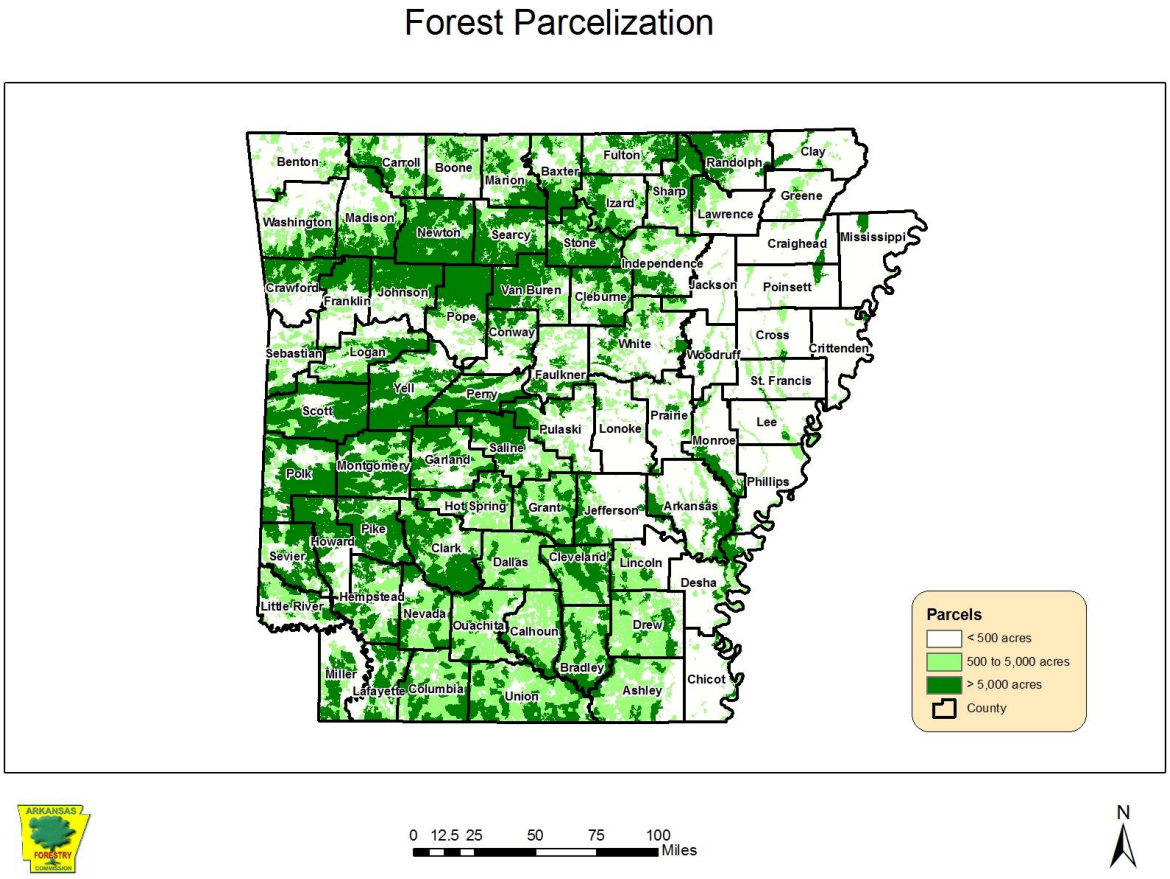


Figure 10. Forest Parcelization

National Priority: Conserve Working Forest Landscapes

Strategic Objectives:

- 1.1. Identify and conserve high priority forest ecosystems and landscapes
- 1.2. Actively and sustainably manage forests
- 2.2. Identify, manage, and reduce threats to forest and ecosystems and landscapes
- 3.1. Protect and enhance water quality and quantity
- 3.5. Protect, conserve, and enhance wildlife and fish habitat

National Direction: Assessments should identify high value forest landscape areas that are especially vulnerable to existing or potential forest health risk factors where management practices are most likely to prevent and mitigate effects. Assessments should also identify areas where management could successfully restore forests.

Source Layers: *Forest Patches* - Southern Forest Land Assessment, 2008

Issue 4. Increase and Enhance Benefits of Working Forests

The benefits of working forests in the state cannot be over emphasized. Working forests are generally thought of as those producing traditional forest products such as wood and providing wildlife habitat for hunting and other recreational uses. Working forests traditionally have been synonymous with timberland. However, the term working forest may be modified as the emerging markets of biomass and environmental services provide additional financial opportunities for forest landowners. An increasing amount of forest land may be considered working as these markets continue to develop. Continued funding of cost share programs, education of outreach to forest landowners, as well as continuing to improve pine and hardwood seed source will increase and enhance the benefits of working forests. Opportunities available to address this issue include developing values associated with ecosystem services, implementing cost share incentives, tax credits for conservation easements, and public education on the value of forest land.

Arkansas forests continue to become more fragmented as ownerships change and population growth occurs. New owners of forest land may not have objectives that are compatible with sustainable forest management. According to the 2006 National Woodland Owners Survey, forest land owners generally don't seek professional forestry advice and have a tendency to not take an active role in forest management (Butler 2010). Because of fragmentation, the trend towards passive management may be growing. Opportunities exist to "get the word out" through education and outreach programs to ensure landowners are aware of the benefits of active forest management.

Developing added values to forest land such as those associated with environmental services, implementation of more focused incentives for reforestation and afforestation, and other forest practices, further developing tax credits for conservation easements, and educating landowners on the value of forest land – especially economic benefit to individuals are potential opportunities for creating more active forest landowners that will have sustainable forest management goals. Financial assistance or "cost-share" for forest management practices is usually available to landowners. These programs are funded through the federal government and administered at the state and county level. Forest practices eligible under these programs include site preparation, tree planting, prescribed burning, fire lane construction, pre-commercial thinning, stream crossings, culverts, water bars, wing ditches, seeding and mulching, and herbicide applications. Landowners enrolled in these programs may be reimbursed 40%-90% of implementation costs. During the fiscal year 2007 Arkansas Forestry Commission County Foresters and Rangers accomplished the following:

- Provided 4,654 landowner assists on 94,466 acres;
- Prepared or revised 1,642 forest management plans covering 122,018 acres;
- Selectively marked for harvesting 217 acres of timberland for 11 landowners;

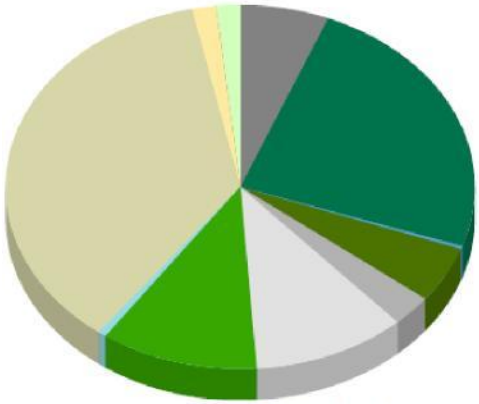
- Provided planting inspections for 654 landowners that planted pine and hardwood seedlings on 28,893 acres;
- Performed seedling survival checks for 603 landowners covering 29,770 acres;
- Conducted prescribed burns on 17,904 acres for site preparation, fuel hazard reduction, or wild-life habitat enhancement purposes for 323 landowners;
- Referred 324 landowners owning 31,799 acres to forest consultants and vendors;
- Provided 4 assists to landowner associations and related organizations;
- Conducted 49 forestry field demonstrations for landowners;
- Erected exhibits at 102 county fairs and festivals;
- Inspected or re-inspected 244 landowner properties enrolled in the Tree Farm System covering 32,635 acres.

The Arkansas Forestry Commission continually strives to expand forestry practices and related benefits to individual landowners all across the state. Additional funds for cost-share programs will ensure all non-industrial private landowner interested in active forest management are afforded that opportunity.

The forests contained within cities and communities function in similar ways to rural working forests, in that they provide numerous quantifiable environmental services. For example, community forests help control storm water runoff, sequester carbon, and regulate urban temperatures. In 2003, American Forests conducted a rapid ecosystem analysis of Jonesboro, Conway and Little Rock which showed that the percent canopy cover in each city was 20%, 39%, and 27% respectively. The analysis estimated the total annual dollar value of the storm water retention and air pollution removal provided by this tree cover to be over $1.6 billion. Figure 12 on page 96 shows the rapid ecosystem analysis charts for Jonesboro, Conway, and Little Rock, Arkansas. A similar American Forest urban forest analysis showed that Fayetteville had 27% canopy cover in 2000 which amounted to over $93 million annually in environmental services. The analysis projected that an additional $43.8 million worth of services could be provided annually by increasing the canopy cover just 13%, from 27% to 40%.

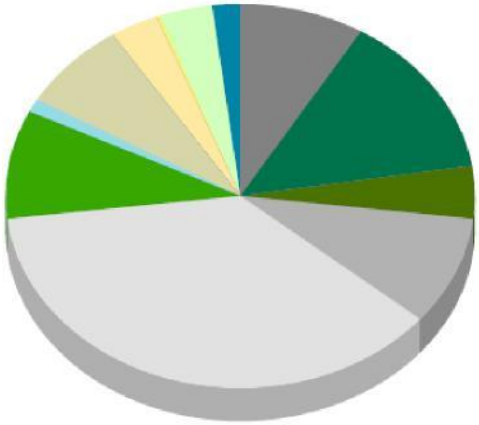
Urban forestry opportunities, such as preserving and increasing canopy cover, are present not only in existing urban areas but also in areas of projected growth. Proactive planning in areas of projected growth will capture the economic value of the environmental services that existing forests provide. The Arkansas Forestry Commission currently has an Urban and Community Forestry program designed to assist communities, non-profit organizations and educational institutions with the necessary tools, information and technology to promote forest stewardship in their communities. Engaging these groups helps build capacity of the program and encourages urban forestry at the local level. Technical assistance and educational services help improve

The City of Conway, AR
Rapid Ecosystem Analysis



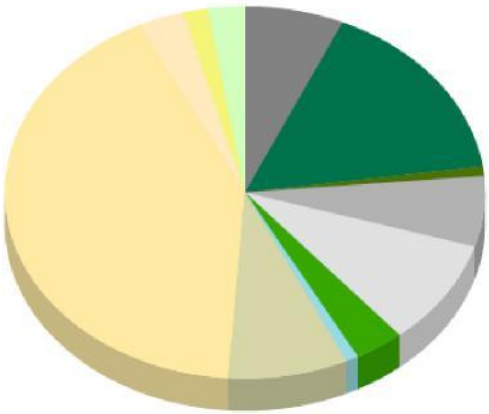
Bare Rock/Sand/Clay	24.3	0.1%
Commercial/Industrial/Transportation	1,377.6	6.1%
Deciduous Forest	5,435.8	24.1%
Emergent Herbaceous Wetlands	84.5	0.4%
Evergreen Forest	1,076.4	4.8%
High Intensity Residential	657.3	2.9%
Low Intensity Residential	2,406.3	10.7%
Mixed Forest	2,389.2	10.6%
Open Water	142.1	0.6%
Pasture/Hay	8,244.9	36.5%
Row Crops	330.0	1.5%
Transitional	7.2	0.0%
Urban/Recreational Grasses	399.3	1.8%
Total:	22,574.9	100.0%

The Little Rock, AR, Urbanized Area
Rapid Ecosystem Analysis



Bare Rock/Sand/Clay	5.4	0.0%
Commercial/Industrial/Transportation	11,369.0	8.6%
Deciduous Forest	18,172.4	13.8%
Emergent Herbaceous Wetlands	192.7	0.1%
Evergreen Forest	5,634.3	4.3%
High Intensity Residential	12,285.2	9.3%
Low Intensity Residential	48,846.0	37.0%
Mixed Forest	12,073.7	9.2%
Open Water	1,386.8	1.1%
Pasture/Hay	9,752.7	7.4%
Quarries/Strip Mines/Gravel Pits	108.5	0.1%
Row Crops	4,433.1	3.4%
Small Grains	24.2	0.0%
Transitional	314.7	0.2%
Urban/Recreational Grasses	4,770.1	3.6%
Woody Wetlands	2,512.8	1.9%
Total:	131,881.7	100.0%

The City of Jonesboro, AR
Rapid Ecosystem Analysis



Commercial/Industrial/Transportation	3,437.9	6.7%
Deciduous Forest	8,222.3	16.0%
Evergreen Forest	412.2	0.8%
High Intensity Residential	3,127.4	6.1%
Low Intensity Residential	4,669.2	9.1%
Mixed Forest	1,835.4	3.6%
Open Water	332.8	0.6%
Pasture/Hay	4,183.8	8.2%
Row Crops	21,386.8	41.7%
Small Grains	1,499.0	2.9%
Transitional	874.4	1.7%
Urban/Recreational Grasses	1,217.1	2.4%
Woody Wetlands	56.2	0.1%
Total:	51,254.6	100.0%

Figure 11. Rapid Ecosystem Analysis Charts for Jonesboro, Conway, and Little Rock, AR

standards for urban forestry management and involve tree protection for water quality and wildlife habitat, greener neighborhoods, and proper tree planting and care by municipal employees, contractors, and volunteers. Urban and Community Forestry highlights for fiscal year 2007 include:

- 223 technical assists were provided to communities for projects such as tree planting and pruning, organizing a tree or beautification committee, discussing tree management in parks, tree inventories, workshops and organizing Arbor Day ceremonies;
- 328 assists to homeowners for proper tree care;
- Over 32,700 volunteer hours were donated for tree programs and projects across the state;
- Arkansas had the nation's highest number of new Tree Cities for the second year in a row, and now 45 communities are proudly displaying Tree City USA entrance signs.

Another method to increase and enhance the benefits of working forests is tree improvement programs. The Arkansas Forestry Commission is a member of the Western Gulf Forest Tree Improvement Program, which continues to improve the genetic quality of plant material available for reforestation in the Western Gulf region. The Arkansas Forestry Commission sells pine seedlings produced from seed with the highest possible genetic gain. Only the best clones in the AFC's loblolly and short leaf pine seed orchards are being harvested. AFC's Baucum Nursery also produces and sells hardwood seedlings. During fiscal year 2007, the nursery sold and distributed 5,832,700 hardwood seedlings and 5,032,000 pine seedlings to Arkansas landowners. Private landowners purchased all of he hardwood and most of the pine. Approximately 250,000 pine seedlings were purchased by forest industry.

Many Arkansans are already actively involved and interested in forest management. However, continued fragmentation and parcelization of forest in Arkansas will require increased communication on the benefits of actively managed forests. The Arkansas Forestry Commission, as demonstrated, is poised to meet this need and will require the assistance of federal cost-share programs to "sell" landowners on the idea of investing in their individual properties to enhance their own personal benefits while increasing the benefits to the rest of the state as well. Enhancing the benefits of the state forests occurs one landowner at a time. Figures 13 and 14 on pages 98 and 99 respectively show the Economic Potential for All Ownership Forests and the Economic Potential for Stewardship Forests.

Figure 15 on page 100 identifies the Forest Legacy Program Areas (FLAs) of Arkansas. Special attention should be given to these areas when communicating the benefits of increasing and enhancing the benefits of working forests.

The purpose of the Forest Legacy Program is to protect forest areas that are threatened by conversion to non-forest uses. The protection is accomplished through fee simple title or conservation easement purchases. The conservation easement allows the seller to retain the right to manage the forest and sell timber while protecting the forest from conversion to non-forest uses. For these purchases

both the seller and buyer must be willing to make the transaction. The Forest Legacy Program provides federal funding for up to 75 percent of the cost of conservation easements or fee acquisition.

Prompted primarily by threats to northeastern forests, the program, established in the 1990 Farm Bill, was initially restricted to Maine, Vermont, New Hampshire, New York, and Washington State, but is now potentially open to any state with threatened forest land. Arkansas became a participating state on October 1, 2004. Governor Mike Huckabee appointed the AFC as the lead agency to administer the Forest Legacy Program in Arkansas.

FLAs include the I-540 Corridor, the Buffalo River, the Texarkana I-49 Corridor, the US 167/I-69 Corridor, the Little Rock-Hot Springs Urban Expansion, the I-40 Corridor, and Crowley's Ridge. The Forest Legacy Assessment of Need is attached as Appendix B.

The greatest threat to the I-540 Corridor and Buffalo River FLAs is the surge in population being experienced in northwest Arkansas. Urban and exurban sprawl into previously forested lands outside the major communities is expected to continue to increase. Existing adjacent landowners will be pressured to develop forested land threatening forest values such as outdoor recreation areas, wildlife habitat, water quality, water quantity, and biodiversity. Additionally, karst recharge areas, designated extraordinary waters, national and state designated scenic areas, and endangered species habitat may be compromised.

The Texarkana I-49 Corridor FLA supports unique plant communities, biodiversity, outstanding terrestrial and wetland conservation values, outdoor recreation values, and timber production. Close proximity to a metropolitan area has resulted in conversion of forests to residential, pasture, and other developed areas. Completion of I-49 will only increase commercial and residential development further threatening the remaining forested areas and the ecosystem services they provide.

The US 167/I-69 Corridor FLA supports exceptional aquatic and terrestrial forest conservation values, which are threatened by fragmentation and parcelization. Consistent markets for ex-urban homestead farms of about 10 to 100 acres, the proposed Interstate 69, high intensity pine management, and scattered oil and gas development negatively affects local flora and fauna through altered fire regimes, unsustainable management, and increased access to nearby rural areas.

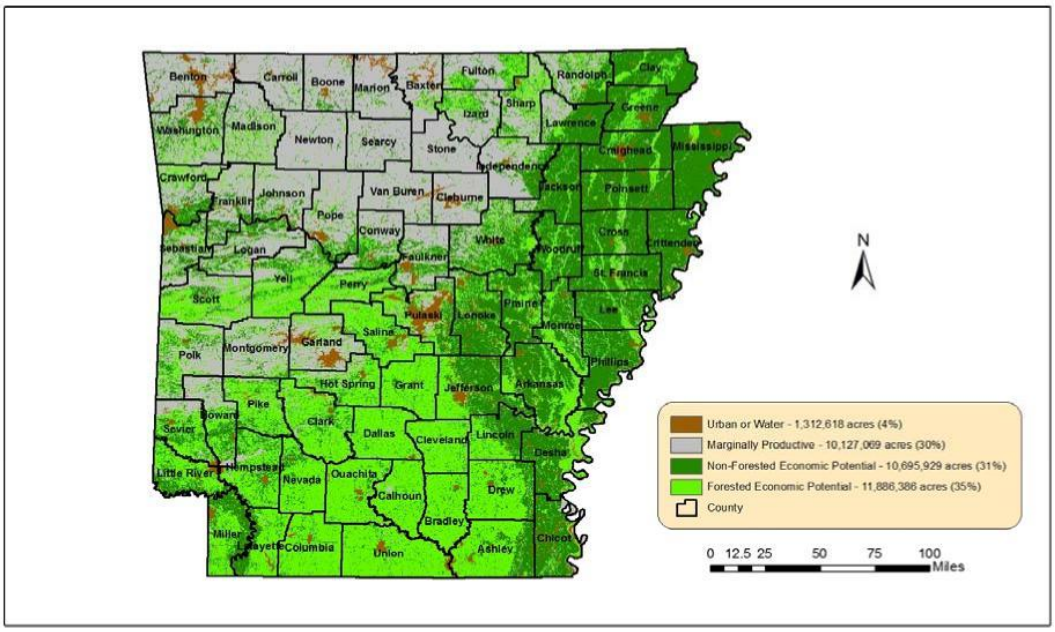
The Little Rock-Hot Springs Urban Expansion FLA threatens aquatic conservation values through parcelization, fragmentation, exurban, suburban, urban development, and high intensity pine management. This FLA includes the Saline River which is one of the most diverse stream systems in the Ouachitas and as such is designated as an Ecologically Sensitive Waterbody and an Extraordinary Resource Waterbody. The ecosystem services provided by the Saline River and Lake Maumelle watersheds is stressed by sedimentation, nutrient loading, and runoff from development and incompatible land use practices. Continued ecosystem disturbances also stresses forest values such as aesthetics, recreation, water quality, and wildlife habitat.

The I-40 Corridor FLA in the northwestern part of the Ouachita Mountain ecoregion is threatened by conversion of forests to urban and exurban development and pasture on private holdings. This FLA supports several of the most scenic mountains of the state including Mt. Magazine and Petit Jean

Mountain. It also includes tall grass prairies which provide considerable biological diversity to the otherwise forested landscape. Increased human populations along the corridor have increased the need for infrastructure expansion and improvements further fragmenting forests. Adequate transportation networks and forest products industries further exacerbate forest values as clearing land for agricultural uses is more affordable. Also, navigational manipulations to the Arkansas River are causing forest health problems as drastic changes to hydrologic regimes have resulted in prolonged inundation into the growing season of the bottomland hardwood forests.

Crowley's Ridge FLA supports terrestrial conservation values, including a number of rare plant species. The deep loess sites on Crowley's Ridge support forests of rich mesophytic hardwoods; the drier sites support oaks, hickories, and shortleaf pine-hardwood plant communities; seepage areas at the northern end of the ridge add further diversity to this unique area of Arkansas. Urban development and gravel mining are the primary threats to this FLA. Relatively thin gravel deposits at the base of the ridge require large areas to be mined at the expense of the soil and vegetation on the surface. Landslides, erosion and alteration of local water tables are possible consequences of the gravel mining on Crowley's Ridge. Figure 16 shows Public Conserved Forested Land in Arkansas.

Economic Potential for All Ownership Working Forests



Economic Potential is land that has 67 or greater Site Index (Base 50) and less than 26% Slope.

Marginally Productive is land that will produce at lower than Economic Potential levels.

Figure 12. Economic Potential for All Ownership Working Forests

National Priority: Conserve working forest lands.

Protect Forests from Harm

Enhance public benefits from trees and forests.

Strategic Objectives:

- 1.1. Identify and conserve high priority forest ecosystems and landscapes
- 1.2. Actively and sustainably manage forests
- 2.2. Identify, manage, and reduce threats to forest and ecosystems and landscapes
- 3.1. Protect and enhance water quality and quantity
- 3.4. Maintain and enhance the economic benefits and values of trees and forests
- 3.5. Protect, conserve, and enhance wildlife and fish habitat

National Direction: Assessments should identify forest landscape areas where there is a real, near term potential to access and supply traditional, non-timber, and/or emerging markets such as those for biomass or ecosystem services. Assessments and strategies can identify viable and high potential working forest landscapes where landowner assistance programs can be targeted to yield the most benefit in terms of economic opportunities and ecosystem services. Assessments and strategies can also identify opportunities for multi-landowner landscape scale planning and landowner aggregation for access to emerging ecosystem service markets.

Source Layers: *Combination of Site Productivity, Slope, Forestland layers* - Southern Forest Land Assessment, all forested/non-forested areas minus urban and water

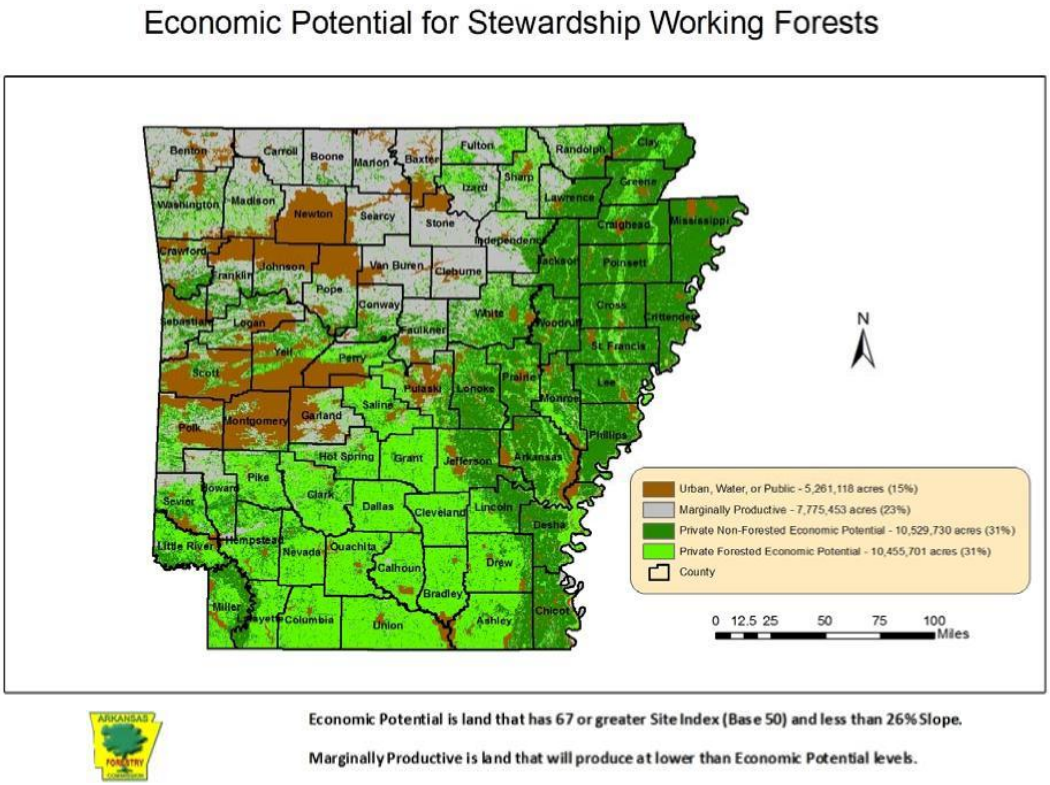


Figure 13. Economic Potential for Stewardship Working Forests

National Priority: Conserve working forest lands.

Protect Forests from Harm

Enhance public benefits from trees and forests.

Strategic Objectives:

- 1.1. Identify and conserve high priority forest ecosystems and landscapes
- 1.2. Actively and sustainably manage forests
- 2.2. Identify, manage, and reduce threats to forest and ecosystems and landscapes
- 3.1. Protect and enhance water quality and quantity
- 3.4. Maintain and enhance the economic benefits and values of trees and forests
- 3.5. Protect, conserve, and enhance wildlife and fish habitat

National Direction: Assessments should identify forest landscape areas where there is a real, near term potential to access and supply traditional, non-timber, and/or emerging markets such as those for biomass or ecosystem services. Assessments and strategies can identify viable and high potential working forest landscapes where landowner assistance programs can be targeted to yield the most benefit in terms of economic opportunities and ecosystem services. Assessments and strategies can also identify opportunities for multi-landowner landscape scale planning and landowner aggregation for access to emerging ecosystem service markets.

Source Layers: *Combination of Site Productivity, Slope, Forestland layers* - Southern Forest Land Assessment, all forested/non-forested areas minus urban and water

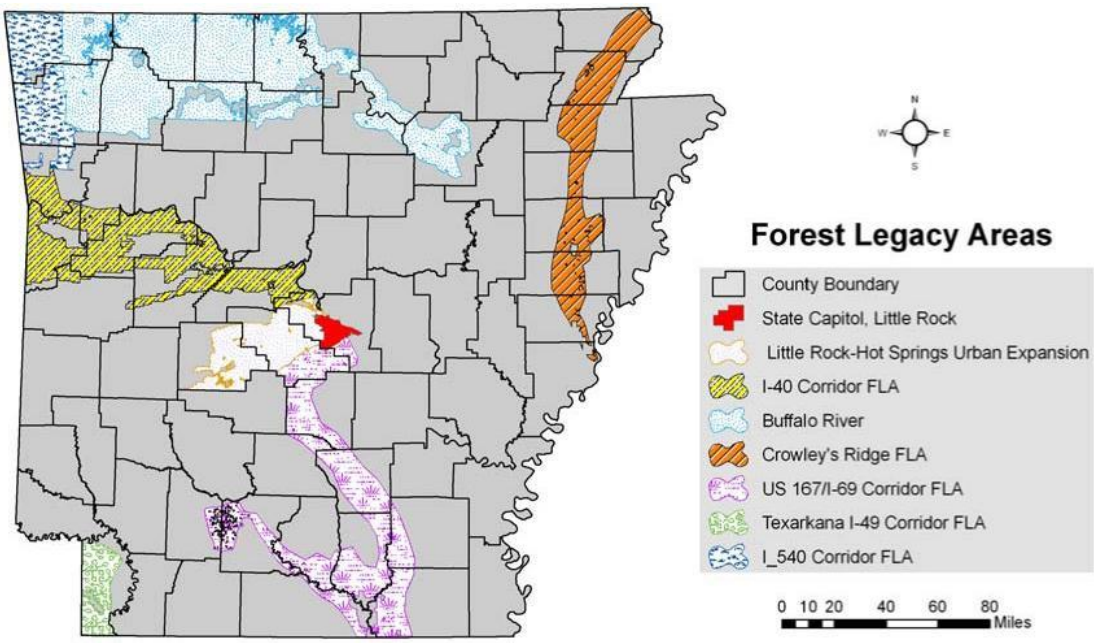


Figure 14. Forest Legacy Areas

National Priority: Conserve working forest lands.
Protect Forests from Harm
Enhance public benefits from trees and forests.

Strategic Objectives:

- 1.1. Identify and conserve high priority forest ecosystems and landscapes
- 1.2. Actively and sustainably manage forests
- 2.2. Identify, manage, and reduce threats to forest and ecosystems and landscapes
- 3.1. Protect and enhance water quality and quantity
- 3.4. Maintain and enhance the economic benefits and values of trees and forests
- 3.5. Protect, conserve, and enhance wildlife and fish habitat

National Direction: Assessments and strategies should attempt to identify, protect, and connect ecologically important forest landscapes, and open space, thus maintaining a green infrastructure , particularly around and within areas of population growth and development. Identify areas where management of the urban or exurban forest will have a positive and measurable effect on air quality and produce substantial energy savings.

Source Layers: *Combination of Site Productivity, Slope, Forestland layers* - Southern Forest Land Assessment, all forested/non-forested areas minus urban and water

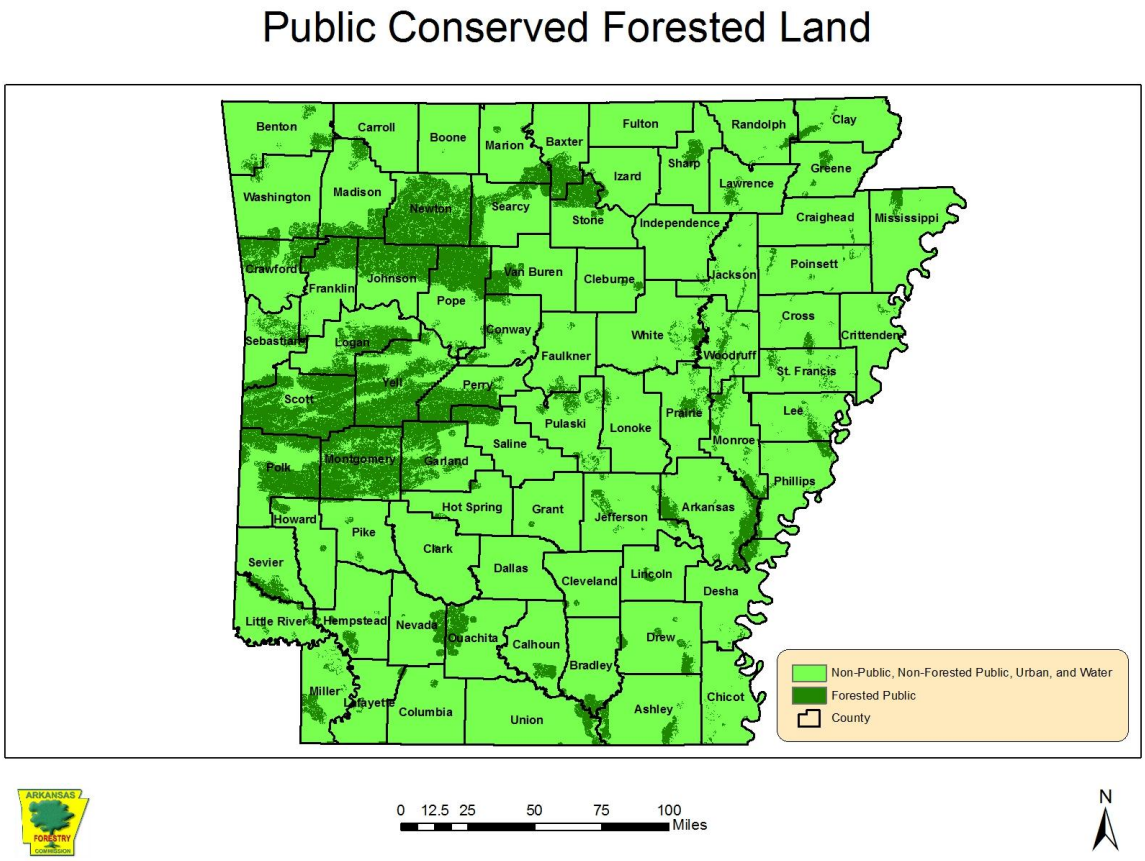


Figure 15. Public Conserved Forested Land

National Priority: Conserve working forest lands.

Protect Forests from Harm

Enhance public benefits from trees and forests.

Strategic Objectives:

- 1.1. Identify and conserve high priority forest ecosystems and landscapes
- 1.2. Actively and sustainably manage forests
- 2.2. Identify, manage, and reduce threats to forest and ecosystems and landscapes
- 3.1. Protect and enhance water quality and quantity
- 3.4. Maintain and enhance the economic benefits and values of trees and forests
- 3.5. Protect, conserve, and enhance wildlife and fish habitat

National Direction: Assessments should identify forest landscape areas where there is a real, near term potential to access and supply traditional, non-timber, and/or emerging markets such as those for biomass or ecosystem services. Assessments and strategies can identify viable and high potential working forest landscapes where landowner assistance programs can be targeted to yield the most

benefit in terms of economic opportunities and ecosystem services. Assessments and strategies can also identify opportunities for multi-landowner landscape scale planning and landowner aggregation for access to emerging ecosystem service markets.

Source Layers: *Proximity to Public Lands - Southern* Forest Land Assessment, 2008; *Forestland* - Southern Forest Land Assessment, 2008*; Wetlands Reserve Program Conservation Easements* - USDA Natural Resources Soil Conservation Service, 2010

Issue 5. Climate Change

All forests in the state are potentially affected by climate change. The ability of forests to adapt to change, amount of carbon sequestered, water quality and quantity, species distribution, and forest loss from catastrophic wildfires could all be the consequence of climate change. As forests are affected by climate change the benefits they provide will also be affected. Benefits of forests potentially affected by climate change include drinking water quality and quantity, forest products, energy costs and independence, as well as, bioenergy, climate change mitigation, air quality, recreation, and wildlife habitat. Specific threats to the resource that could result in decreased benefits include drought, wildfire, increased occurrence of natural disasters, species mortality, spread of invasive and native insects and diseases, and urban-wildland interface expansion.

Studies have shown that forests have adapted to temperature increases of 3.6—5.4^{o} F over a period of thousands of years. Current climate predictions suggest that average global mean temperatures could rise by 2.7—10.4^{o} F in the coming century alone (Shugart et al 2003). The ability of forests to adapt to temperature changes in a compressed time span is uncertain. Managed and natural forest ecosystems could differ significantly in their potential responses to climate change (Shugart, et al. 2003). Forest trees are evolutionarily adapted to thrive in certain climates. However, other factors also regulate species presence including fire and competition from other plants. If climate changes enough, species will adjust to suitable conditions or go locally extinct if suitable conditions are no longer available (Woodward 1987). As climate models project continued warming in all seasons across the Southeast (Karl et al. 2009), species shift is likely to be northward. Southern forests and markets appear most susceptible to climate change for two reasons. First, southern species are sensitive to drying effects and second, because northward migration would erode the comparative advantage for timber production currently enjoyed by southern producers (Shugart, et al. 2003). The primary abiotic factors that affect forest productivity are temperature, water, and radiation. Productivity on a particular site is generally limited by one of these three factors. Any response to changing climate will depend on the corresponding change in the limiting factor (Backlund et al. 2008).

Forests ability to sequester carbon could also be affected by climate change. A number of recent studies show that North American forests could absorb more carbon dioxide and might retain more carbon as atmospheric carbon dioxide increases (King et al. 2004; Norby et al. 2005; McCarthy et al. 2006; Palmroth et al. 2006). However, these studies do note several yet unresolved questions that prevent definitive assessment of the effect of elevated carbon dioxide on other components of the carbon cycle in the forest ecosystems that will require longer time series (Walther 2007). Also, other complexities in forest growth could limit the capacity for more absorption. For example, ozone, nitrogen deposition, and forest age all influence carbon sequestration (Backlund 2008). Ozone pollution will modify the effects of elevated carbon dioxide and any changes in temperature and precipitation (Hanson et al. 2005); these interactions are difficult to predict due to lack of scientific research (Backlund et al. 2008). Field studies and experiments have shown that the positive effect of carbon dioxide on productivity and carbon storage can be constrained by low nitrogen availability (Finzi et al. 2006; Johnson 2006; Luo et al. 2006;

Reich et al. 2006). Higher forest age corresponds to less growth, impeding carbon dioxide uptake and therefore carbon sequestration. Many other factors influence tree growth. Tree growth and the combined effect of changes to those factors and how they influence carbon sequestration may not be fully understood now.

Changes to water quality and quantity could also be realized as climate patterns adjust to increased levels of carbon dioxide. One would assume increased temperatures and the corresponding atrophy experienced by the polar regions would translate to increased water availability. However, while most of the continental United States experienced reductions in drought severity and duration over the 20th century, there is some indication to the opposite in the western and southwestern United States. This may have resulted from increased actual evaporation dominating the trend toward soil wetness (Backlund 2008). While there is evidence to substantiate human induced global warming, decadal scale variability in climate may be at play. Evidence to the contrary is difficult to deduce, so influence from anthropogenic means must be assumed. Increased temperatures will translate to increased soil temperature, increased evaporation, and possibly more arid soils in ecosystems dependent upon high soil moisture. Thus, ideal species habitat could migrate northward translating to decreased growth in species currently inhabiting local geographies. Water quality is sensitive to both increases in temperature and precipitation pattern changes. There is some evidence to suggest that stream temperatures have risen in some western U.S. streams (Backlund 2008). Higher water temperatures translate to decreased water quality as warmer water decreases dissolved oxygen content. Water quality and quantity are likely to be adversely affected due to warming climate changes. Forecasted population trends will no doubt stress current water supplies, decreases due to climate change will only compound the rate at which adequate water supplies are exhausted. Increased temperatures will not only increase evaporation, but also decrease water quality as lower dissolved oxygen contents translate to increased aquatic flora.

Climate change, along with the associated changes in disturbance regimes, will result in shifts in the distribution of tree species and the composition of forest stands (Gray et al. 2008). Forest tree species are expected to shift their ranges both northward and upslope (Karl et al. 2009). Determinates of species migration due to climate change will depend on future land use patterns and habitat fragmentation. Consideration to migration should also account for the fact that plants are long lived and may persist for some time in previous ranges despite changing climate and the resulting site specific environmental conditions (Gray et al. 2008).

Increased temperatures, reductions in available water resulting in droughts will likely increase the potential frequency for large stand-replacing wildfires over the next several decades. Forest fire seasonal severity in the southeastern United States could increase from 10 to 30 percent (Backlund et al. 2008). Regrowth will sequester the carbon released in the fires, however forest burned in the next few decades can be sources of CO2 that will not be recovered for centuries. (Kashian et al. 2006).

Climate change will affect the forest resources in the state of Arkansas as well as the rest of the nation. The potential affects to forest by climate change are more than enough to prompt the employment of mitigation techniques. The most active mitigation technique natural resource managers

can employ on the individual level is to promote reforestation and afforestation. Cost-share programs will ensure more non-industrial private landowners will consider actively managing their forest instead of passively watching them. Other opportunities include new and expanding markets such as carbon sequestration and biofuels.

Issue 6. Fire Management

The management of fire, especially smoke management, has recently become more of an issue in Arkansas as the wildland-urban interface has expanded into more forested areas. Well managed fire is a factor in growing diverse, healthy forests that provide a multitude of public benefits. Factors affecting fire management include public policy on air quality standards, lack of prescribed fire, climate change, poorly managed forest stands, urban development patterns, landownership changes, fragmentation and parcelization. Benefits of fire include reduction in hazardous fuels and logging debris, improvement of wildlife habitat, control of insects and disease, enhance aesthetics, access improvement, and the perpetuation of fire dependent species (Wade and Lunsford 1989). It is important to note different prescribed fire uses, fire hazard reduction prescribed burns attempt relieve a site of those flash fuels which create unnecessarily high fire risk. Fire hazard reduction prescribed burns, when done properly, do not kill overstory species. Conversely, site preparation prescribed burns are used by timber management personnel to completely remove brush and logging debris from clearcuts in preparation for planting desirable economically advantageous species on localized sites. This discussion will be limited to fire hazard reduction prescribed burns.

Smoke management has the greatest potential to be pushed to the forefront of fire management as Arkansas is projected to have the fifth highest portion of elderly by 2025. Smoke is often considered a major barrier to the use of prescribed fire (McCaffrey 2006). Currently, Arkansas has voluntary smoke management guidelines that assure adherence to air quality standards and to manage smoke from prescribed fire. The guidelines allow fire managers to minimize the effect of particulate matter released into the atmosphere by estimating how many tons of fuel may be consumed in an area. The amount of fuels that can be consumed in an airshed (36 square miles) is based on the ability of the atmosphere to disperse the particulate matter, the distance downwind to a smoke-sensitive area, and the tons of fuel being consumed (AR SMG). While these guidelines are voluntary, any natural resource manager in the state will be informed of his/her influence on air quality when notifying state agencies of prescribed burns (which is mandatory). Natural resource managers can then choose to alter their prescribed burn to ensure acceptable particulate matter in the atmosphere is not exceeded. Aside from all the benefits, both public and ecologic, well managed fires provide, ensuring the health of our residents is not impeded due to poorly managed smoke from prescribed fires is sure to become more of an issue in the future than it is today.

With respect to the central hardwoods (Ozark Forests), fire exclusion has resulted in an altered plant communities with altered structures and a concurrent buildup of forest floor fuels (Beilman and Brenner 1951). Lack of prescribed fire contributes to fire risk as Arkansas's long growing season require uninterrupted cycles of prescribed fire to maintain acceptable fuel loads in our forests. Prescribed fire is the most practical method to reduce dangerous combustible fuels under southern pine stands (Wade and Lunsford 1989). Land management goals achieved with the continual application of prescribed fires include the management of stand composition, increase in water quality and quantity, reduction of insect or disease damage, and increase in aesthetic and recreational values (Hartman 1989). Another

benefit of prescribed fires is that when wildfires do burn into areas where fuels have burned under prescribed fires they tend to cause much less damage and are much easier to control (Wade and Lunsford 1989). Increasing the use of prescribed fire has both environmental and social benefits as undesirable species are controlled, fire hazard is minimized, and state fire protection agencies have a much less difficult time of containing wildfires when they do occur.

Climate change affects fire management on many different scales. Weather is perhaps the most important factor to consider when preparing for and conducting a prescribed burn. Temperature, wind speed, wind direction, relative humidity, and mixing height are all weather related factors considered when attempting to perform a prescribed burn. As such, changing climate conditions have the potential to increase the complexity of fire weather. Warming temperatures influence fire management as longer growing seasons require more frequent burns to maintain the same long term effects as fewer burns under cooler conditions where vegetation grows slower. Climate change is a slowly evolving phenomenon so the effects to fire management are also slowly evolving and as such in depth discussion of climate change's effects to fire management will be reserved for the issue of climate change.

Poorly managed forest create unnecessary fire risk over the entire landscape. Arkansas is 85% privately owned, making increased fire risk the fault of those who manage its forests, or in many cases fail to manage Arkansas's forests. Reasons for owning land and forests are as varied as the number of people who own it. Many landowners exclude fire from their land unknowledgeable to the fact that managed fire will protect the land from wildfire more effectively than many other management tools. Landowners must be informed of the benefits of conducting prescribed burns, agencies available to conduct those burns, and when available cost-share programs to assist in financing such activities. Other management tools available include commercial or pre-commercial thinning operations to remove undesirable species or thin out stagnant and disease prone desirable species. Many landowners are unaware of the benefits of planned disturbance. They need to be informed that disturbance helps to maintain healthy forest conditions regardless of the forest type desired.

Urban development and ownership change patterns are having enormous effect on fire management. Many homes and landscapes within the wildland-urban interface are designed without regard for fire risk or protection (Macie and Hermansen 2003). Some natural resource managers are foregoing burning altogether simply because proximity to urban areas creates unnecessary risk, opting instead for more capital intensive chemical and/or mechanical site preparation or not managing properties on the fringe altogether. Opportunities exist to educate developers and landowners alike on reduced fire risk development practices and the importance of fire management.

Ownership changes including subdividing and forest industry divestitures create barriers to effective fire management. Subdividing large tracts into smaller ones in effect subdivides the management objectives and management options making fire management nearly impossible, economically, and logistically. Where timber industry has the equipment and manpower to conduct prescribed burns, many landowners have neither and are not willing or unable to pay for such a project. Recent divestitures of many forest industry lands to Real Estate Investment Trusts has decreased fire fighting equipment and

manpower in the state as those organizations typically forgo burning altogether and do not retain/purchase fire suppression equipment. Both subdividing land and ownership changes will continue to strain state and federal equipment and personnel when dryer years with higher than normal wildfires occur. Opportunities exist to make prescribed burning more available and more affordable to those who wish to utilize its benefits.

The benefits of well managed fire in growing diverse healthy forests must be communicated so as to change public perception of this much needed management tool for natural resource professionals. Utilizing fire as a management tool will relieve state agencies of resources during drought years as wildfire fires will require less to control and ensure healthy forests are available for the benefit of future generations. As urbanization continues, public lands will become increasingly important to provide essential habitat for forest ecosystems and their corresponding wildlife component. This will put pressure on natural resource managers to prescribe fire in the urban/wildland interface (Miller and Wade 2003). Arkansas currently engages in the National FireWise program which has proved effective in communicating to homeowners the importance of and simple steps to making their homes and communities safer from the threats of wildfires. FireWise staff work with fire departments and community leaders to teach fire safety in the wildland/urban interface. Participating communities are eligible for grants to be used for the purchase of equipment for fuel reduction projects, such as chainsaws, pole prunners, etc. Arkansas leads the nation with 105 FireWise communities, holding one-fifth of all FireWise communities in the nation. As more communities are actively participating in the FireWise program, more controlled burns to reduce wildfire risk near the wildland/urban interface will not only be possible, but also safer.

Figures 17 and 18 show the Southern Wildfire Risk Assessment Communities at Risk and Rural Level of Concern. Table 12 shows Arkansas Wildfire Data from 1999 - 2008. Central/north central Arkansas currently poses the greatest risk for wildfire. Management of the areas shown on the maps must undergo fire reduction management. Many properties in the areas of highest risk have substantial private property within or around them. State professionals must communicate to the public the necessity of fire reduction management in order to prevent the expense of fire suppression in the future. Cost shares made available to private landowners could help increase participation by those who would be unable to participate otherwise.

Year	Number of Fires	Number of Acres	Average Size
1999	2563	25681	10
2000	2705	34717	13
2001	1374	14681	11
2002	1199	14351	12
2003	1620	23279	14
2004	1356	22145	16
2005	2216	34396	15
2006	2461	47172	19
2007	1222	17123	14
2008	846	10636	12
10 year total	**17562**	**244181**	**14**

Table 12. Arkansas Wildfire Occurrence 1999 - 2008.

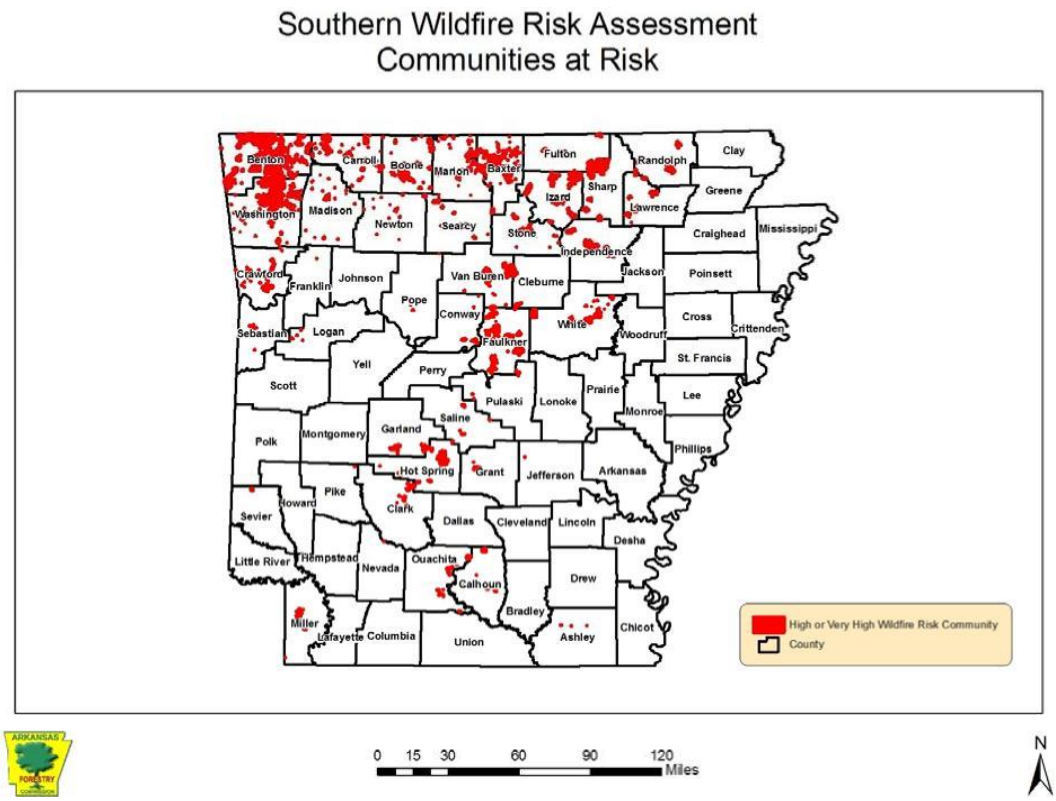


Figure 16. Southern Wildfire Risk Assessment Communities at Risk

National Priority: Conserve Working Forest Landscapes

Protect forests from harm.

Enhance public benefits from trees and forests.

Strategic Objectives:

- 1.1. Identify and conserve high priority forest ecosystems and landscapes
- 2.1. Restore fire-adapted lands and reduce risk of wildfire effects
- 2.2. Identify, manage, and reduce threats to forest and ecosystem health
- 3.2. Improve air quality and conserve energy
- 3.3. Assist communities in planning fore and reducing wildfire risks
- 3.7. Manage and restore trees and forests to mitigate and adapt to global climate change

National Direction: Assessments should identify areas where management can significantly reduce the risk of catastrophic wildfire while enhancing multiple associated forest values and risks. Assessments should identify areas where the effects of fire exclusion can feasibly be mitigated or countered through sound management, particularly where there are opportunities for federal, state, and community partnerships. Assessments should incorporate existing Community Wildfire Protection Plan's and identify communities in especially vulnerable areas that need a CWPP.

Source Layers: *Communities At Risk* - Southern Fire Risk Assessment, 2006; *January 2009 Ice Storm* Arkansas Forestry Commission, 2009

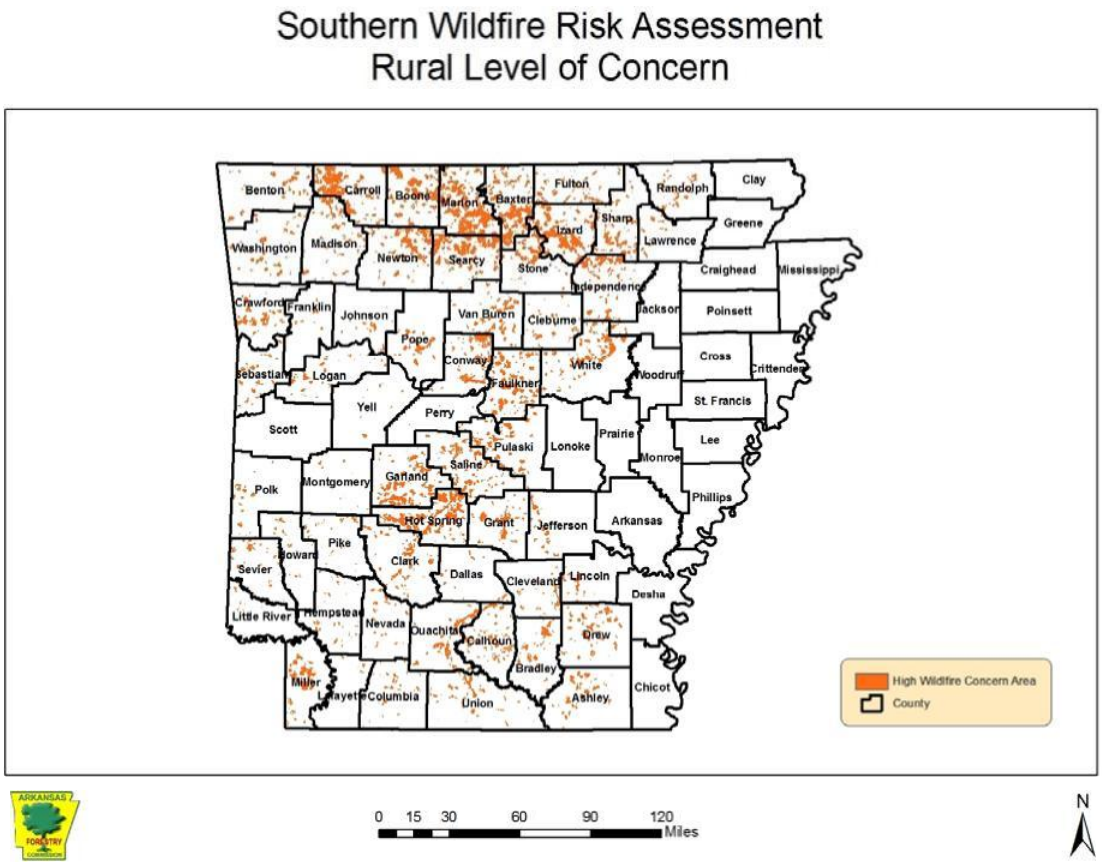


Figure 17. Southern Wildfire Risk Assessment Rural Level of Concern

National Priority: Conserve Working Forest Landscapes

Protect forests from harm.

Enhance public benefits from trees and forests.

Strategic Objectives:

- 1.1. Identify and conserve high priority forest ecosystems and landscapes
- 2.1. Restore fire-adapted lands and reduce risk of wildfire effects
- 2.2. Identify, manage, and reduce threats to forest and ecosystem health
- 3.2. Improve air quality and conserve energy
- 3.3. Assist communities in planning fore and reducing wildfire risks
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Source Layers: *Level of Concern* - Southern Forest Land Assessment, 2008

Priority Areas

Priority Area Delineation and Methodology

The Arkansas Statewide Assessment of Forest Resources is an issue based assessment which defines areas that are of importance to each issue. AFC staff assumed that the six issues affecting Arkansas forests as defined in the assessment are of equal importance. Therefore each issue's important area(s) were used to create an unweighted composite map. Overall priority areas are the areas on the composite map where there is the greatest element of occurrence of multiple important areas.

The issue specific important areas used in the composite map are figures 7, 8, 9, 10, 11, 14 and 15 in the assessment. These figures were each derived from a GIS analysis in which multiple layers were used to determine the "important" area for each issue. Refer to Appendix for source data for issue specific maps.

Eight priority areas were identified using this composite methodology (Figure 20). The priority areas are: Crowley's Ridge Priority Area, Velvet Ridge Priority Area, River Valley/Plains Priority Area, Ozark Highlands Priority Area, Shirley Priority Area, Sulphur River Priority Area, Millwood Priority Area, and Ouachita Mountains Priority Area. Figures 21, 22 and 23 show the 8 priority areas in relation to 3 issue specific important areas which are Southern Wilfire Risk Assessment Rural Level of Concern, Rural Water Quality, and Forest Parcelization respectively. On the following pages, a list of relevant forest threats follows a description of each priority area.

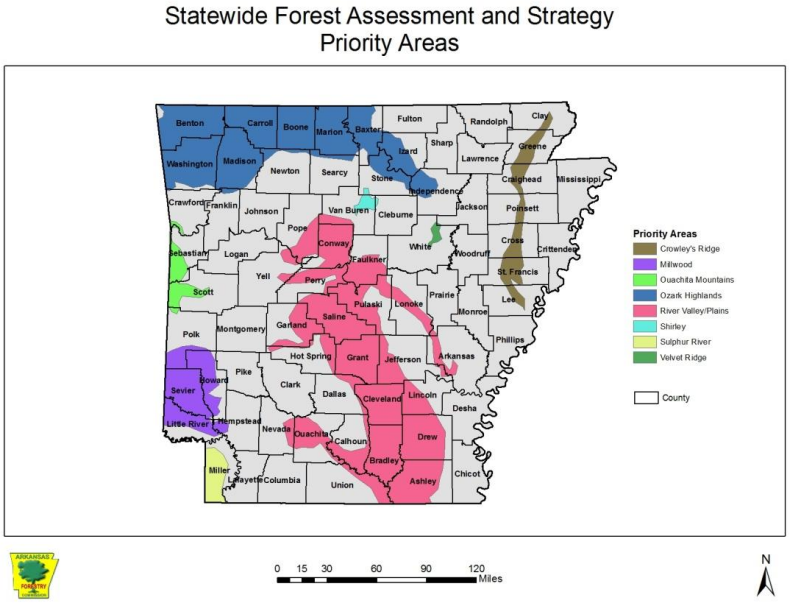

Figure 18. Statewide Forest Assessment and Strategy Priority Areas

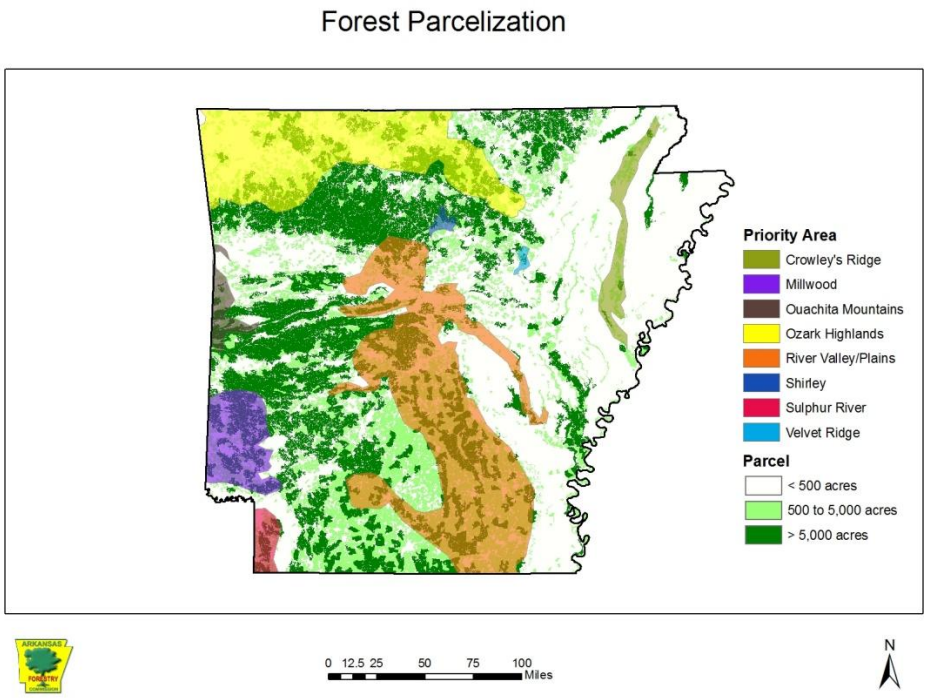

Figure 19. Forest Parcelization and Priority Areas

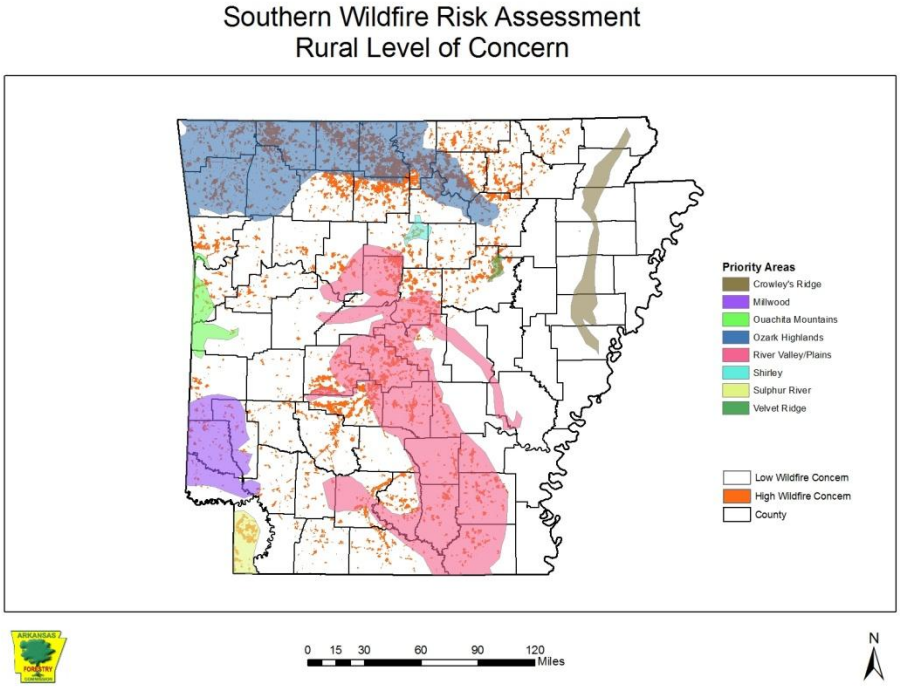

Figure 2. Southern Wildfire Risk and Priority Areas

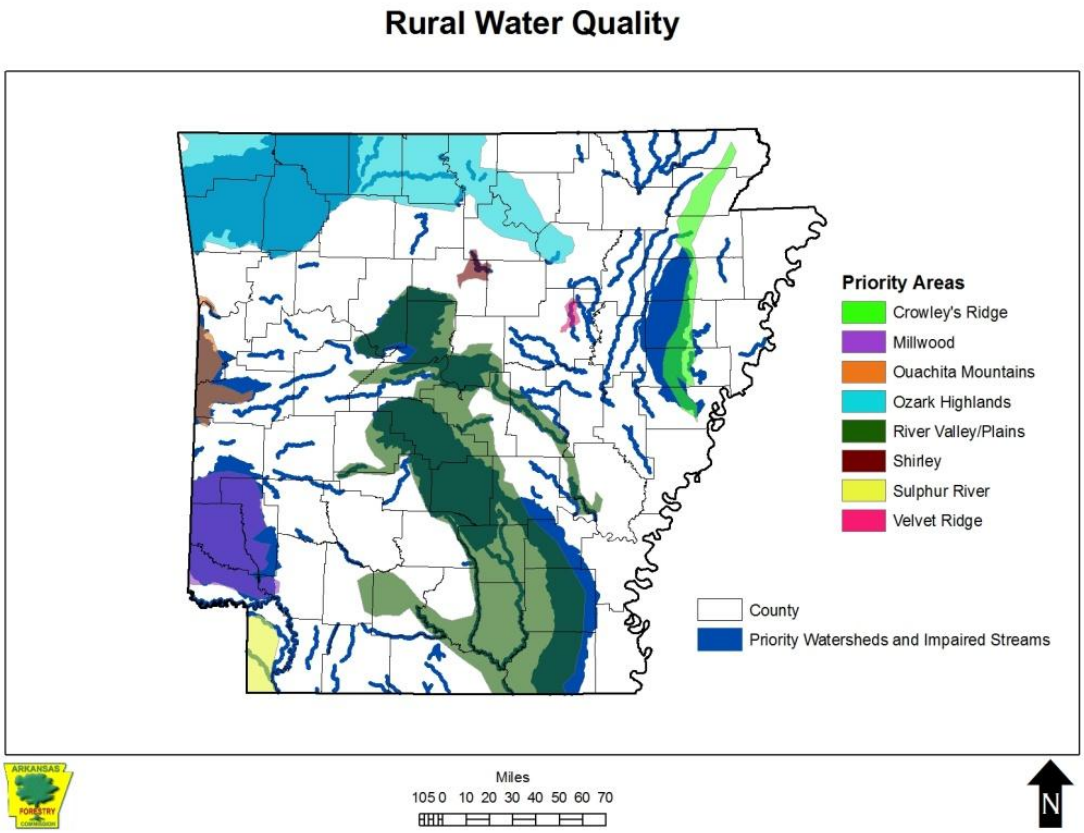

Figure 21. Water Quality and Priority Areas

Arkansas Ecoregions

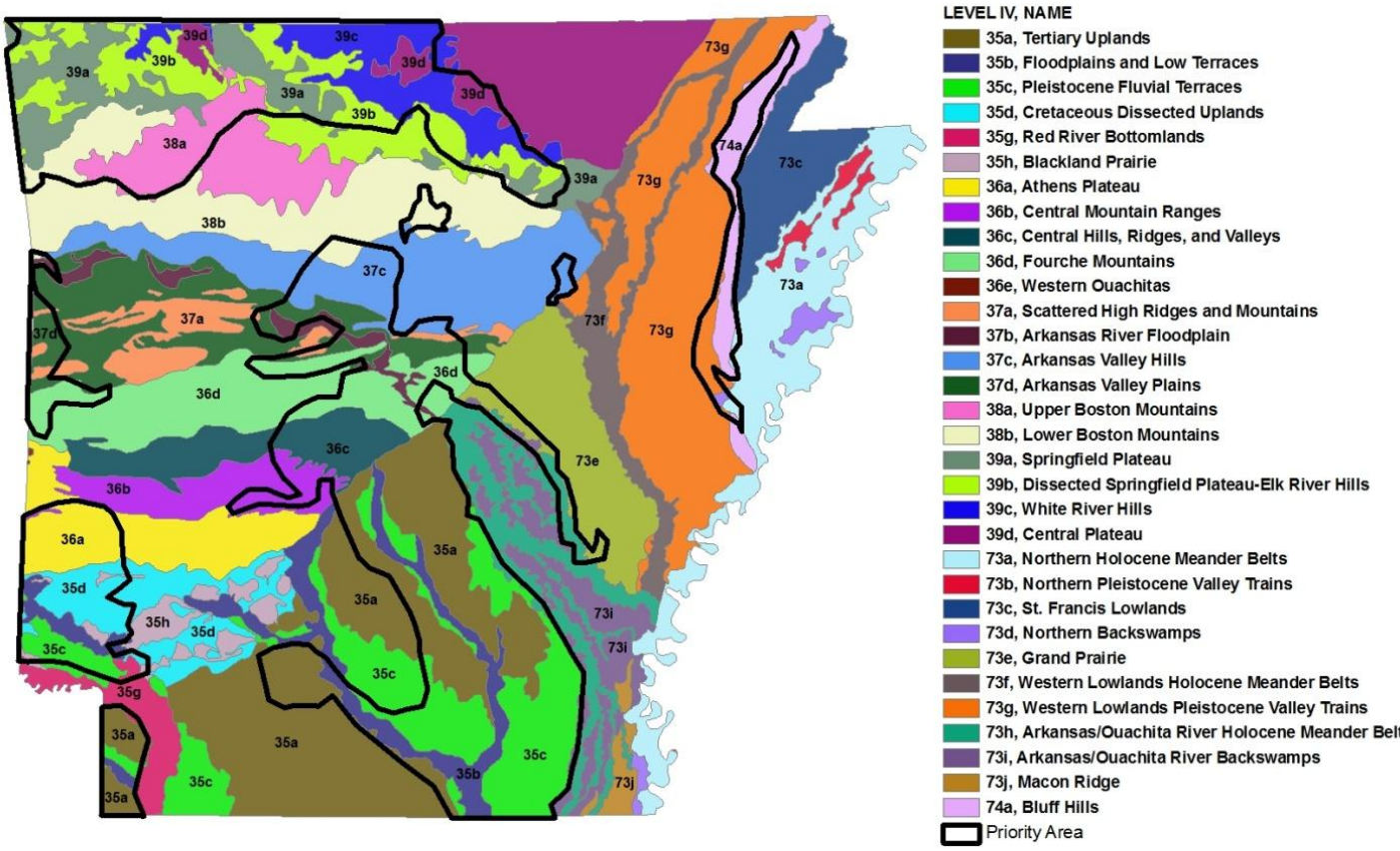

Figure 22. Arkansas Ecoregions and Priority Areas

1. Crowley's Ridge Priority Area

   The Crowley's Ridge Priority Area is composed of mesic upland forests confined to a series of narrow ridges along the western margin of the lower Mississippi River on Crowley's Ridge. It is a remnant loess-capped feature rising from 100-20 feet above the alluvial plain. The forest canopies are dominated by American beech, white oak, yellow poplar, northern and southern red oak, black hickory, shortleaf pine and black oak. Jonesboro is the largest city within Crowley's Ridge Priority Area. Some forest threats, unique characteristics, and related topics associated with this priority area are:

   Gypsy moth

Removal of historic fire regime
Conversion to pasture
Conversion to development
Increase in impervious surface
Mississippi River Basin Initiative watershed
Highly erodible soil type
Priority Watersheds (L'Anguille)
303 d Impaired Streams
Invasive Species – specifically kudzu

2. Velvet Ridge Priority Area

The Velvet Ridge Priority Area is generally dominated by upland forest species including white oak, northern red oak, various hickory species, and short leaf pine. Riparian area found along streams in this area are sycamore, sweetgum, river birch, and maples. Some forest threats and unique characteristics associated with this priority area are:

Invasive and exotic trees, shrubs, and woody vines
Removal of historic fire regime
Excessive stem densities of woody plants
Conversion of forests to open lands
Gypsy Moth
Communities at Risk High Level of Concern
303 d Impaired Streams

3. River Valley/Plains Priority Area

The River Valley/Plains Priority Area is the largest and probably most diverse priority area. It contains parts of 5 of the 7 Level III ecoregions in Arkansas. However, most of the area lies in the Ouachita Mountains and South Central Plains ecoregions. The priority area extends north into the Arkansas Valley and just into the Boston Mountains and eastward into the Mississippi Alluvial Plain. Most of the forests in this priority area are dominated by loblolly and/or shortleaf pine with a variety of dry-mesic site hardwood species. However, interspersed within this priority area are bottomland hardwood forests and hardwood forests on upper terraces which are oak dominated and contain species such as willow oak. This area encompasses much of the Little Rock metropolitan area including the city of Conway, Saline County, and western Pulaski County and also the growing area around Monticello the southeastern part of the state. Some forest threats, unique characteristics, and related topics associated with this priority area are:

Forest parcelization
Forest fragmentation
Conversion to development
Increase of impervious surface
Removal of historic fire regime
Communities at Risk high level of concern
303 d impaired streams
Priority watersheds (Upper Saline and Bayou Bartholomew)
Mississippi River Basin Initiative watershed
Southern pine beetle
Cogongrass
Loss of native shortleaf pine component (particularly in the Ouachita Mountains)

4. Ozark Highlands Priority Area

The Ozark Highlands Priority Area contains almost all of 6 counties in northwest Arkansas. Washington, Benton, and Baxter Counties which are all in this priority area have seen large population growth in recent years The forests in this area are typically a closed canopy of oak species including northern red oak and white oak and often associated with hickory species. Some forest threats, unique characteristics, and related topics associated with this priority area are:

Illinois River watershed and Beaver Reservoir watershed multi state issues
Shortleaf pine multi state common issue
Priority watersheds (Illinois River and Beaver Reservoir)
Forest parcelization
Forest fragmentation
Conversion of forests to non forests
Increase in impervious surface
Removal of historic fire regime
Communities at Risk high level of concern
Excessive stem densities of woody plants

5. Shirley Priority Area

The Shirley Priority Area is almost entirely contained within Van Buren County and is also almost entirely within the Lower Boston Mountains ecoregion. Red oak, white oak, and hickory are the

dominant vegetation types in this region, although shortleaf pine and eastern red cedar are found in many of the lower areas and on some south and west facing slopes. Some forest threats, unique characteristics, and related topics associated with this priority area are:

Conversion of forests to non forest
Removal of historic fire regime
303 d impaired stream

6. Sulphur River Priority Area

The Sulphur River Priority Area is located in Miller County and is entirely within South Central Plain Level III ecoregion. Most of this priority area is rolling upland where loblolly pine is the dominant vegetation type. Floodplains and terraces are also common which contain forested wetlands and pine flatwoods respectively. Some forest threats, unique characteristics, and related topics associated with this priority area are:

High wildfire risk multistate issue
303 d impaired streams
Forest parcelization
Communities at Risk high level of concern
Invasive and exotic trees, shrubs, and woody vines
Southern pine beetle

7. Millwood Priority Area

Most of the Millwood Priority Area is contained within the South Central Plains Level III ecroregion. The priority area extends northward into the Ouachita Mountains ecoregion. Loblolly pine and oaks are the most common vegetation cover in this southern portion of this area which is interspersed with hardwood wetlands. The northern extent of this priority area are the lower, less rugged parts of the Ouachita Mountains ecoregion. It contains widespread pine plantations and pastureland. Some forest threats, unique characteristics, and related topics associated with this priority area are:

Red oak borer and oak decline multi state common issue
Shortleaf pine multi state common issue
Forest parcelization
Communities at Risk high level of concern
Invasive and exotic trees, shrubs, and woody vines

Priority watershed (Lower Little River)
Southern pine beetle

8. Ouachita Mountains Priority Area

The Ouachita Mountains Priority Area is in the extreme western Arkansas. Upland oaks, hickory, shortleaf pine, and loblolly pine are the most common forest types. Prior to the 19th century, this area burned frequently and had extensive prairies on droughty soils; scattered pine–oak savanna also occurred. Today, pastureland are extensive but remnants of prairie still exist. Parts of the cities of Fort Smith and Van Buren are in this priority area. Some forest threats, unique characteristics, and related topics associated with this priority area are:

Ancient Cross Timbers multi state issue
Short leaf pine multi state issue
Priority watershed (Poteau)
Southern pine beetle
Removal of historic fire regime
Conversion of forests to non forests
Increase in impervious surface

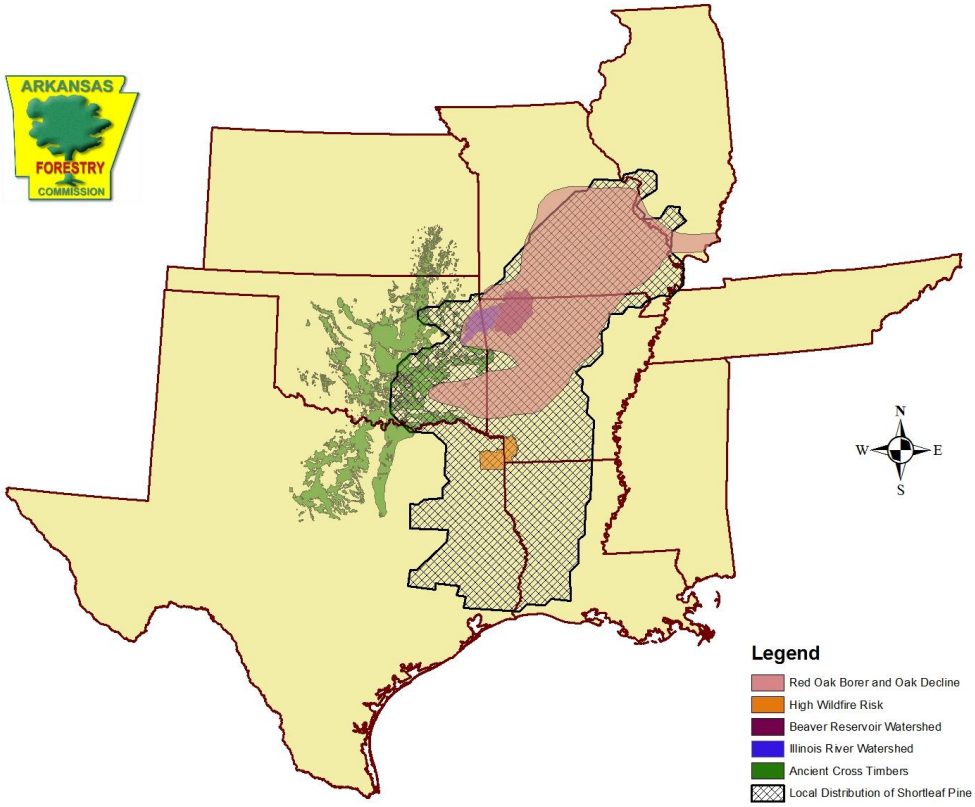

Figure 23. Multi-State Common Issues

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Appendix A

Process for Development of Arkansas's Statewide Forest Resource Assessment

Arkansas's Statewide Forest Resource Assessment was developed under the leadership and guidance of the Arkansas Forestry Commission through a contract with Terracon Consultants, Inc.

Assessment development began by AFC staff identifying issues confronting Arkansas'ss forests. AFC and Terracon staff identified appropriate geospatial data to illustrate the issues.

The 2008 Farm Bill provides a list of committees and agencies in which the AFC shall coordinate with in developing the assessment. AFC staff chose to work most closely with the Arkansas Forest Stewardship Committee in the development of the assessment because of the broad representation on the committee. Many AFC partners, such as the Natural Resources Conservation Service, Resource Conservation and Development Council and the U. S. Forest Service, are represented on the committee. AFC staff believed working closely with this committee best fulfilled the intent of the 2008 Farm Bill.

The most significant contribution from the Forest Stewardship Committee came from a subcommittee composed of representatives from the Arkansas Game and Fish Commission, the Arkansas Chapter of The Nature Conservancy, and the Arkansas Natural Heritage Commission. This subcommittee identified important parts of the Arkansas Wildlife Action Plan that needed to be included in the Assessment as well as making a significant contribution to writing parts of the assessment. Emphasis was placed on ensuring that the assessment furthers the priorities for species and habitat conservation established in the Arkansas Wildlife Action Plan.

AFC staff, Terracon staff, and the Arkansas Forest Stewardship Committee also collaborated to ensure that appropriate parts of other state level natural resource plans were integrated in the Assessment. An example is geospatial data from the State Water Plan.

Some members of the Arkansas Forest Stewardship Committee are also members of the State Technical Committee. Those people whose committee membership overlapped tended to provide significant contributions in the form of editing and advice regarding geospatial layers.

Appendix B

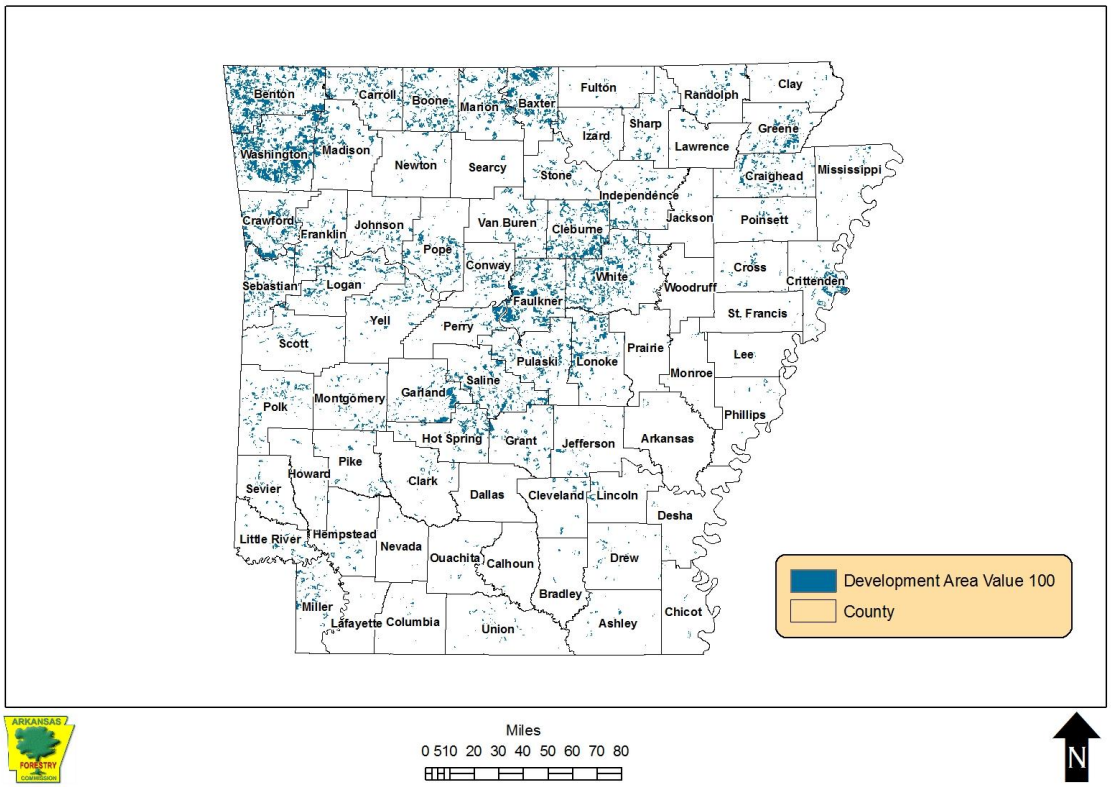
Source Data Used for Issue Development Layers

&

Composite Issue Data Layer

Source data for Water Quality for Developing Populations (Figure 7)

Development Level

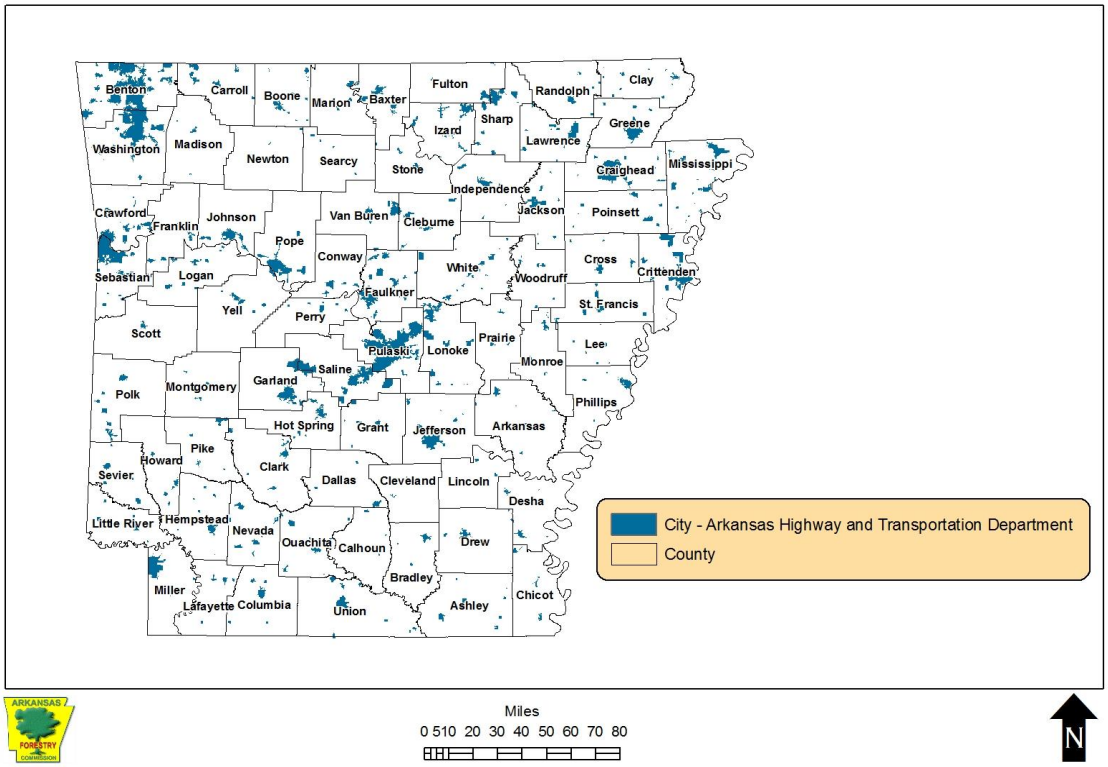


Miles
0 510 20 30 40 50 60 70 80

N

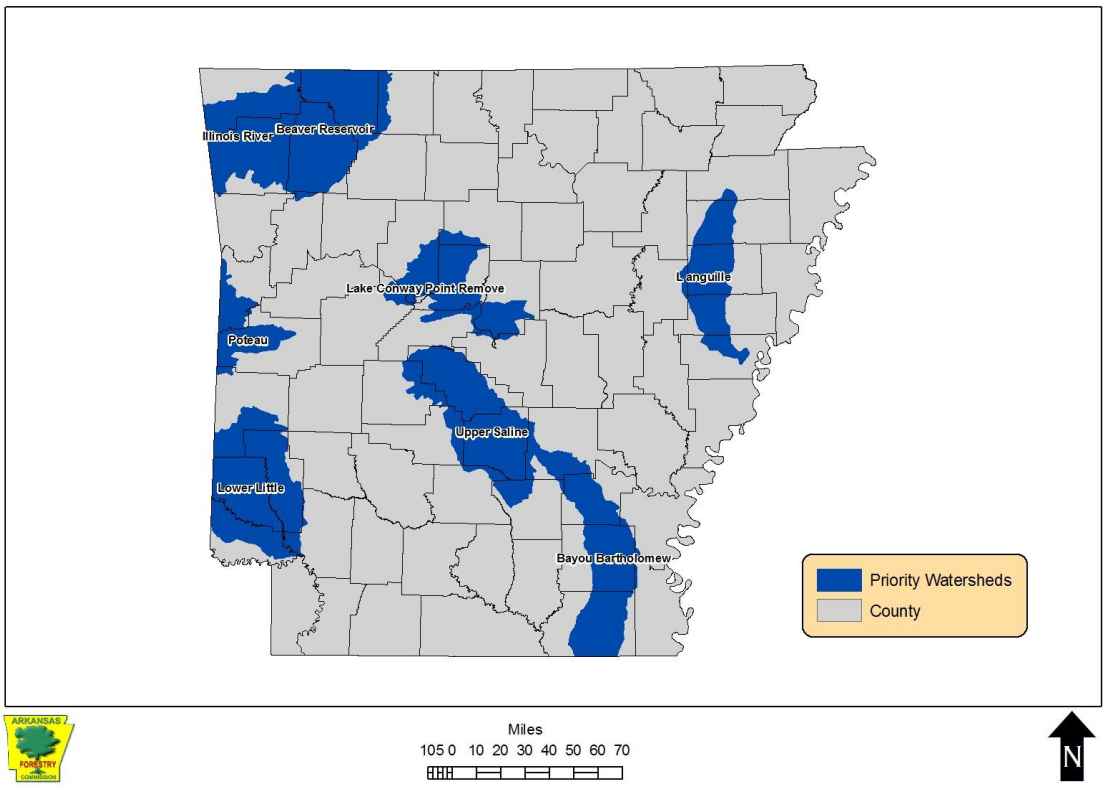
Source data for Water Quality for Developing Populations (Figure 7)

City Limits



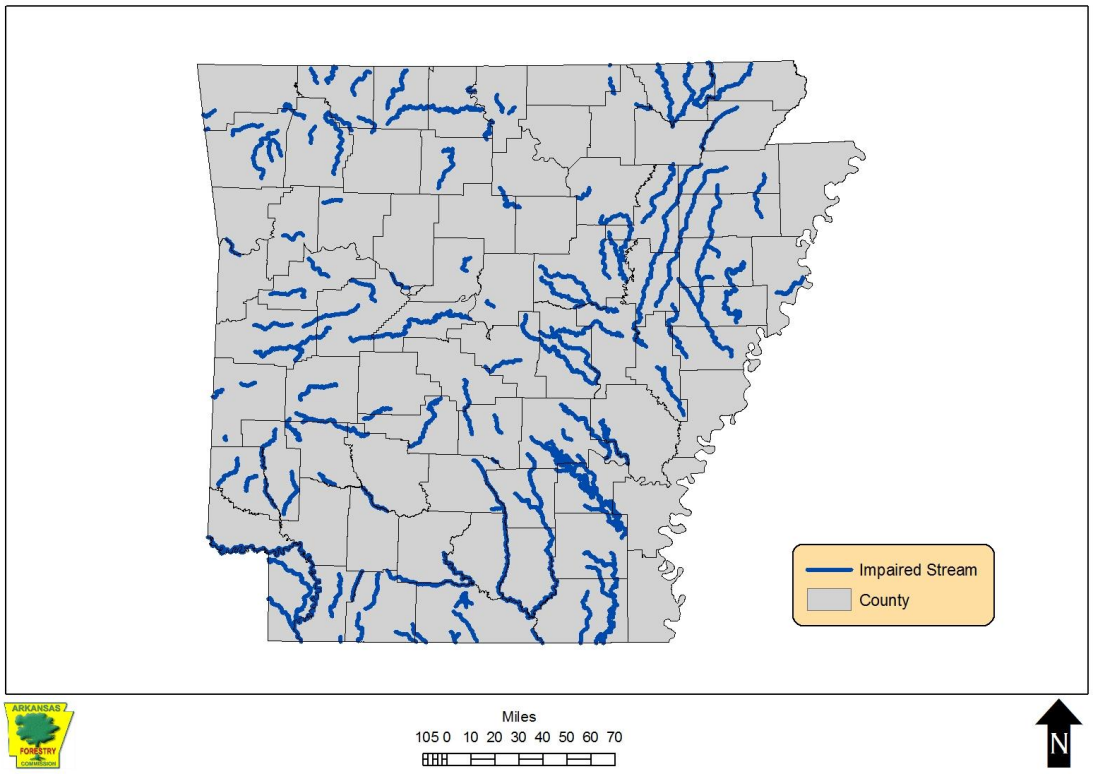
Source data for Rural Water Quality (Figure 8)

Priority Watersheds



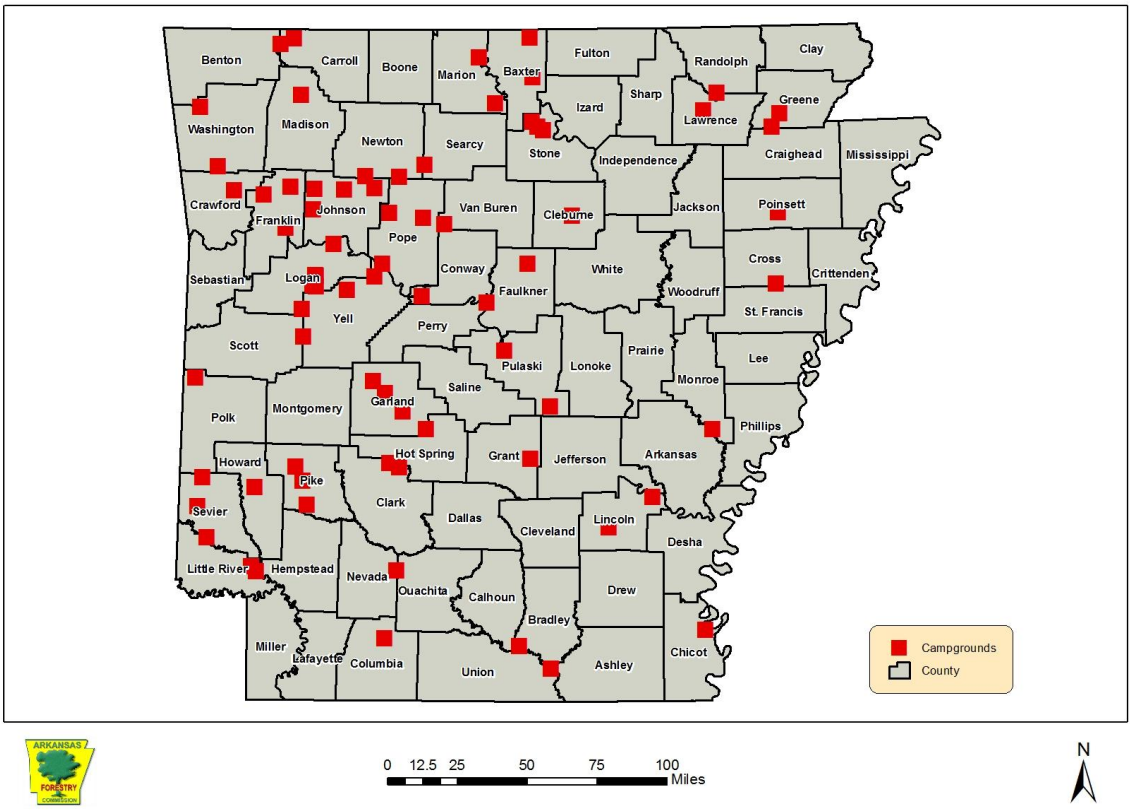
Source data for Rural Water Quality (Figure 8)

303d Impaired Streams



Source data for Non-Native Invasive Species Entry Potential (Figure 9)

State and Federal Campgrounds

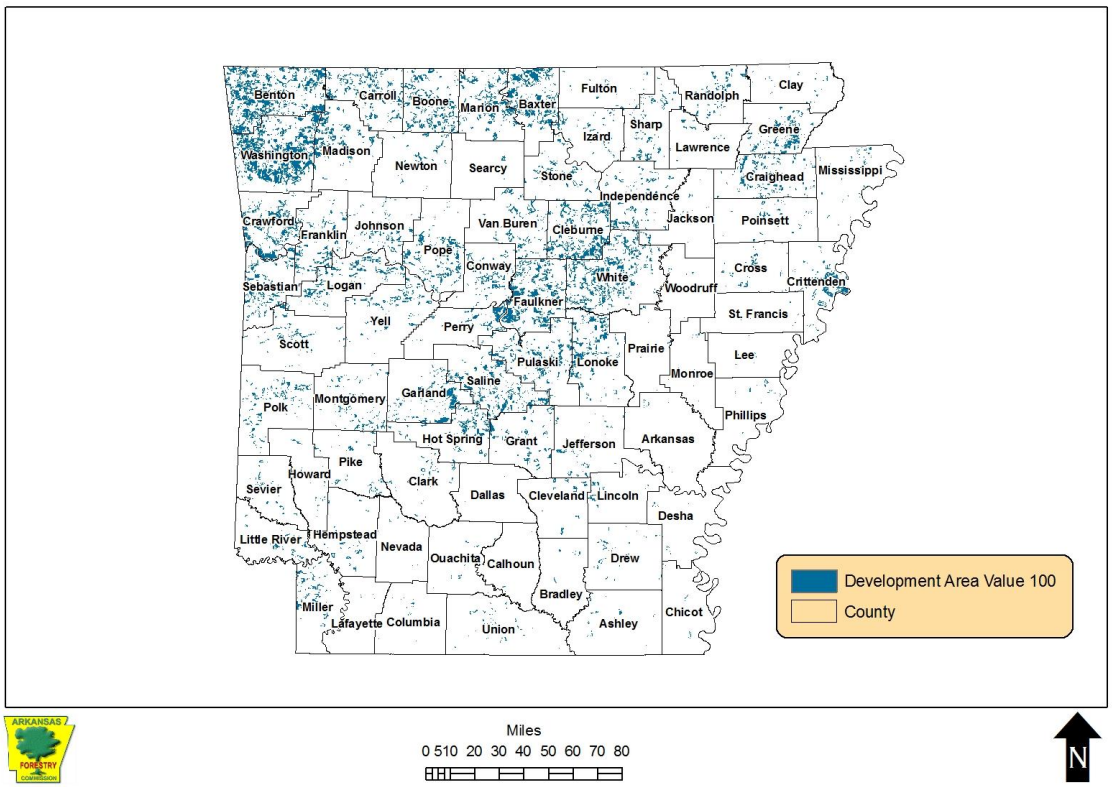


0 12.5 25 50 75 100 Miles

N

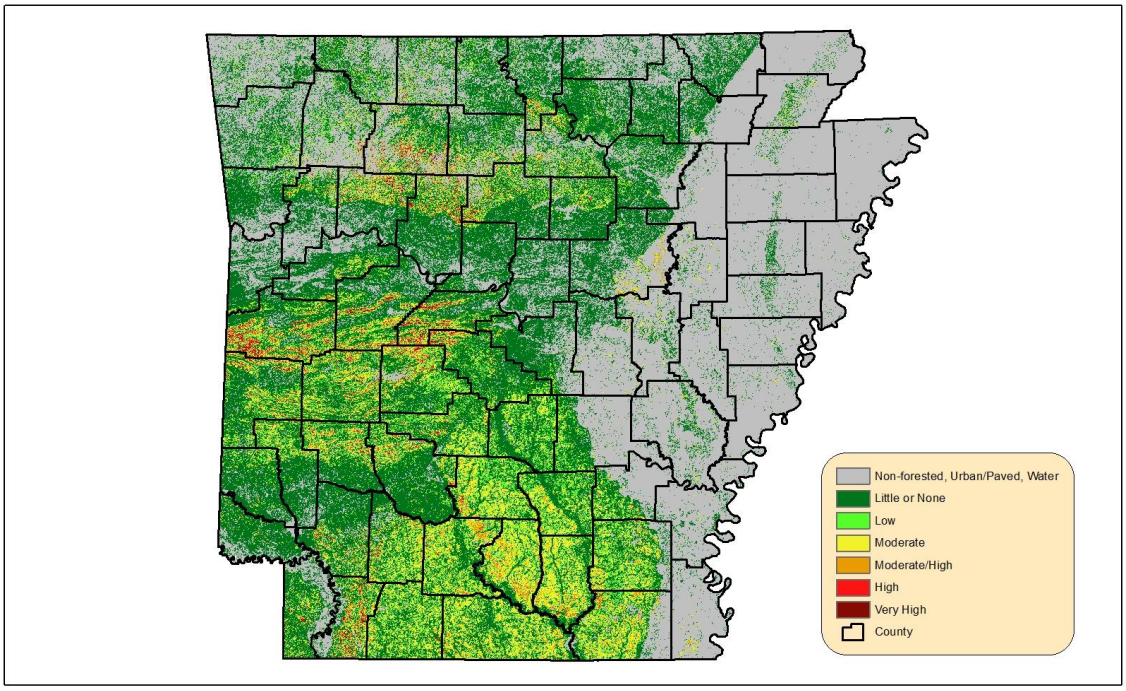
Source data for Non-Native Invasive Species Entry Potential (Figure 9)

Development Level



Source data for Forest Health Risk-Southern Pine Beetle (Figure 10)

Forest Health Risk
Southern Pine Beetle

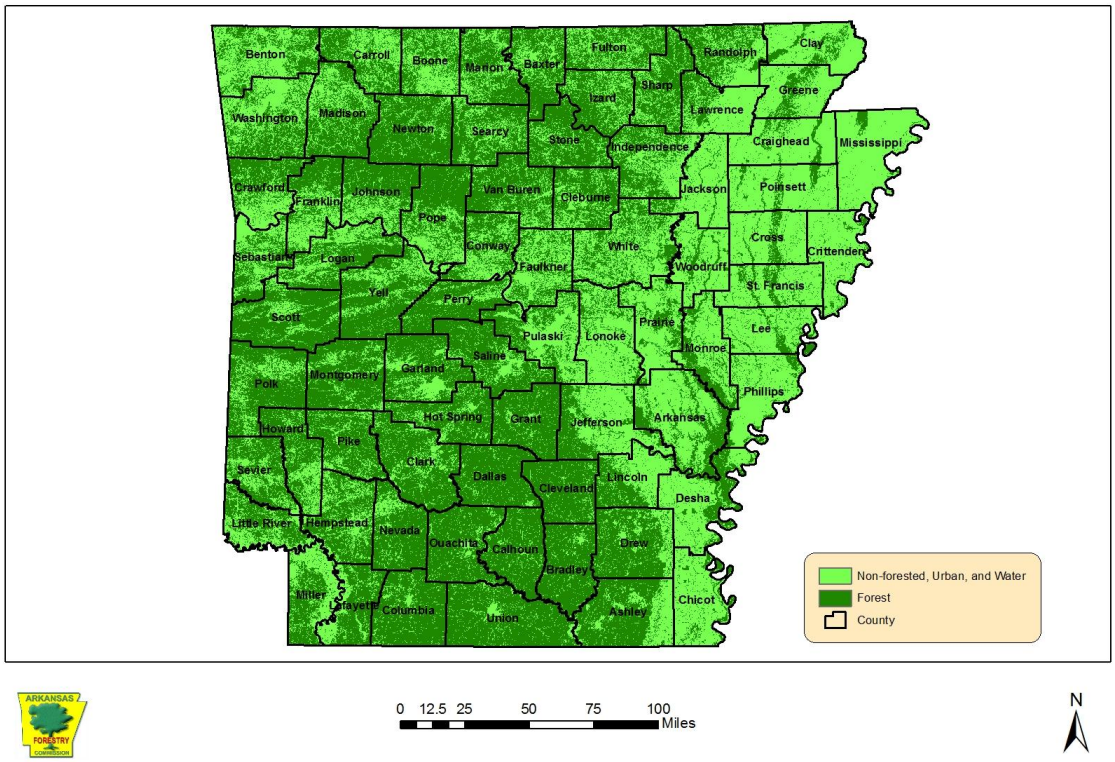


0 12.5 25 50 75 100 Miles

N

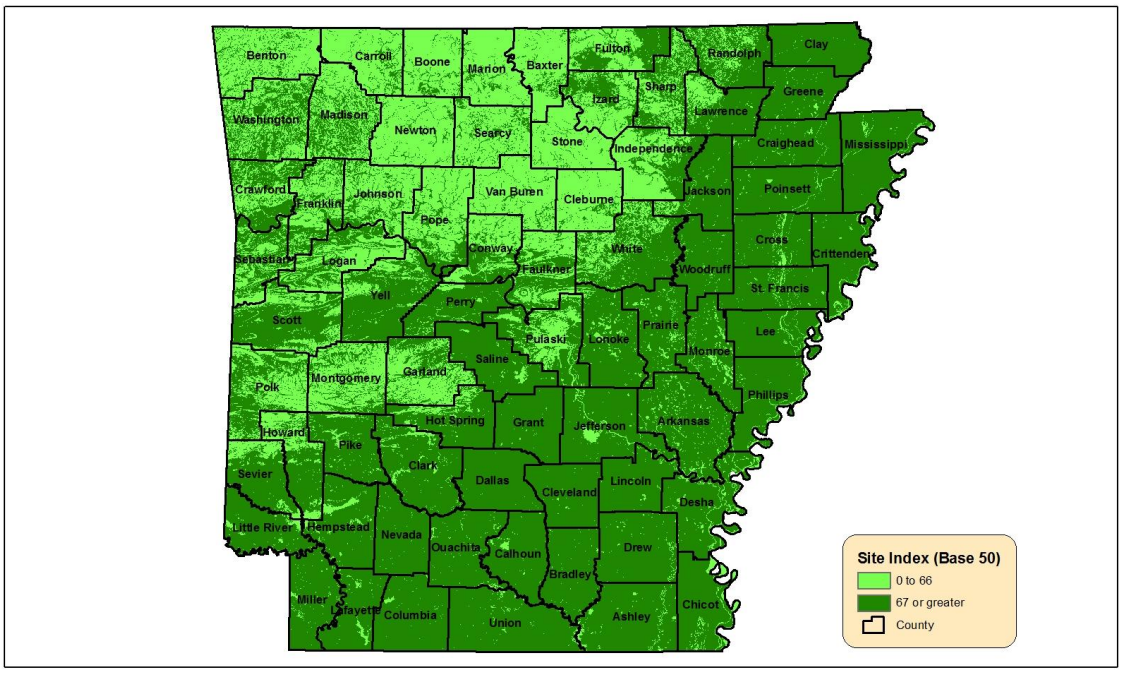
Source data for Economic Potential for All Ownership Working Forests (Figure 13)

All Forest Land



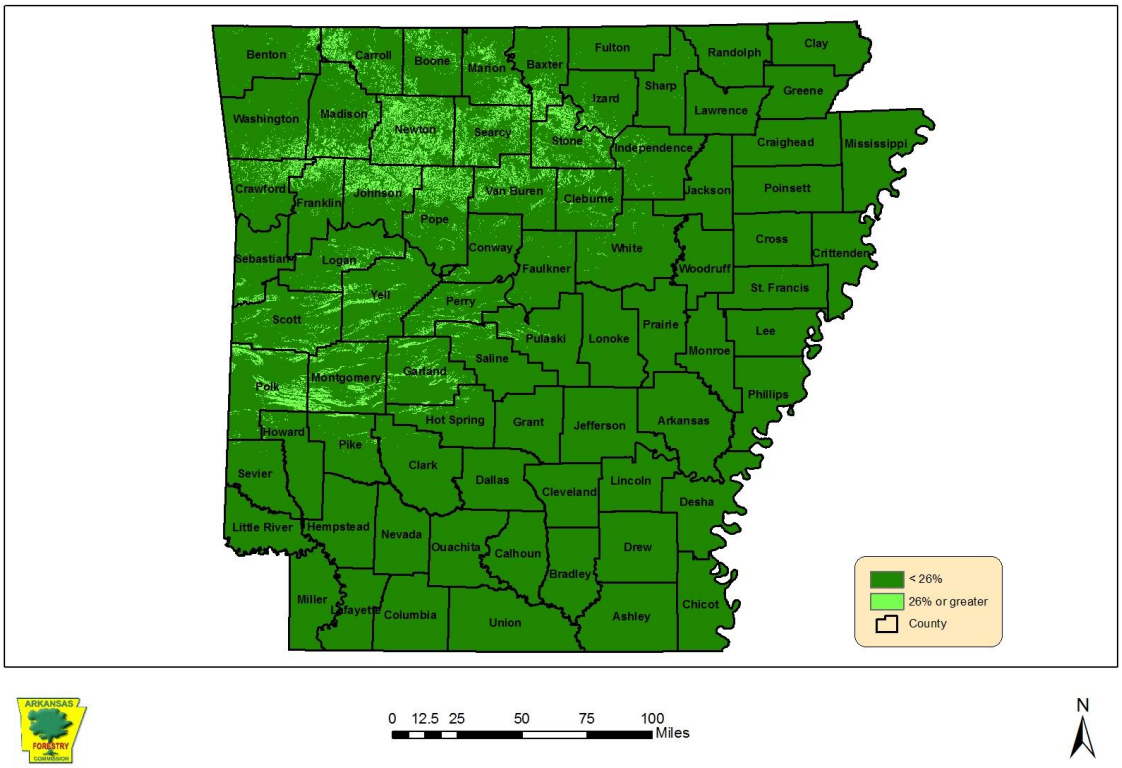
Source data for Economic Potential for All Ownership Working Forests (Figure 13)

Site Productivity



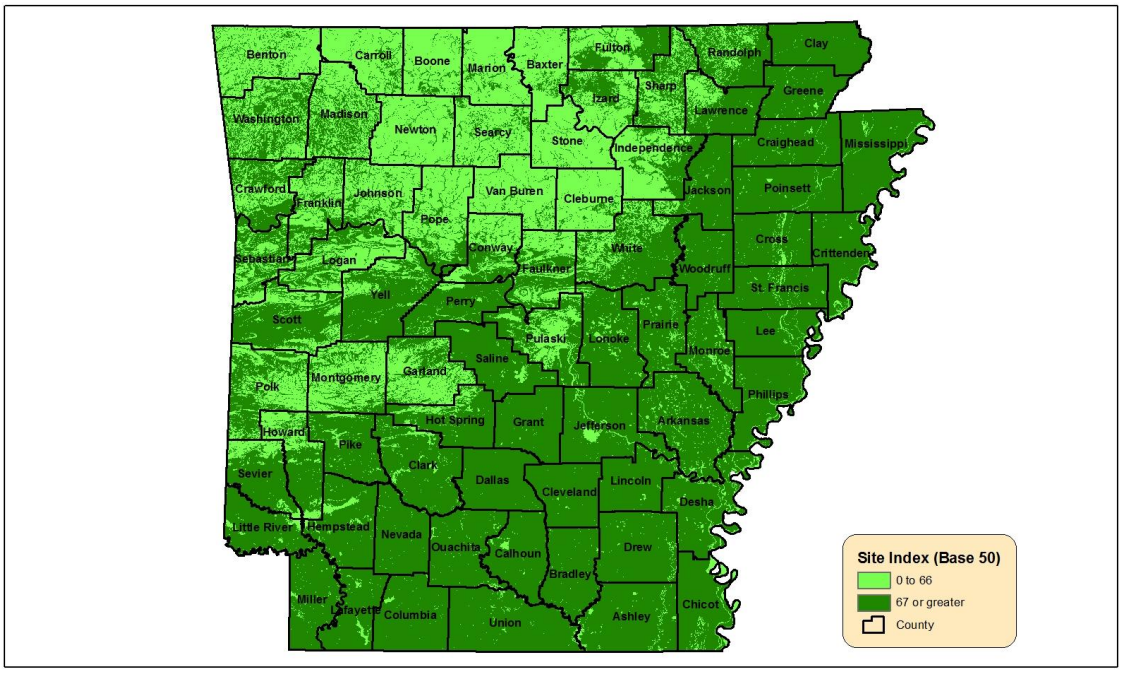
Source data for Economic Potential for Stewardship Working Forests (Figure 14)

Slope



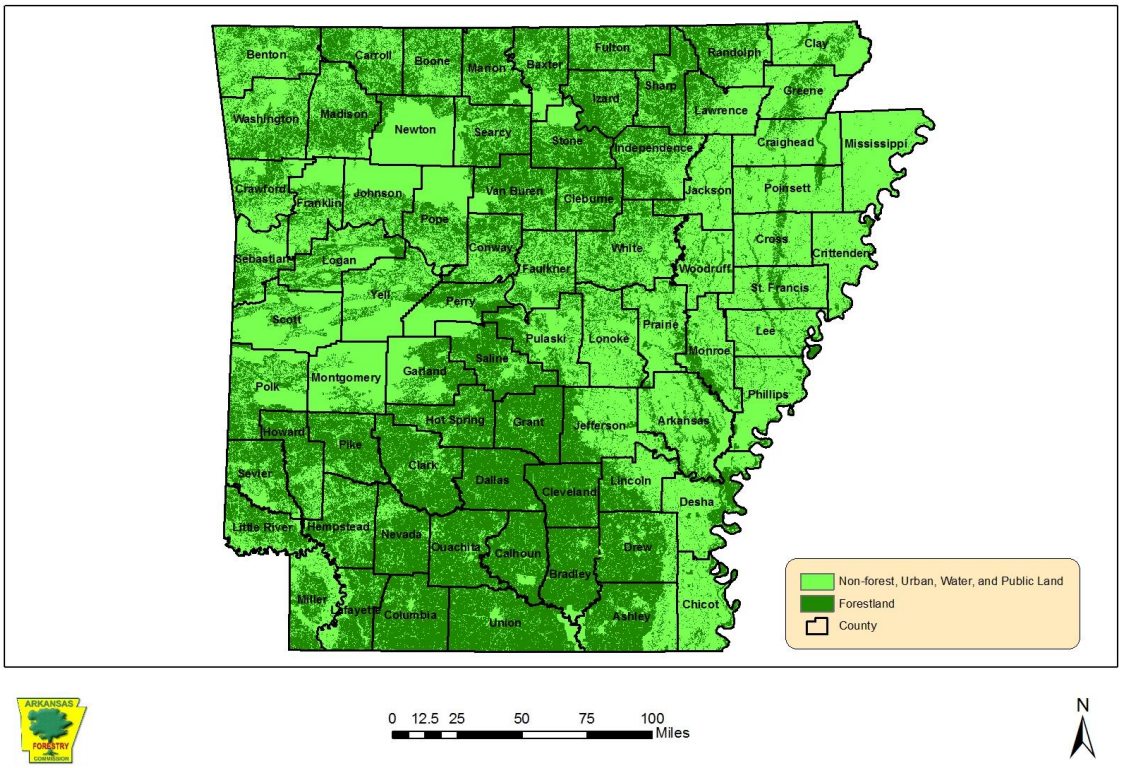
Source data for Economic Potential for Stewardship Working Forests (Figure 14)

Site Productivity



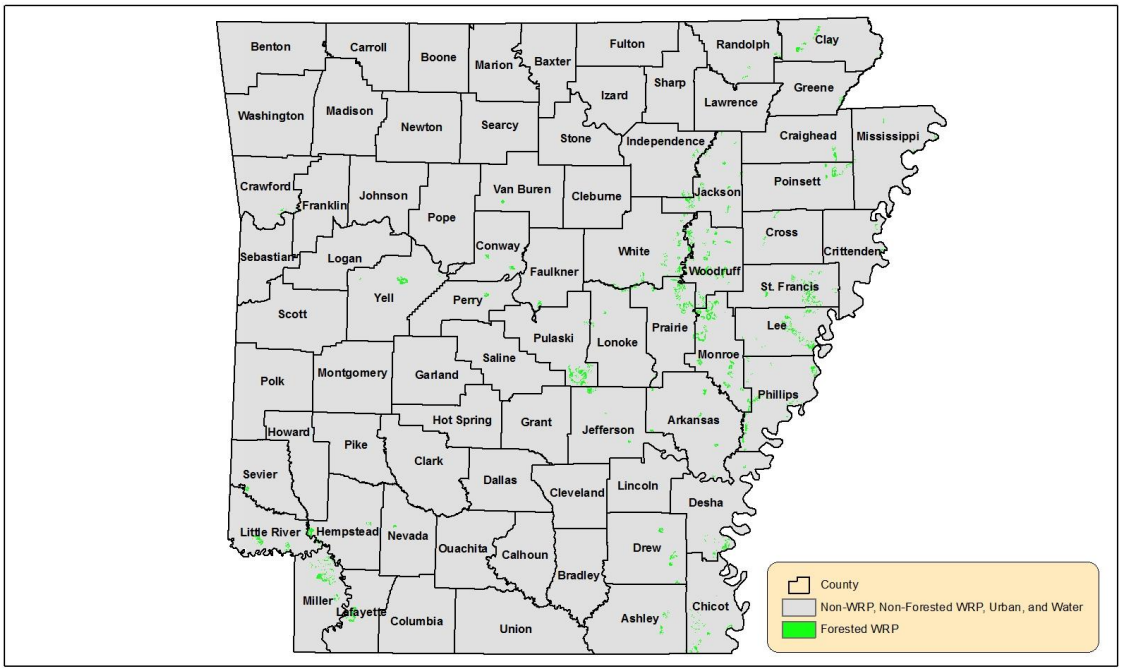
Source data for Economic Potential for Stewardship Working Forests (Figure 14)

Forest Land Minus Urban, Water, and Public Lands

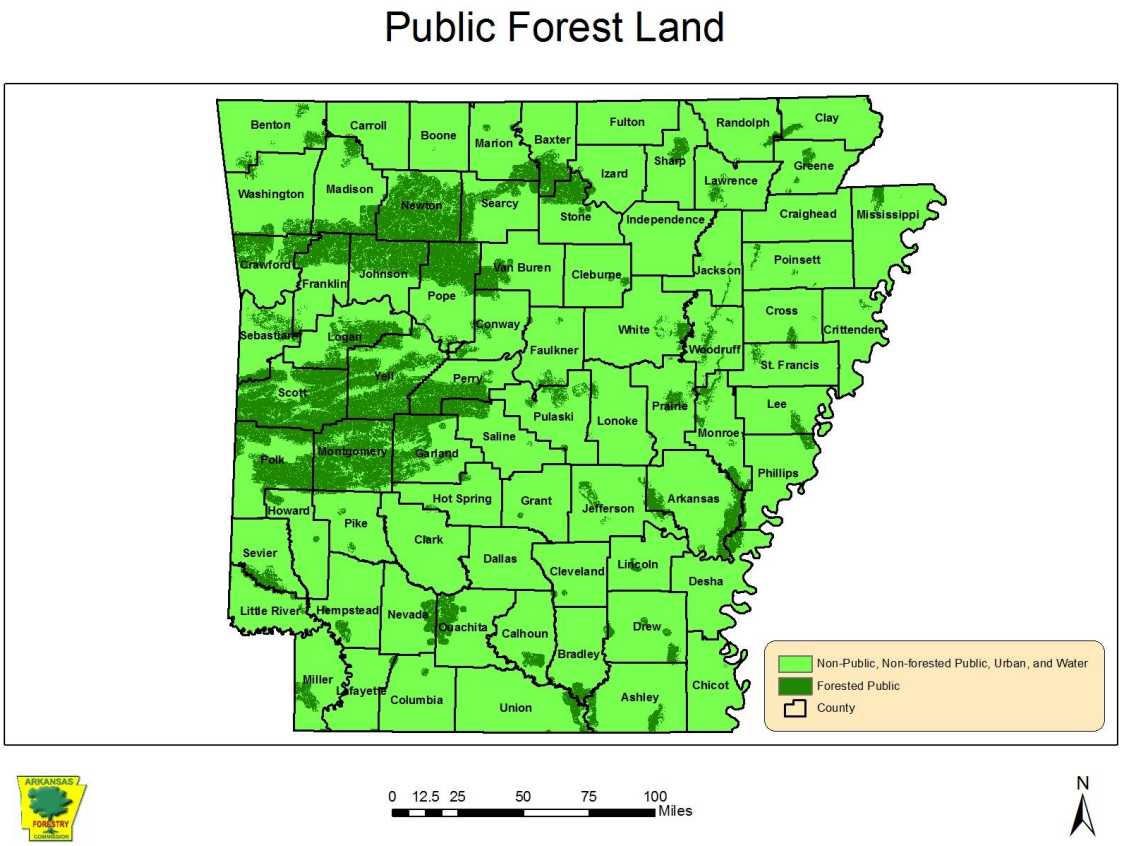


Source data for Public Conserved Forested Land (Figure 16)

Wetlands Reserve Program Conservation Lands

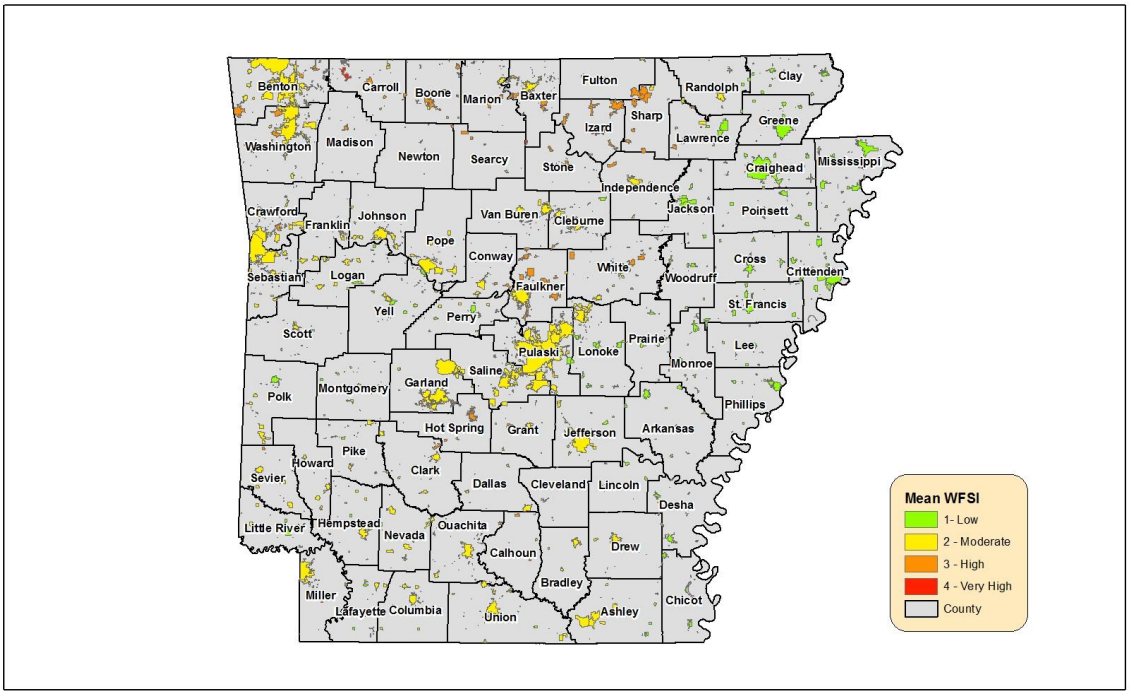


Source data for Public Conserved Forested Land (Figure 16)



Source data for Southern Wildfire Risk Assessment Communities at Risk (Figure 17)

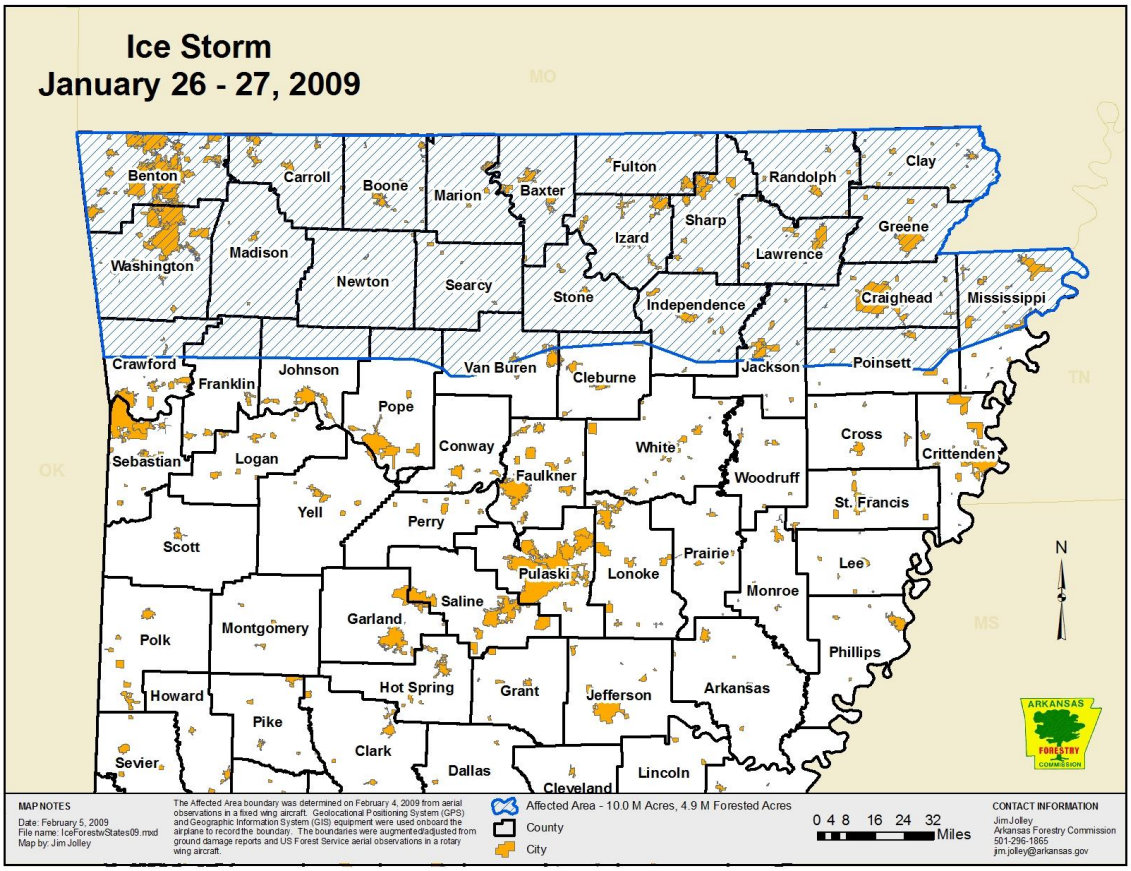
SWRA Communities at Risk Preliminary



0 15 30 60 90 120 Miles

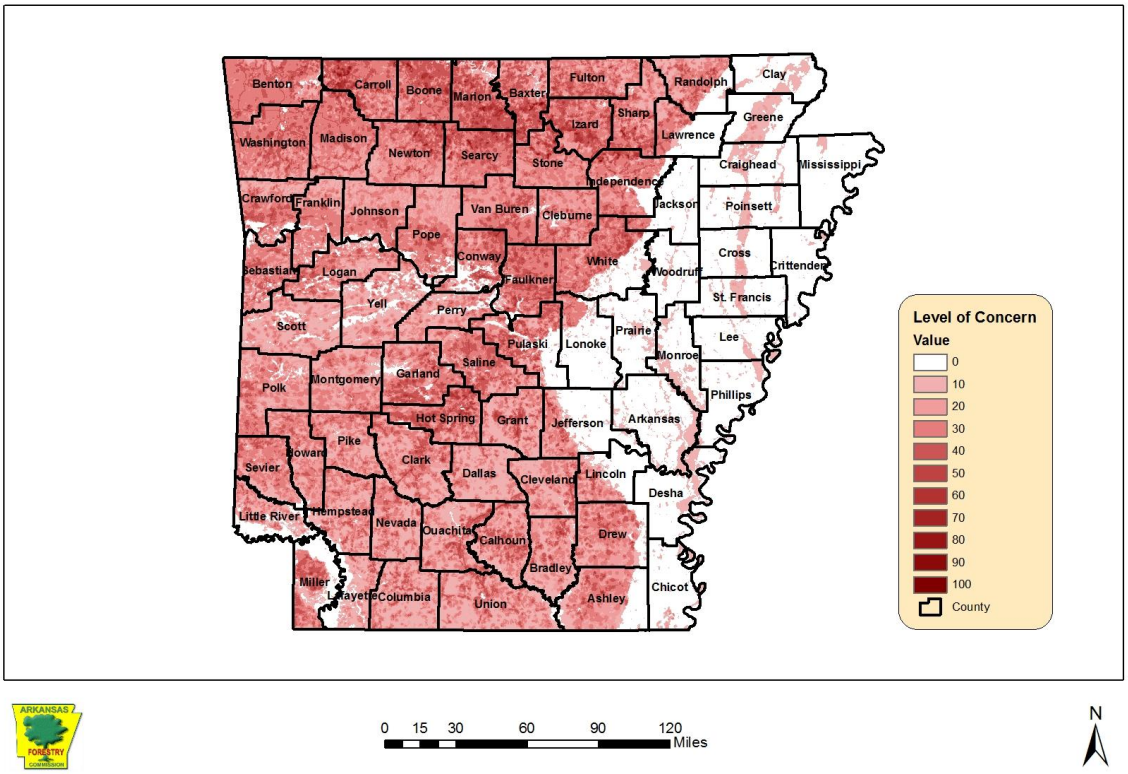
N

Source data for Southern Wildfire Risk Assessment Communities at Risk (Figure 17)



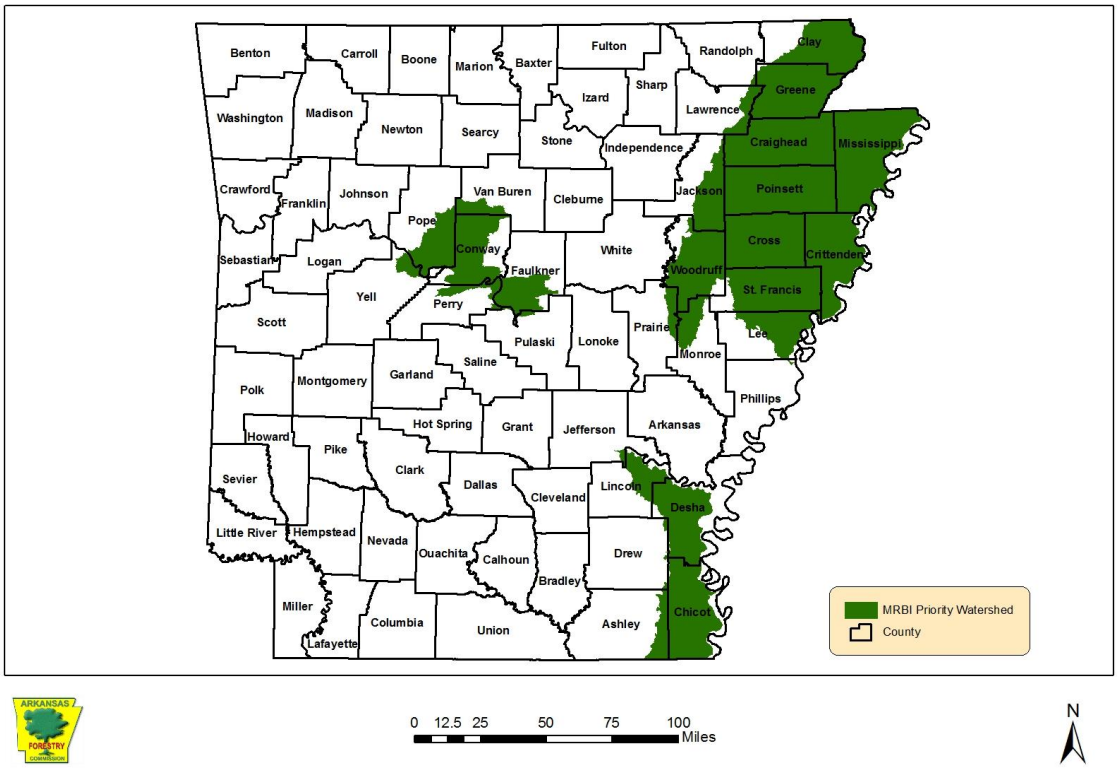
Source data for Southern Wildfire Risk Assessment Rural Level of Concern (Figure 18)

SWRA Level of Concern Preliminary



Source data for Multi-State Common Issues (Figure 19)

Mississippi River Basin Healthy Watersheds Initiative Priority Watersheds



Appendix C

Terrestrial Habitat Reports
From
The Arkansas Wildlife Action Plan

Components of Terrestrial Habitat Reports

Habitat Type Description: Portions of the description from the AWAP for each terrestrial habitat type including predominate forest tree species and ecoregion(s) the habitat type is associated with.

Ranking (Priority Score): The Habitat Priority Score of each terrestrial community is a sum of all Species Priority Scores associated with species for which this habitat is associated. A higher score implies a higher quantity of SGCN and/or more greatly imperiled species occurred in the habitats listed. Refer to the AWAP website for a defined methodology of priority scoring.

Example of Species Associated with Habitat Type: For each Habitat Report is listed several of the higher scored and dependent species to serve as an example from the SGCN list contained in the AWAP. Under each Habitat Type SGCN are also listed according to their individual dependence upon the vegetative communities in good condition. The terms used and their definitions for the level of dependency are as follows:

Obligate: specie requires this habitat to complete its lifecycle.
Optimal: a given habitat produces the highest population densities of the species.
Suitable: specie will breed and maintain populations under this habitat type.
Marginal: a population may subsist at low numbers under this type but is vulnerable to extirpation.

Problems Faced: For each terrestrial habitat type is provided a list of many of the threats and problems facing these forested and woodland areas. The listed problems were derived from a combination of species oriented threats from the SGCN reports as well as problems facing the particular habitat type from the Terrestrial Habitat reports in the AWAP. Most of the problems faced within existing listed habitats are a result of either a lack of historic disturbance or due to compositional degradations from previous mis-management.

Conservation Actions: For each terrestrial habitat type is provided a list of solutions to the above described problems facing these forested and woodland areas. The listed conservation actions were derived from a combination of species oriented needs from the SGCN reports as well as management actions from the particular habitat type from the Terrestrial Habitat reports in the AWAP. The sustainability of most all of the listed terrestrial habitats are dependent upon management actions to promote desired conditions for the guild of SGCN that exist or migrate to these ecosystems.

Terrestrial Habitat Reports

Habitat Name (Score): Arkansas Valley Prairie and Woodland (2,452)

Description: This system of prairies and associated woodlands is found in the Arkansas Valley region of Arkansas and adjacent Oklahoma. This region is distinctly bounded by the Boston Mountains to the north and the Ouachita Mountains to the south. The valley is characterized by broad, level to gently rolling uplands derived from shale and is much less rugged and more heavily influenced by Arkansas River erosion processes than the adjacent mountainous regions.

Ecoregion where the habitat occurs: Ouachita Ecoregion

Examples of SGCN associated with this habitat type:

Prairie Mole Cricket (*Gryllotalpa major*) Weight: Obligate

Henslow's Sparrow (*Ammodramus henslowii*) Weight: Optimal

Strecker's Chorus Frog (*Pseudacris streckeri*) Weight: Optimal

Ornate Box Turtle (*Terrapene ornata ornata*) Weight: Optimal

Northern Bobwhite (*Colinus virginianus*) Weight: Optimal

Painted Bunting (*Passerina ciris*) Weight: Optimal

Southeastern Shrew (*Sorex longirostris*) Weight: Suitable

Problems Faced:

- Afforesting prairies
- Planting of exotic forbs and grasses
- Invasive shrubs and woody vines
- Removal of historical fire regime; densification of woodlands

Conservation Actions Needed:

- Retain native prairie and grasslands within forested matrix
- Maintain or, where necessary, restore the percent of groundcover in invasive woody species to nine percent or less.
- Maintain or, where necessary, restore the percent of groundcover in non-native herbaceous vegetation to nine percent or less.
- Maintain and restore appropriate fire regime in grassland and prairie components

Habitat Name (Score): Cultivated Forests (193)

Description: This type includes plantations primarily composed of pine (although more recently bottomland oaks in the Mississippi Alluvial Plain WRP restorations) with regularly spaced trees planted for commercial production and subject to periodic silvicultural maintenance. This habitat type is extensive in Arkansas.

Ecoregions where the habitat occurs: Ouachita Mountains, Ozark Mountains, Mississippi Alluvial Plain, West Gulf Coastal Plain

Examples of SGCN associated with this habitat type:

EasternTowhee (*Pipilo erythrophthalmus*) Weight: Suitable

Lark Sparrow (*Chondestes grammacus*) Weight: Suitable or Marginal

Northern Bobwhite (*Colinus virginianus*) Weight: Marginal

Yellow-billed Cuckoo (*Coccyzus americanus*) Weight: Marginal

Swainson's Warbler (*Limnothlypis swainsonii*) Weight: Marginal

Bachman's Sparrow (*Aimophila aestivalis*) Weight: Marginal

Problems Faced:

- Invasive and exotic non-native shrubs, vines, forbs and grasses
- Bedding or hipping
- Lack of timely thinning (recutions of stem density)
- Removal of historical fire regime

Conservation Actions Needed:

- Create openings in forests and woodlands
- Reduce percent of non-native vegetation
- Reduce percent of acreage of bedded conditions
- Use of forest management to restore appropriate tree density
- Maintain and restore appropriate fire regime

Habitat Name (Score): Lower Mississippi Flatwoods Woodlands and Forest (733)

Description: This system is composed of forests, prairies and woodlands on Pleistocene terraces in the Mississippi Alluvial Plain ecoregion. It occurs primarily west of Crowley's Ridge on Pleistocene glacial outwash deposits in Arkansas and Missouri, and on Macon Ridge in Louisiana and Arkansas. The sites are above modern floodplains, but have poor internal drainage and are flat with poor runoff, leading to very wet conditions in winter and spring.

Ecoregion where the habitat occurs: Mississippi Alluvial Plain

Examples of SGCN associated with this habitat type:

Mississippi Kite (*Ictinia mississippiensis*) Weight: Optimal

American Black Bear (*Ursus americanus americanus*) Weight: Optimal

Yellow-billed Cuckoo (*Coccyzus americanus*) Weight: Optimal

American Woodcock (*Scolopax minor*) Weight: Suitable

Black-Western Chicken Turtle (*Deirochelys reticularia miaria*) Weight: Suitable

Cerulean Warbler (*Dendroica cerulea*) Weight: Suitable

Problems Faced:

- Habitat destruction – Conversion of flatwood forests
- Percent of loblolly pine dominance in crown position
- Invasive and exotic non-native shrubs, vines, forbs and grasses
- Removal of historical fire regime
- Current block sizes are minimal

Conservation Actions Needed:

- Protect flatwoods forested habitat
- Reduce percentage of loblolly pine crown dominance
- Reduce percent of non-native vegetation
- Maintain and restore appropriate fire regime
- Increase block sizes through conservation easements and increased management
- Use of forest management to maintain appropriate tree densities and species composition

Habitat Name (Score): Lower Mississippi River Bottomland Depression (840)

Description: This system represents semi-permanently flooded to saturated depressional areas. They are typically created by changes in channels of meandering streams and depending on time since abandonment by the river, character may vary from large oxbow swamps to small saturated swales. These may occur both within and outside the frequently flooded bottoms where they river flows.

Ecoregion where the habitat occurs: Mississippi Alluvial Plain

Examples of SGCN associated with this habitat type:

Prothonotary Warbler (*Protonotaria citrea*) Weight: Optimal

Rafinesque's Big-Eared Bat (*Corynorhinus rafinesquii*) Weight: Optimal

Southeastern Bat (*Myotis austroriparius*) Weight: Optimal

Yellow-crowned Night-heron (*Nyctanassa violacea*) Weight: Suitable

Mississippi Kite (*Ictinia mississippiensis*) Weight: Suitable

Ivory-billed Woodpecker (*Campephilus principalis*) Weight: Suitable

Gulf Crayfish Snake (*Regina rigida sinicola*) Weight: Suitable

Problems Faced:

- Loss of old growth forests
- Potential draining and hydrologic alteration

Conservation Actions Needed:

- Riparian zone protection from excessive management
- Protect portions of old growth forests.

Habitat Name (Score): Lower Mississippi River Dune Woodland and Forest (193)

Description: This system represents the vegetation of sand dunes and related eolian features. These Pleistocene dunes were overlooked or unrecognized until the late 1970s (Saucier 1978). This fact coupled with long periods of weathering and human disturbance, as well as proximity to a terrace mapped as "prairie" in General Land Office records, has led to considerable confusion regarding this type (T. Foti pers. comm.). The dunes support very open Post oak (*Quercus stellata)* woodlands with Little bluestem (*Schizachyrium scoparium*) and abundant lichen cover (presumably *Cladonia spp*.), along with Prickly pear (*Opuntia sp*). Less edaphically extreme slopes support more closed-canopied forests in which Post oak is still important, along with Southern Red oak (*Quercus falcata*) and possibly other species.

Ecoregion where the habitat occurs: Mississippi Alluvial Plain

Examples of SGCN associated with this type:

Gulf Crayfish Snake (*Regina rigida sinicola*) Weight: Suitable

Chimney Swift (*Chaetura pelagica*) Weight: Suitable

Northern Bobwhite (*Colinus virginianus*) Weight: Suitable

Mississippi Kite (*Ictinia mississippiensis*) Weight: Marginal

Rafinesque's Big-Eared Bat (*Corynorhinus rafinesqui*) Weight: Marginal

Problems Faced:

- Very rare community easily converted to agriculture
- Removal of historical fire regime

Conservation Actions Needed:

- Identify locations for conservation easements or fee title purchase
- Return appropriate native species composition
- Maintain and restore appropriate fire regime

Habitat Name (Score): Lower Mississippi River High Bottomland Forest (1,377)

Description: High Bottomlands are often temporarily flooded on older Holocene point bars and natural levees, with flooding less frequent than every 5 years. These floodplains are of particular conservation interest because they have been cleared to a greater extent than riparian or low floodplains because of the reduced flooding of these sites. Also, flood control levees protect many of these sites and with protection from levees almost all sites are cleared. Thus most wetlands remaining in large bottomland areas are riparian or low bottomlands, and the species, communities and other characteristics of high bottomlands have been essentially lost.

Ecoregion where the habitat occurs: Mississippi Alluvial Plain

Examples of SGCN associated with this type:

Yellow-billed Cuckoo (*Coccyzus americanus*) Weight: Optimal

Rafinesque's Big-Eared Bat (*Corynorhinus rafinesquii*) Weight: Optimal

American Black Bear (*Ursus americanus americanus*) Weight: Optimal

Mississippi Kite (*Ictinia mississippiensis*) Weight: Optimal

Woodland Tiger Beetle (*Cicindela unipunctata*) Weight: Suitable

Mole Salamander (*Ambystoma talpoideum*) Weight: Suitable

Cerulean Warbler (*Dendroica cerulea*) Weight: Suitable

Problem Faced:

- Habitat fragmentation and loss due to conversion
- Loss of old growth forests
- Degradation of forest composition and structure through previous management
- Loss of oak dominance in canopy position
- Current block sizes are minimal
- Manage towards more open canopy and structurally diverse conditions

Conservation Actions Needed:

- Manage access to sensitive areas
- Manage forests for a consistent supply of recently dead timber (2-4 years)
- Manage forests to achieve "desired future conditions" as defined for the Mississippi Alluvial Plain by the LMV Joint Venture.
- Provide information on ecosystem importance to the public.
- Reforest cleared lands
- Protect portions of old growth forests.
- Increase block sizes through conservation easements and reforestation efforts

Habitat Name (Score): Lower Mississippi River Low Bottomland Forest (1,370)

Description: "Low Bottomlands" are usually seasonally flooded in backswamps, with flooding more frequent than every 5 years, usually more frequently than every two years, generally by still water that may be impounded behind natural levees, and are classed as Low Gradient Riverine Backwater wetlands in hydrogeomorphic classifications (Klimas and others 2004). Prolonged flooding dominates this system, and its duration is greater that in the adjacent Mississippi River Riparian Forest. Overcup oak (*Quercus lyrata*) is the characteristic dominant species.

Ecoregion where the habitat occurs: Mississippi Alluvial Plain

Examples of SGCN associated with this type:

American Black Bear (*Ursus americanus americanus*) Weight: Obligate

Rafinesque's Big-Eared Bat (*Corynorhinus rafinesquii*) Weight: Optimal

Southeastern Bat (*Myotis austroriparius*) Weight: Optimal

Bird-voiced Treefrog (*Hyla avivoca*) Weight: Optimal

Mole Salamander (*Ambystoma talpoideum*) Weight: Suitable

Ivory-billed Woodpecker (*Campephilus principalis*) Weight: Suitable

Cerulean Warbler (*Dendroica cerulea*) Weight: Suitable

Problems Faced:

- Loss of old growth forests
- Hydrology and drainage problems
- Degradation of forest composition and structure through previous management
- Loss of red oak to Overcup oak (*Q.* lyrata) ratios in canopy position
- Manage towards more open canopy and structurally diverse conditions

Conservation Actions Needed:

- Protect portions of old growth forests
- Restore hydrology and drainage patterns
- Manage forests to achieve "desired future conditions" as defined for the Mississippi Alluvial Plain by the LMV Joint Venture
- Increase block sizes through conservation easements and reforestation efforts

Habitat Name (Score): Lower Mississippi River Riparian Forest (1,137)

Description: This system is composed of "Riverfront" Associations, generally temporarily (but rarely seasonally) flooded on point bars and natural levees adjacent to the river that formed them, with flooding more frequent than every 5 years, by flowing water directly from the stream. They occur along the lower Mississippi River and its tributaries. Giant cane (*Arundinaria gigantea*) is a common understory in these forests on natural levees and higher point bars, and may become dominant after thinning or removal of the overstory. Willow (*Salix spp.*) and Eastern cottonwood (*Populus deltoides*) sandbars may have an open-canopy (woodland-type) structure.

Ecoregion where the habitat occurs: Mississippi Alluvial Plain

Examples of SGCN associated with this type:

American Black Bear (*Ursus americanus americanus*) Weight: Optimal

Bald Eagle (*Haliaeetus leucocephalus*) Weight: Optimal

Swainson's Warbler (*Limnothlypis swainsonii*) Weight: Optimal

Rafinesque's Big-Eared Bat (*Corynorhinus rafinesquii*) Weight: Optimal

Swallow-tailed Kite (*Elanoides forficatus forficatus*) Weight: Optimal

Problems Faced:

- Habitat destruction – Conversion of riparian forests
- Percent increase of sugarberry to cottonwood ratio

Conservation Actions Needed:

- Manage species composition through sugarberry reduction
- Riparian zone protection from excessive management
- Manage forests to achieve "desired future conditions" as defined for the Mississippi Alluvial Plain by the LMV Joint Venture.

Habitat Name (Score): Mississippi River Alluvial Plain Loess Slope Forest (643)

Description: This system of mesic upland forests is confined to a series of narrow ridges along the western margin of the lower Mississippi River on Crowley's Ridge. This vegetation is very distinctive from that of the adjacent alluvial plain, and may represent the only forested terrain in a largely agricultural landscape. It is a remnant loess-capped feature rising from 30 to over 60 m (100-200 feet) above the alluvial plain surface, to about 150 m (50 feet) above sea level. In the ravines and slopes, canopies are dominated by American beech (*Fagus grandifolia*), White oak (*Quercus alba*), and Yellow poplar (*Liriodendron tulipifera*), with many associates. Forests on the ridgetops are dominated by White oak, Northern Red oak (*Quercus rubra*), Southern Red oak (*Quercus falcata*), Black hickory (*Carya texana*), Shortleaf pine (*Pinus echinata*) and Black oak (*Quercus velutina*).

Ecoregion where the habitat occurs: Mississippi Alluvial Plain

Examples of SGCN associated with this type:

Midwest Worm Snake (*Carphophis amoenus helenae*) Weight: Obligate

Spotted Dusky Salamander (*Desmognathus* conanti) Weight: Obligate

Red-headed Woodpecker (Melanerpes erythrocephalus) Weight: Optimal

American Woodcock (*Scolopax minor*) Weight: Suitable

Swainson's Warbler (*Limnothlypis swainsonii*) Weight: Suitable

Problems Faced:

- Removal of historical fire regime
- Conversion to pasture land
- Loss of forest structure due to canopy closure
- Loss of oak dominance in overstory
- Conversion to development

Conservation Actions Needed:

- Create openings in forests and woodlands
- Maintain and restore appropriate fire regime
- Forest management to open canopy promoting oak regeneration
- Use partnership to include forested cover throughout developments
- Maintain areas of cane and high stem densities of native woody species in the midstory
- Manage forests to achieve "desired future conditions" as defined for the Mississippi Alluvial Plain by the LMV Joint Venture.

Habitat Name (Score): Ouachita Montane Oak Forest (418)

Description: This system represents hardwood forests of the highest elevations of the Ouachita Mountains, including Mount Magazine. Vegetation consists of either forests or open woodlands dominated by White oak (*Quercus alba*) or Post oak (*Quercus stellata*). Canopy trees are often stunted (dwarf forests) due to the effects of ice, wind and cold conditions, in combination with fog, shallow soils over rock, and periodic severe drought. Some stands form almost impenetrable thickets. However rare and often in a protected management status in Arkansas, this is a unique forest type rich in biodiversity.

Ecoregion where the habitat occurs: Ouachita Mountains

Examples of SGCN associated with this type:

Fourche Mountain Salamander (*Plethodon fourchensis*) Weight: Optimal

Rich Mountain Salamander (*Plethodon ouachitae*) Weight: Optimal

Southeastern Shrew (*Sorex longirostris*) Weight: Suitable

Western Diamondback Rattlesnake (*Crotalus atrox*) Weight: Suitable

Yellow-billed Cuckoo (*Coccyzus americanus*) Weight: Suitable

Chuck-will's-widow (*Caprimulgus carolinensis*) Weight: Marginal

Problems Faced:

- Invasive and exotic non-native shrubs, vines, forbs and grasses
- Removal of historical fire regime
- Lack of herbaceous ground coverage

Conservation Actions Needed:

- Create openings in forests and woodlands
- Reduce percent of non-native vegetation
- Maintain and restore appropriate fire regime
- Increase native herbaceous plant diversity

Habitat Name (Score): Ouachita Mountain Forested Seep (1,069)

Description: This system of seeps may be found along the bottom slopes of smaller valleys where rock fractures allow water to seep out of the mountainsides. The soil remains saturated to very moist throughout the year. The vegetation is typically forested with highly variable canopy composition. In acid seeps, vegetation is characterized by Carolina Red maple (*Acer rubrum var. trilobum*), Blackgum (*Nyssa sylvatica*), Sweetgum (*Liquidambar styraciflua*), and White oak (*Quercus alba*). Other canopy species may include American beech (*Fagus grandifolia*) and Umbrella magnolia (*Magnolia tripetala*).

Ecoregions where the habitat occurs: Ozark and Ouachita Mountains

Examples of SGCN associated with this type:

Four-toed Salamander (*Hemidactylium scutatum*) Weight: Obligate

Rich Mountain Salamander (*Plethodon ouachitae*) Weight: Optimal

crayfish (*Fallicambarus harpi*) Weight: Optimal

Mole Salamander (*Ambystoma talpoideum*) Weight: Suitable

Yellow-billed Cuckoo (*Coccyzus americanus*) Weight: Suitable

Sequoyah Slimy Salamander (*Plethodon sequoyah*) Weight: Suitable

Problems Faced:

- Invasive and exotic non-native shrubs, vines, forbs and grasses
- Removal of historical fire regime
- Excessive disturbance in and around the seep area

Conservation Actions Needed:

- Reduce percent of non-native vegetation
- Institute protective zones and restrict excessive management

Habitat Name (Score): Ozark Ouachita Dry Oak Woodland (1,284)

Description: This system occurs along gentle to steep slopes and over bluff escarpments with southerly to westerly aspects. It was historically woodland in structure, composition, and process but now includes areas of more closed canopy. Oak species such as Post oak (*Quercus stellata*), Blackjack oak (*Quercus marilandica*), and Scarlet oak (*Quercus coccinea*) dominate this system with an understory of grassland species such as Little Bluestem (*Schizachyrium scoparium*) and shrub species such as Tree huckleberry (*Vaccinium arboretum*).

Ecoregions where the habitat occurs: Ozark and Ouachita Mountains

Examples of SGCN associated with this type:

Indiana Bat (*Myotis sodalis*) Weight: Optimal

Northern Bobwhite (*Colinus virginianus*) Weight: Optimal

Prairie Warbler (*Dendroica discolor*) Weight: Optimal

Bewick's Wren (*Thryomanes bewickii*) Weight: Optimal

Blue-winged Warbler (*Vermivora pinus*) Weight: Optimal

Great Plains Skink (*Eumeces obsoletus*) Weight: Suitable

Problems Faced:

- Loss of old growth forests
- Removal of historical fire regime
- Disturbance to bat hibernacula
- Excessive stem densities of woody plants
- Lack of herbaceous ground coverage
- Canopy closure

Conservation Actions Needed:

- Create openings in forests and woodlands
- Protect portions of old growth forests.
- Maintain and restore appropriate fire regime
- Protect hibernacula and caves used by this species.
- Forest thinning of overstory and midstory
- Reduction of understory non-oak woody competitors
- Maintain diversity in basal area of tree cover across landscape
- Increase native herbaceous plant diversity

Habitat Name (Score): Ozark Ouachita Dry-Mesic Oak Forest (1,149)

Description: This system is the matrix system of these regions and occurs on dry-mesic to mesic gentle to moderately steep slopes. Soils are typically moderately to well-drained and more fertile than those associated with oak woodlands. A closed canopy of oak species including Northern Red oak (*Quercus rubra*) and White oak (*Quercus alba*) often associated with hickory species (*Carya spp.*) typify this system. Sugar maple (*Acer saccharum*) [or Florida maple (*Acer barbatum*) to the south] may occur on more mesic examples of this system.

Ecoregions where the habitat occurs: Ozark and Ouachita Mountains

Examples of SGCN associated with this type:

Prairie Warbler (*Dendroica discolor*) Weight: Optimal

Whip-poor-will (*Caprimulgus vociferus*) Weight: Optimal

Indiana Bat (*Myotis sodalis*) Weight: Suitable

Fourche Mountain Salamander (*Plethodon fourchensis*) Weight: Suitable

Ouachita Pseudactium (*Pseudactium magazinensis*) Weight: Suitable

Chuck-will's-widow (*Caprimulgus carolinensis*) Weight: Suitable

Cerulean Warbler (*Dendroica cerulea*) Weight: Suitable

Problems Faced:

- Loss of old growth forests
- Removal of historical fire regime
- Disturbance to bat hibernacula
- Reduction in oak component
- Excessive stem densities of woody plants
- Lack of herbaceous ground coverage
- Canopy closure

Conservation Actions Needed:

- Create openings in forests and woodlands
- Protect portions of old growth forests.
- Maintain and restore appropriate fire regime
- Protect hibernacula and caves used by this species.
- Forest thinning of overstory and midstory
- Forest management to favor increase in oak component
- Maintain diversity in basal area of tree cover across landscape

Habitat Name (Score): Ozark Ouachita Mesic Hardwood Forest (2,191)

Description: This system is found on toeslopes, valley bottoms and north slopes. Northern Red oak (*Quercus rubra*) increases in abundance compared to dry-mesic habitats, and Sugar maple (*Acer saccharum*) is sometimes a leading dominant. On more alkaline moist soils, Chinkapin oak (*Quercus muehlenbergii*), Florida basswood (*Tilia americana*), and Redbud (*Cercis canadensis*) may be common.

Ecoregions where the habitat occurs: Ozark and Ouachita Mountains

Examples of SGCN associated with this type:

Prairie Warbler (*Dendroica discolor*) Weight: Optimal

Fourche Mountain Salamander (*Plethodon fourchensis*) Weight: Optimal

Ground beetle (*Scaphinotus inflectus*) Weight: Optimal

Caddo Mountain Salamander (*Plethodon caddoensis*) Weight: Optimal

Wood Frog (*Rana sylvatica*) Weight: Optimal

Swamp Metalmark (*Calephelis muticum*) Weight: Suitable

Problem Faced:

- Loss of early successional habitat
- Removal of historical fire regime
- Habitat destruction – Conversion of forests to openlands
- Invasive and exotic shrubs, woody vines, forbs and grasses
- Excessive stem densities of woody plants
- Canopy closure

Conservation Actions Needed:

- Manage for early successional habitat
- Create openings in forests and woodlands
- Maintain diversity in basal area of tree cover across landscape
- Reduce percent coverage of invasive and exotic plant species
- Maintain and restore appropriate fire regime
- Manage forests to achieve "desired future conditions" as defined for the Mississippi Alluvial Plain by the LMV Joint Venture.

Habitat Name (Score): Ozark Ouachita Pine/Bluestem Woodland (728)

Description: This system is composed of pine-dominated woodlands with intermittent canopy and abundant herbaceous groundcover, few or no hardwoods among dominant canopy trees. The habitat component is associated with early successional conditions, with a mature pine overstory. Fire is important to maintaining open canopy and allowing prairie species to flourish.

Ecoregions where the habitat occurs: Ozark and Ouachita Mountains

Examples of SGCN associated with this type:

Red-cockaded Woodpecker (*Picoides borealis*) Weight: Obligate

Red-headed Woodpecker (*Melanerpes erythrocephalus*) Weight: Optimal

Western Slender Glass Lizard (*Ophisaurus attenuatus attenuatus*) Weight:Optimal

Bachman's Sparrow (*Aimophila aestivalis*) Weight: Optimal

Northern Bobwhite (*Colinus virginianus*) Weight: Optimal

Seminole Bat (*Lasiurus seminolus*) Weight: Suitable

Problems Faced:

- Loss of shortleaf pine/bluestem communities from fire suppression
- Encroachment of woody midstory and understory species
- Invasive and exotic shrubs, woody vines, forbs and grasses
- Lack of herbaceous ground coverage

Conservation Actions Needed:

- Maintain or restore historical fire regimes
- Maintain open, mature pine forest habitat
- Maintain or restore shortleaf pine/bluestem communities
- Reduce percent coverage of invasive and exotic plant species
- Increase native herbaceous plant diversity

Habitat Name (Score): Ozark Ouachita Pine-Oak Forest (1,082)

Description: This system represents forests and woodlands in which Shortleaf pine (*Pinus echinata*) is an important or dominant component. Shortleaf pine occurs with a variable mixture of hardwood species. The exact composition of the hardwoods is much more closely related to aspect and topographic factors than is the pine component.

Ecoregions where the habitat occurs: Ozark and Ouachita Mountains

Examples of SGCN associated with this type:

Prairie Warbler (*Dendroica discolor*) Weight: Optimal

Seminole Bat (*Lasiurus seminolus*) Weight: Suitable

EasternTowhee (*Pipilo erythrophthalmus*) Weight: Suitable

Kiamichi Slimy Salamander (*Plethodon kiamichi*) Weight: Suitable

Chuck-will's-widow (*Caprimulgus carolinensis*) Weight: Suitable

Western Diamondback Rattlesnake (*Crotalus atrox*) Weight: Suitable

Problems Faced:

- Loss of old growth forests
- Loss of early successional habitat and/or pine and oak regeneration
- Encroachment of non-pine-oak woody midstory and understory species
- Removal of historical fire regime
- Canopy closure
- Encroachment of off-site Loblolly pine (*P. taeda*)

Conservation Actions Needed:

- Manage for early successional habitat
- Maintain or restore historical fire regime
- Protect portions of old growth forests.
- Create openings in forests and woodlands
- Maintain diversity in basal area of tree cover across landscape
- Reduction in basal area of Loblolly pine (*P. taeda*)

Habitat Name (Score): Ozark Ouachita Pine-Oak Woodland (484)

Description: This system is composed of pine, pine-oak, or oak-pine dominated woodlands with intermittent canopy and abundant herbaceous groundcover. It is intermediate in character between Ozark-Ouachita Pine-Oak Forest and Ozark-Ouachita Pine-Bluestem Woodland, having greater herbaceous understory than the former and fewer early successional species than the latter. The open canopy and herbaceous diversity are maintained by frequent fires.

Ecoregions where the habitat occurs: Ozark and Ouachita Mountains

Examples of SGCN associated with this type:

Northern Bobwhite (*Colinus virginianus*) Weight: Suitable

Red-headed Woodpecker (*Melanerpes erythrocephalus*) Weight: Suitable

Painted Bunting (*Passerina ciris*) Weight: Suitable

Chuck-will's-widow (*Caprimulgus carolinensis*) Weight: Suitable

Texas Frosted Elfin (*Callophrys irus hadros*) Weight: Suitable

Ringed Salamander (*Ambystoma annulatum*) Weight: Suitable

Problems Faced:

- Loss of early successional habitat and/or pine and oak regeneration
- Encroachment of non-pine-oak woody midstory and understory species
- Removal of historical fire regime
- Canopy closure
- Encroachment of off-site Loblolly pine (*P. taeda*)
- Encroachment of woody midstory and understory species
- Invasive and exotic shrubs, woody vines, forbs and grasses
- Lack of herbaceous ground coverage

Conservation Actions Needed:

- Maintain or restore historical fire regime
- Create openings in forests and woodlands
- Maintain diversity in basal area of tree cover across landscape
- Reduction in basal area of Loblolly pine (*P. taeda*)
- Reduction of understory non-pine-oak woody competitors
- Increase native herbaceous plant diversity
- Reduce percent coverage of invasive and exotic plant species

Habitat Name (Score): Ozark Ouachita Riparian (3,201)

Description: This system is found along streams and small rivers. In contrast to larger floodplain systems, this system has little to no floodplain development and often contains cobble bars and steep banks. It is traditionally higher gradient than larger floodplains and experiences periodic, strong flooding. It is often characterized by a cobble bar with forest right adjacent with little to no marsh development. Canopy cover can vary within examples of this system, but typical tree species include Sweetgum (*Liquidambar styraciflua*), Sycamore (*Platanus occidentalis*), River birch (*Betula nigra*), maples (*Acer spp.*), and oaks (*Quercus spp.*).

Ecoregions where the habitat occurs: Ozark and Ouachita Mountains

Examples of SGCN associated with this type:

Ozark Pocket Gopher (*Geomys bursarius ozarkensis*) Weight: Obligate

Ozark Snaketail Dragonfly (*Ophiogomphus westfalli*) Weight: Obligate

Kentucky Warbler (*Oporornis formosus*) Weight: Optimal

Kiamichi Slimy Salamander (*Plethodon kiamichi*) Weight: Optimal

Wood Thrush (*Hylocichla mustelina*) Weight: Optimal

Queen Snake (*Regina septemvittata*) Weight: Optimal

Gray Bat (*Myotis grisescens*) Weight: Suitable

Problems Faced:

- Habitat destruction – Conversion of riparian forests
- Excessive disturbance within riparian zone
- Invasive, exotic shrubs, vines, forbs and grasses

Conservation Actions Needed:

- Protect riparian forest habitat
- Reduce pesticide use near riparian areas
- Impose limitations to excessive use and management
- Impose strict enforcement of state's Best Management Practices
- Reduce percent coverage of invasive and exotic plant species

Habitat Name (Score): South-Central Interior Large Floodplain (1,267)

Description: This floodplain system occurs along large rivers where topography and alluvial processes have resulted in a well-developed floodplain. A single occurrence may extend from river's edge across the outermost extent of the floodplain or to where it meets a wet meadow or upland system. Many examples of this system will contain well-drained levees, terraces and stabilized bars, and some will include herbaceous sloughs and shrub wetlands resulting, in part, from beaver activity. Although vegetation is quite variable in this broadly defined system, examples may include Silver maple (*Acer saccharinum*), Sycamore (*Platanus occidentalis*), Sweetgum (*Liquidambar styraciflua*), and oaks (*Quercus spp.*). Understory species are mixed, but include shrubs, such as Buttonbush (*Cephalanthus occidentalis*) and Giant cane (*Arundinaria gigantea*). Canes and sedges (*Carex spp.*). This system inhabits broad floodplains along large creeks and rivers that are usually inundated for at least part of each year.

Ecoregions where the habitat occurs: Ozark and Ouachita Mountains

Examples of SGCN associated with this type:

Rafinesque's Big-Eared Bat (*Corynorhinus rafinesquii*) Weight: Optimal

Bird-voiced Treefrog (*Hyla avivoca*) Weight: Optimal

Red-headed Woodpecker (*Melanerpes erythrocephalus*) Weight: Optimal

Swainson's Warbler (*Limnothlypis swainsonii*) Weight: Suitable

Gulf Crayfish Snake (*Regina rigida sinicola*) Weight: Suitable

Yellow-crowned Night-heron (*Nyctanassa violacea*) Weight: Suitable

Problems Faced:

- Loss of old growth forests
- Habitat destruction – Conversion of riparian forests
- Canopy closure
- Invasive and exotic shrubs, vines, forbs and grasses

Conservation Actions Needed:

- Create openings in forests and woodlands
- Protect portions of old growth forests.
- Protect riparian forest habitat
- Reduce pesticide use near riparian areas
- Impose strict enforcement of state's Best Management Practices
- Reduce percent coverage of invasive and exotic plant species
- Create openings in forests and woodlands through forest management
- Manage forests to achieve "desired future conditions" as defined for the Mississippi Alluvial Plain by the LMV Joint Venture.

Habitat Name (Score): West Gulf Coastal Plain Dry Pine-Hardwood Flatwoods (458)

Description: This system represents predominately dry flatwoods usually found on Pleistocene high terraces, typically outside the floodplain. Drier sites support Loblolly pine (*Pinus taeda*) and Post oak (*Quercus stellata*); more mesic sites have Shortleaf pine (*Pinus echinata*) with Willow oak (*Quercus phellos*) and species such as Sweet leaf (*Symplocos tinctoria*) and Southern arrow-wood (*Viburnum dentatum*). Fire is an important natural process in this system (T. Foti pers. comm.). Embedded swales tend to support hardwood forests or swamps, often heavily oak-dominated with species tolerant of some inundation such as Willow oak and Laurel oak (*Quercus laurifolia*) with sparse coverage of wetland herbs such as Southern Waxy sedge (*Carex glaucescens*).

Ecoregion where the habitat occurs: Upper West Gulf Coastal Plain

Examples of SGCN associated with this type:

Red-cockaded Woodpecker (Picoides borealis) Weight: Obligate

Seminole Bat (Lasiurus seminolus) Weight: Optimal

American Woodcock (Scolopax minor) Weight: Suitable

Brown-headed Nuthatch (Sitta pusilla) Weight: Suitable

Bachman's Sparrow (Aimophila aestivalis) Weight: Suitable

Northern Bobwhite (Colinus virginianus) Weight: Marginal

Problems Faced:

- Lack of herbaceous groundcover with minimal woody plants
- Removal of historical fire regime
- Habitat destruction – Conversion of flatwood forests
- Invasive and exotic non-native shrubs, vines, forbs and grasses

Conservation Actions Needed:

- Maintain or restore historical fire regime
- Increase and maintain percent of non-woody herbaceous understory
- Protect flatwoods forested habitat
- Reduce percent of non-native vegetation
- Use of forest management to maintain appropriate tree densities and species composition

Habitat Name (Score): West Gulf Coastal Plain Large River Floodplain Forest (1,186)

Description: This system represents broad bottomlands along larger rivers such as the Saline and Ouachita. The Red River is considered as another habitat type. Several distinct plant communities are recognized within this system that may be related to the array of different geomorphic features present within the floodplain. Vegetation generally includes forests dominated by bottomland hardwood species and other trees tolerant of flooding.

Ecoregion where the habitat occurs: Upper West Gulf Coastal Plain

Examples of SGCN associated with this type:

Yellow-billed Cuckoo (*Coccyzus americanus*) Weight: Optimal

Kentucky Warbler (*Oporornis formosus*) Weight: Optimal

Bird-voiced Treefrog (*Hyla avivoca*) Weight: Optimal

Southeastern Bat (*Myotis austroriparius*) Weight: Optimal

American Black Bear (*Ursus americanus americanus*) Weight: Optimal

Problems Faced:

- Habitat fragmentation and loss due to conversion
- Loss of old growth forests
- Degradation of forest composition and structure through previous management
- Loss of oak dominance in canopy position
- Current block sizes are minimal
- Manage towards more open canopy and structurally diverse conditions
- Habitat destruction – Conversion of bottomland forests

Conservation Actions Needed:

- Create openings in forests and woodlands
- Protect riparian forest habitat
- Reduce pesticide use near riparian areas
- Manage access to sensitive areas
- Manage forests to achieve "desired future conditions" as defined for the Mississippi Alluvial Plain by the LMV Joint Venture.
- Provide information on ecosystem importance to the public.
- Reforest cleared lands
- Protect portions of old growth forests.
- Increase block sizes through conservation easements and reforestation efforts

Habitat Name (Score): West Gulf Coastal Plain Mesic Hardwood Forest (546)

Description: This ecological system is found in limited upland areas, especially side slopes and narrow ridgetops. These areas were somewhat protected topographically from historically fire-prone, pine-dominated uplands. Sites are often found along slopes above perennial streams in the region. Vegetation indicators are mesic hardwoods such as American beech (*Fagus grandifolia*), White oak (*Quercus alba*), and American holly (*Ilex opaca*), although scattered, large-diameter pines, often Loblolly pine (*Pinus taeda*) are also often present.

Ecoregion where the habitat occurs: Upper West Gulf Coastal Plain

Examples of SGCN associated with this type:

Hooded Warbler (*Wilsonia citrina*) Weight: Optimal

Yellow-billed Cuckoo (*Coccyzus americanus*) Weight: Optimal

Wood Thrush (*Hylocichla mustelina*) Weight: Optimal

Louisiana Slimy Salamander (*Plethodon kisatchie*) Weight: Optimal

Southeastern Bat (*Myotis austroriparius*) Weight: Suitable

American Woodcock (*Scolopax minor*) Weight: Suitable

Problems Faced:

- Loss of old growth forests
- Habitat destruction – Conversion of riparian forests
- Invasive and exotic shrubs and vines

Conservation Actions Needed:

- Create openings in forests and woodlands
- Protect portions of old growth forests.
- Reduce percent of non-native vegetation
- Use of forest management to maintain appropriate tree densities and species composition

Habitat Name (Score): West Gulf Coastal Plain Pine-Hardwood Forest (808)

Description: This ecological system consists of forests and woodlands dominated by Loblolly pine (*Pinus taeda*) and/or Shortleaf pine (*Pinus echinata*) in combination with a host of dry to dry-mesic site hardwood species. This type was the historical matrix (dominant vegetation type). This habitat was historically present on nearly all uplands in the region except on the most edaphically limited sites. This system has undergone major transformations since European settlement of the region and has been largely converted to cultivated pine plantations.

Ecoregion where the habitat occurs: Upper West Gulf Coastal Plain

Examples of SGCN associated with this type:

Red-cockaded Woodpecker (*Picoides borealis*) Weight: Obligate

Seminole Bat (*Lasiurus seminolus*) Weight: Optimal

Prairie Warbler (*Dendroica discolor*) Weight: Optimal

Texas Frosted Elfin (*Callophrys irus hadros*) Weight: Suitable

American Black Bear (*Ursus americanus americanus*) Weight: Suitable

Giant Stag Beetle (*Lucanus elephus*) Weight: Suitable

Problems Faced:

- Loss of old growth forests
- Changes in species composition
- Conversion to cultivated pine plantations
- Loss of native Shortleaf pine (*P. echinata*) component
- Canopy closure
- Removal of historic fire regime

Conservation Actions Needed:

- Maintain or restore historic fire regime
- Create openings in forests and woodlands
- Protect portions of old growth forests.
- Begin thinning plantations as early as possible
- Maintain through conservation easements or fee title purchase areas managed towards older age class pine woodlands and forests with the inclusion of prescribed fire.

Habitat Name (Score): West Gulf Coastal Plain Red River Floodplain Forest (1,071)

Description: This system represents a geographic subset of Kuchler's (1964) Southern Floodplain Forest which is specifically restricted to the main stem of the Red River in southwestern Arkansas. Vegetation generally includes forests dominated by bottomland hardwood species and other trees tolerant of flooding, including Bald-cypress (*Taxodium distichum*) and Water tupelo (*Nyssa aquatica*). Nearly all this habitat has been converted to row crops.

Ecoregion where the habitat occurs: Upper West Gulf Coastal Plain

Examples of SGCN associated with this type:

Wood Thrush (*Hylocichla mustelina*) Weight: Optimal

Hooded Warbler (*Wilsonia citrina*) Weight: Optimal

Southern Prairie Skink (*Eumeces obtusirostris*) Weight: Suitable

Rusty Blackbird (*Euphagus carolinus*) Weight: Suitable

Gulf Crayfish Snake (*Regina rigida sinicola*) Weight: Suitable

Duke's Skipper (*Euphyes dukesi*) Weight: Suitable

Cerulean Warbler (*Dendroica cerulea*) Weight: Suitable

Problems Faced:

- Loss of old growth forests
- Hydrology and drainage problems
- Degradation of forest composition and structure through previous management
- Loss of red oak to Overcup oak (*Q. lyrata*) ratios in canopy position
- Closed canopy and lack of structural diversity

Conservation Actions Needed:

- Protect portions of old growth forests.
- Restore drainage and increase rodent control
- Manage forests to achieve "desired future conditions" as defined for the Mississippi Alluvial Plain by the LMV Joint Venture.
- Increase block sizes through conservation easements and reforestation efforts
- Manage towards more open canopy and structurally diverse conditions

Habitat Name (Score): West Gulf Coastal Plain Sandhill Oak and Shortleaf Pine Forest and Woodland (334)

Description: This ecological system occurs west of the Mississippi River. This habitat occurs on uplands underlain with deep, coarse sandy soils. Vegetation indicators are species tolerant of droughty sites, especially Bluejack oak (*Quercus incana*) and Arkansas oak (*Quercus arkansana*). Shortleaf pine (*Pinus echinata*) is usually present. This habitat is characterized by relatively open wooded canopies (<60% closure) and may be essentially treeless. Fire is a critical natural disturbance process which affects the vegetation.

Ecoregion where the habitat occurs: Upper West Gulf Coastal Plain

Examples of SGCN associated with this type:

Texas Coral Snake (*Micrurus tenere tenere*) Weight: Optimal

Chuck-will's-widow (*Caprimulgus carolinensis*) Weight: Suitable

Red-headed Woodpecker (*Melanerpes erythrocephalus*) Weight: Suitable

Georgia Satyr (*Neonympha areolata areolata*) Weight: Suitable

Hurter's Spadefoot (*Scaphiopus hurterii*) Weight: Suitable

Northern Bobwhite (*Colinus virginianus*) Weight: Marginal

Problems Faced:

- Removal of historic fire regime
- Conversion to Loblolly pine (*P. taeda*) plantation
- Increase in tree density
- Canopy closure
- Degradation of forest composition and structure

Conservation Actions Needed:

- Maintain or restore historic fire regime
- Create openings in forests and woodlands
- Begin thinning plantations as early as possible
- Maintain areas managed towards older age class pine woodlands and forests with the inclusion of fire through conservation easements or fee title purchases
- Use of forest management to maintain appropriate tree densities and composition

Habitat Name (Score): West Gulf Coastal Plain Seepage Swamp and Baygall (630)

Description: This habitat consists of forested wetlands (often densely wooded) in acidic seepage influenced wetland habitats. These wetlands may occur in poorly developed upland drainages, toe-slopes, and small headwaters stream bottoms. The vegetation is characterized by Sweetbay (*Magnolia virginiana*), Black gum (*Nyssa sylvatica*), Swamp black gum (*Nyssa biflora*), and Red maple (*Acer rubrum*), although there is some variation according to latitude. Due to excessive wetness, these habitats are normally protected from fire except those which occur during dry years.

Ecoregion where the habitat occurs: Upper West Gulf Coastal Plain

Examples of SGCN associated with this type:

Spotted Dusky Salamander (*Desmognathus conanti*) Weight: Obligate

Western Chicken Turtle (*Deirochelys reticularia miaria*) Weight: Optimal

crayfish (*Fallicambarus gilpini*) Weight: Suitable

Rafinesque's Big-Eared Bat (*Corynorhinus rafinesquii*) Weight: Optimal

Dwarf Salamander (*Eurycea quadridigitata*) Weight: Optimal

Problems Faced:

- Habitat destruction – Conversion of riparian forests
- Alteration of natural hydrology
- Major soil disturbance

Conservation Actions Needed:

- Protect riparian forest habitat
- Reduce pesticide use near riparian areas

Habitat Name (Score): West Gulf Coastal Plain Small Stream/River Forest (1,056)

Description: This is a forested habitat associated with small rivers and creeks. Bottomland hardwood tree species are typically important and diagnostic, although mesic hardwood species are also present in areas with less inundation, such as upper terraces and possibly second bottoms.

Ecoregion where the habitat occurs: Upper West Gulf Coastal Plain

Examples of SGCN associated with this type:

Mole Salamander (*Ambystoma talpoideum*) Weight: Optimal

Dwarf Salamander (*Eurycea quadridigitata*) Weight: Optimal

Ozark Clubtail Dragonfly (*Gomphus ozarkensis*) Weight: Optimal

Western Chicken Turtle (*Deirochelys reticularia miaria*) Weight: Suitable

Swainson's Warbler (*Limnothlypis swainsonii*) Weight: Suitable

Yehl Skipper (*Poanes yehl*) Weight: Suitable

Problems Faced:

- Habitat destruction – Conversion of riparian forests
- Alteration of natural hydrology
- Major soil disturbance

Conservation Actions Needed:

- Protect riparian forest habitat
- Reduce pesticide use near riparian areas
- Restore damaged stream banks

Habitat Name (Score): West Gulf Coastal Plain Wet Hardwood Flatwoods (507)

Description: These habitats are usually found on Pleistocene high terraces outside the floodplains. The local landscape is often a series of ridges and swales. Most examples support hardwood forests or swamps, which are often heavily oak-dominated. Important species are tolerant of inundation. They include Willow oak (*Quercus phellos*) and Laurel oak (*Quercus laurifolia*) with sparse coverage of wetland herbs such as Southern Waxy sedge (*Carex glaucescens*).

Ecoregion where the habitat occurs: Upper West Gulf Coastal Plain

Examples of SGCN associated with this type:

Red-headed Woodpecker (*Melanerpes erythrocephalus*) Weight: Suitable

Rafinesque's Big-Eared Bat (*Corynorhinus rafinesquii*) Weight: Suitable

Northern Pintail (*Anas acuta*) Weight: Suitable

Mole Salamander (*Ambystoma talpoideum*) Weight: Suitable

American Woodcock (*Scolopax minor*) Weight: Suitable

Western Chicken Turtle (*Deirochelys reticularia miaria*) Weight: Suitable

Problems Faced:

- Loss of old growth forests
- Conversion to bedded pine plantation
- Loss of hydrologic function

Conservation Actions Needed:

- Create openings in forests and woodlands
- Protect portions of old growth forests.
- Protect portions of restorable forests with fee title or easement purchase

Appendix D
Arkansas Forest Legacy Program
Assessment of Need

FOREST LEGACY PROGRAM
ASSESSMENT OF NEED

FOR THE STATE OF ARKANSAS

The Arkansas Forestry Commission offers its programs to all eligible persons regardless of race, color, national origin, sex, age, or disability; and is an Equal Opportunity Employer.

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EXECUTIVE SUMMARY

In 1990 the Forest Legacy Program (FLP) was established to promote the long-term integrity of forest lands. The Secretary of the U.S. Department of Agriculture (USDA) was directed to establish the FLP in cooperation with state, regional, and other units of government. Landowner participation in the FLP, including the sale of lands and interests in lands, is done entirely on a willing seller, willing buyer basis. The program is implemented through state participation, consistent with National FLP guidelines, and as described in this Assessment of Need (AON). The FLP identifies and protects environmentally important private forestlands that are threatened by conversion to non-forest uses and provides the opportunity for continuation of traditional forest uses such as forest management activities, and outdoor recreation.

The goal of Arkansas' Forest Legacy Program is to focus on environmentally important forest areas that can be effectively protected and managed which have important forest values such as forest based economies, water quality, ground water recharge potential, wildlife, biological diversity and integrity of landscapes, connection to existing forested conservation areas, aesthetics, geologic values, cultural resources, educational, and recreational values threatened by present or future conversion to non-forest uses as viewed by the state. Arkansas geology naturally divides the state into four major ecoregions, they are: the Ozark Mountains, the Ouachita Mountains, the Mississippi Alluvial Valley, and the Upper West Gulf Coastal Plain. With these ecoregions, seven areas have been identified as meeting Arkansas' goal. These areas are designated as Forest Legacy Areas (FLAs) and encompass just under 8.24 million acres of which approximately 4.6 million acres are forested. Selection of FLAs were based on prior ecoregional assessments of water sheds, streams, groundwater recharge areas, wildlife, recreation, aesthetics, geology, biodiversity, threatened and endangered species, unique plant and animal communities, and cultural resources conducted by a wide range of state agencies involved in natural resources management.

Threats to Arkansas forestlands were assessed by the State Stewardship Committee for each FLA. The major threats to Arkansas' forests are: Fragmentation, Parcelization, and Urban and Exurban Sprawl.

Projects will be ranked based on the national ranking criterion. The three criteria are: 1.) Importance; 2.) Threatened; 3.) Strategic. There is a possible 30 points for each criterion. Each State can submit a maximum of three projects per year. The total combined value cannot exceed $10 million. Regardless of how many projects are submitted, no project may exceed $7 million individually. Projects are ranked at the state level before going to the USDA Forest Service where it will compete nationally against other state projects for Forest Legacy funding.

Arkansas' AON scientifically justifies a need in the state and serves as a tool to focus attention on the conservation needs of Arkansas' forest resources. Specifically, the purposes of the AON are: To document the need for a Forest Legacy Program in Arkansas; To identify and delineate areas important to Arkansas that meet the eligibility requirements for designation as Forest Legacy Areas; and, To recommend areas to the USDA Forest Service for inclusion in the Forest Legacy Program. Once the AON has been approved projects may be submitted for funding. To be eligible for FLP the lands or interest in lands must fall within in a designated FLA.

1. INTRODUCTION

a. Purpose of the Forest Legacy Program

The Forest Legacy Program was created to protect environmentally important private forest lands from conversion to non forest uses and to promote protection of forestland and other conservation opportunities. These opportunities include protection of important ecological, scenic, cultural, fish, wildlife, water quality, and recreational resources. Almost 60% of Arkansas' 18.4 million acres of forest lands are in private ownership; the following are pressures that private landowners are facing that threaten to convert forest lands to nonforest uses:

- Fragmentation
  - ✓ Higher monetary value;
- Parcelization
  - ✓ Land that is divided into smaller parcels
- Urban/Exurban Sprawl
  - ✓ Greater population density/mobility

Good stewardship of privately held forest lands requires a long-term commitment that can be fostered through a partnership of Federal, State, and local government efforts.
In 1990, the Forest Legacy Program was one of several programs established by the USDA to promote the long-term integrity of forestlands. The Secretary of Agriculture, in conjunction with the USDA Forest Service, was directed to establish a Forest Legacy Program in cooperation with state, regional, and other units of government. In carrying out this mandate, the Secretary has been authorized to acquire lands and interests in lands through Fee Purchases or Conservation Easements in perpetuity for inclusion in the Forest Legacy Program.

To be eligible for FLP, properties and interests in lands must be located within identified Forest Legacy Areas (FLAs). These are defined as "a geographic area with important forest and environmental values that satisfies identified Eligibility Criteria and has been delineated, described, and mapped". These lands may be acquired under Forest Legacy Program (FLP) authority by the State (or other governmental entity), only on a willing seller/willing buyer basis. Landowner participation in the Forest Legacy Program, including the sale of lands and interests in lands, is entirely voluntary

b. Background on Creation of the Program

Appreciation for the intrinsic value of the rich, diverse landscapes of Arkansas was evident even before "The Natural State" became the marketing strategy for the state's tourism industry in 1982. In Arkansas, forests are an integral part of this mosaic. The Forest Legacy Program offers an excellent opportunity to ensure that significant measures can be taken to preserve the integrity of Arkansas' forestlands for future generations.
The state of Arkansas is blessed with a vast forest resource covering 18.4 million acres, more than half which is held by private landowners. The forest products industry is the second largest manufacturer in the state. The forest products industry directly accounts for more than 40,000 jobs, a $1.17 billion payroll in 1995, and contributed $4 billion to the Arkansas economy. In addition to timber, other resources are highly valued by the State, e.g. outdoor recreation, water quality, wildlife, aesthetics, and biodiversity.

However, these values are increasingly threatened by a number of factors including habitat fragmentation, ownership parcelization, human population demographics (urban sprawl), and management (or lack thereof) that does not protect all the values of environmentally important forests. Although largely a rural state, there are areas facing negative impacts from development and population increases forcing the conversion of forests to non-forest uses. An additional threat is conversion of multiple value forests to those with a narrower range of values.

Nationally, the loss of forest land has been recognized as a concern for at least a century. During the 1900s, various programs and laws were established at the federal, state, and local levels to protect and maintain forestlands. More recently, the Forestry Assistance Act of 1978, as amended, (16 U.S.C. 2103c et.seq.) provided authority for the USDA to give financial, technical, educational, and related assistance to states, communities, and private forest landowners.

Although beneficial, some issues still had not been addressed. In response to those needs, Section 1217 of Title XII of the Food, Agriculture, Conservation and Trade Act of 1990 (P.L. 101-624:104 stat.3359) also referred to as the 1990 Farm Bill, amended the Cooperative Forestry Assistance Act to allow the Secretary of Agriculture to establish the Forest Legacy Program to protect environmentally important forest areas threatened by conversion to non-forest uses through the use of conservation easements and other mechanisms. The goal of the legislation was to protect scenic, cultural, fish, wildlife, water quality, and recreational resources. This authority continues indefinitely, and permitted the outright purchase of threatened forest land (or development rights via conservation easements) by federal agencies. This legislation was further amended in 1996 to allow state agencies to hold the title or easement on properties in the program.

Through the 1996 Farm Bill (federal Agriculture Improvement and Reform Act of 1996; Public Law 104-127); Title III – Conservation; Subtitle G – Forestry; Section 374, Optional State Grant for Forest Legacy Program), the Secretary is authorized, at the request of a participating State, to make a grant to the State to carry out the Forest Legacy Program in the State, including the acquisition by the State of lands and interest in lands.

Arkansas has requested the State Grant Option. In 2004, Governor Mike Huckabee petitioned the USDA Forest Service to allow Arkansas to participate in the Forest Legacy Program with the Arkansas Forestry Commission as the Lead Agency. The Forest Service approved the request pending the development of an Assessment of Need document and its approval.

A Forest Legacy Committee was selected from the State Forest Stewardship Coordinating Committee (SFSCC) to develop the Assessment of Need (AON) document. Additional committee members were recruited from natural resource agencies and organizations with conservation easement experience. The committee represents a cross-section of ownership classes, field training, and expertise for all of Arkansas' natural resources. This document is a product of the input from all these experts dedicated to the conservation of Arkansas' natural resources. Committee members and contact information are included in the Appendix A of the Assessment of Need.

Arkansas' Forest Legacy Program is delivered to the ground through the creation of Forest Legacy Areas (FLAs). The FLAs were created based on the many values of Arkansas' forests recognized by the Arkansas Forest Stewardship Coordinating Committee. Public and private lands under conservation protection, population growth and density, extraordinary resource waters, groundwater recharge zones, and watersheds, USDA Conservation Programs, rare species (animal, plant, and community) element occurrences, scenic areas, timber production, wildlife resources, geologic attributes, cultural resources, and recreational assets were all considered in the design of the FLAs.

Preceding the Forest Legacy Program in Arkansas (1999-2003), agency scientists from Arkansas Natural Heritage Commission, Arkansas Game & Fish Commission, Arkansas Soil & Water Conservation Commission, USDI Fish & Wildlife Service, USDA Forest Service, USDA Natural Resources Conservation Service, The Nature Conservancy, Arkansas Forestry Commission, and Arkansas Department of Environmental Quality participated in a series of ecoregional assessments that focused on biodiversity. From these ecoregional assessments, areas were designated by the group as environmentally important. The development of these areas included environmental factors such as species element occurrence data, soils, geology, ownership, stream courses, watersheds, and water recharge areas and their relationships to one another. Since the assessments contain much of the material needed to design the Forest Legacy Areas (FLAs), and well over one half of these areas are forested, the Forest Stewardship Committee used them in conjunction with other spatial data, such as population density, timber resources, aesthetics, cultural resources, and wildlife to define Arkansas' FLAs.

2. PROGRAM DIRECTION

The federal guidelines for the Forest Legacy Program establish the program's purpose: to ascertain and protect environmentally important forest areas that are threatened by conversion to non-forest uses and promote protection of forestland and other conservation opportunities, such as protecting important ecological values and scenic, cultural, fish, wildlife, water quality, and recreational resources. Traditional forest uses, including timber management, are usually accepted as consistent with the purpose of the program. As a result, the Forest Legacy Program can help protect both the traditional uses of private forestlands and the public values that those lands provide.

GOAL/OBJECTIVES

The goal and objectives listed below are the basis for implementing the Forest Legacy Program in Arkansas. They provide a vision for managing the state program: The goal defines the program direction, and the objectives declare how that intention should be met and provide tactical direction.

a. GOAL

Arkansas' goal for the Forest Legacy Program is to focus on environmentally important forest areas that can be effectively protected and managed which have important values such as forest based economies, water quality, ground water recharge potential, wildlife, biological diversity and integrity of landscapes, connection to existing forested conservation areas, aesthetics, geologic values, cultural resources, educational, and recreational values threatened by present or future conversion to non-forest uses. Our intent is to address all values and not just traditional values. The specific values listed below have been identified by the SFSCC as important to the citizens of Arkansas. This list does not indicate or imply any order of importance.

- Forest based economies;
- Water quality values within the forest;
- Ground water recharge areas;
- Wildlife (including rare, threatened, and endangered species);
- Biological diversity and integrity of landscapes;
- Connection to existing forested conservation areas;
- Aesthetic values of forested landscapes;
- Geologic Values;
- Cultural Resources;
- Legal rights of willing sellers;
- Environmental education;
- Forest-based recreation;

Priority forests should be working forests that exhibit multiple values and provide opportunities for the continuation of traditional forest uses, such as science-based forest management, sustainable timber harvesting, and outdoor recreation.

b. OBJECTIVES

While the goal gives the general intent of the program, the objectives sharpen the vision of the program by identifying the kinds of lands to include in the program. One or more objectives have been identified for each value that was stated earlier. Although the list below separates the objectives by value, close examination will show how these objectives are tied to each value and reflect the program's goal.

Forest based economies

- Promote the continued or potential use of lands for sustainable commodity production (working forest).
- Link working forest landscapes
- Sustain or enhance forest based employment
- Protect the economic value of all forest uses

Water quality values within the forest

- Protect important riparian forest functions
- Maintain forested wetlands
- Protect watersheds of state identified extraordinary resource waters

Ground water recharge areas

- Enhance recharge benefits to important aquifers and/or enhance protection of priority watersheds.
- Protect important karst (cave) recharge areas.

Wildlife

- Provide access for hunting and wildlife viewing as appropriate for public benefit and to maintain game animal populations.
- Protect rare, threatened and endangered animals & their key habitat
- Protect, enhance and/or buffer important habitat.
- Promote appropriate forest management practices for wildlife.
- Promote and maintain wildlife corridors.

Biological diversity and integrity of landscapes

- Protect rare or important forested ecological systems and their functions.
- Protect species and biological communities at a scale that ensures species viability.
- Protect landscape scale areas that support native species and natural communities.

Connection to existing forested conservation areas

- Link permanently protected forested conservation areas, public and private.
- Add new tracts as a part of an organized planning effort or "Initiative" to create additional conservation areas.

Aesthetic values of forested landscapes

- Protect lands with special scenic values.

Geologic values

- Maintain, protect, and provide access to outstanding geologic attributes for public education, and recreation as appropriate, e.g. important karst formations, and exposed rock outcrops.

Cultural resources

- Protect existing prehistoric/historic cultural sites
- As new sites are found, protect, record, and add to cultural resource database.
- Provide access for public education as appropriate.

Legal rights of willing sellers

- Protect the voluntary nature of the program.
- Provide landowners with alternatives to development of forest properties through conservation easements or fee title purchase.

Environmental education

- Provide models of multiple-use forestry to the public
- Allow access for outdoor education for a wide range of user groups as appropriate.

Forest-based Recreation

- Allow recreational opportunities whenever appropriate.
- Increase public access accordingly.

3. PAST & PRESENT FOREST RESOURCE CONDITIONS

a. Arkansas Forests: A Historical Perspective

When the English naturalist Thomas Nuttall journeyed across Arkansas in 1819, he saw a vast wilderness. There were extensive tall grass prairies, pine woodlands, and large areas covered by massive bald cypress and bottomland hardwoods at that time - landscapes teeming with wildlife like the Carolina parakeets, greater prairie chickens, and red wolves. Nearly two centuries later, much of what Nuttall observed has been lost, with tall grass prairies converted into agricultural fields, old-growth forests cut-over and replaced with pine plantations, and free-flowing rivers dammed and channelized. With destruction of native habitat, many plant and animal species have declined. Plants such as the snowy orchid, Texas paintbrush, and slender marsh pink have not been seen in Arkansas for decades. However, there is much hope for the forests of Arkansas. The recent rediscovery of the Ivory-Billed Woodpecker in the swamps of Arkansas' delta proves that native forest habitat can be revitalized and maintained through modern conservation efforts.

Recently, Dr. John Gray summarized the history of forests in Arkansas. Dr. Gray began by pointing out that forests have been a dominant element in the Arkansas environment throughout our state's history, and continued:

• Time of Settlement to 1880

As settlement continued, following the War of 1812, forests covered 96 percent of what is now Arkansas. In the Delta, the virgin forest consisted of magnificent stands of bottomland oaks, gums, ash, other hardwoods, and bald cypress. In the West Gulf Coastal Plain, shortleaf pine (our state tree) and loblolly pine, and mixtures of pine and hardwood dominated the forest landscape. In the Ouachita Mountains, drier sites supported shortleaf pine and pine-hardwood mixtures and hardwoods grew on the moister, cooler aspects. In the Ozarks, oaks, hickories, gums and other upland hardwoods occupied the forest for the most part. In addition to land clearing for farming and settlement there was limited timber harvesting. Most harvesting provided for local building, and products for home use (firewood, fence posts and other uses.) In southern Arkansas, logs were rafted down the rivers to Louisiana sawmills. All of these activities had a limited impact on the largely virgin forests.

• **Pre-Forestry Exploitation Era**

The situation changed in the 1880's, when the state's rail network expanded from 800 to 2200 miles of track. This not only provided access to a much greater proportion of forest, but also connected rail lines to major lumber markets in Midwestern and eastern cities. Large lumber companies from the Lake States and Midwest, backed by northern capital, moved here, bought up large tracts of timber, built mills, and began large scale liquidation harvesting. From 1879 to 1909, the peak production year of, what might be termed, the "Pre-Forestry Exploitation Era", Arkansas lumber production increased twelve-fold. In 1909, the lumber industry employed 73 percent of all factory wage earners in Arkansas. However, by the end of the 1920's; the initial timber-harvesting boom was over. Many of the big mills had closed up completely or moved operations westward. In most cases, paper manufacturers and small portable-type mills able to operate on the scattered, smaller trees left behind took over the industry. As an example, International Paper Company opened the first pulp and paper mill in Camden, Arkansas in 1928.

The first field survey of Arkansas forest conditions in 1929 found the situation grim. Of the 22 million total acres of land remaining in forest at that time (65 percent of the total land area), 20 million acres had been cut over. Although 85 percent of the harvested area had naturally reseeded or resprouted, 70 percent of these new stands had experienced severe damage by wildfires. During the survey year (1929), 11,000 such fires burned 2.5 million acres, or more than 11 percent of the total forest in just one year. Most of this loss was due to a strong tradition of woods burning by Arkansans.

• **Initial Recovery, 1930 to 1953**

During the 1930's and 1940's a substantial recovery of forests occurred because of several factors. First, not all of the forest products companies that came here during the exploitation era "cut-out and got-out." A number of the more far-sighted ones, which included Union Sawmill Company at Huttig, Malvern Lumber Company, Crossett, Dierks, Ozan Company at Prescott, Ozark-Badger at Wilmar, International Paper at Camden, and others, began taking steps to assure a continuing supply of timber ("sustainable forestry") from their own lands. These included providing fire protection, selective logging, and reserving seed trees to restock sites after final harvesting.

A major public forest ownership and conservation effort in 1907 and 1908 reserved an initial 1.1 million acres of federal public domain land as the Arkansas (now Ouachita) and Ozark National Forests. Almost immediately, the newly created U.S. Forest Service began providing protection from fire, trespass, and timber theft to these lands. A state initiative created the Arkansas Forestry Commission in 1930, bringing all non-federal forestland under state-provided forest fire protection.

During the 1930's, the newly established Forestry Commission and the two National Forests benefited greatly from services provided by the Depression Era Civilian Conservation Corps (CCC) Program. CCC enrollees from the 13 camps established in Arkansas helped fight forest fires, built fire lookout towers, and constructed roads, campgrounds, picnic areas and swimming lakes on the National Forests. They also planted trees on thousands of acres of worn out and eroded highland farmland added to these National Forests in the 1930's from purchase and transfer by the U.S, Department of Agriculture's Resettlement Administration Program. A sharp decline in building, and the corresponding lower demand for lumber,

reduced harvesting pressure on the recovering forest in the 1930's. Furthermore, by the 1940's, home heating and cooking had largely shifted away from using wood as fuel.

The first statewide systematic survey of Arkansas forest conditions conducted by the USDA Forest Service reflected some of these factors. This 1953 report showed that although 2.5 million acres of forests had been lost since 1929 to other land uses (mainly to farm expansion in the Delta) overall forest cover had stabilized. Yearly pine growth was 13 percent greater than removals; while the annual hardwood growth surplus exceeded 60%. In addition, fire protection proved effective almost immediately, only 90,000 acres per year were lost to fire on the 60 percent of the forest under state protection by the late 1940s.

• **Growth Over The Next 45 Years**

The 45 years from around 1950 to mid-1990 were marked by major increases in demand for all forest-related commodities. There was explosive growth in forest-based outdoor recreation especially, but not exclusively, on the forests in public ownership. From 1948 to 1998, there was an 86 percent increase in hunting licenses and a 132 percent increase in fishing licenses issued by the Arkansas Game and Fish Commission. By 1996, the two National Forests of Arkansas were providing nearly 4 million recreation visitor days per year. These factors, and the growth in travel and tourism, made the appearances of forestlands and forest operations a public issue. Changes in ownership, industrial to non-industrial, and forest management, non-intensive to intensive, are the trends that bring Arkansas' forests to 2005. Figure 1 was taken from the Southern Research Station, Resource Bulletin SRS-99, "Arkansas' Timber Industry-An assessment of Timber Product Output and Use, 2002". It represents an increasing trend in wood products usage within a 45 year period.

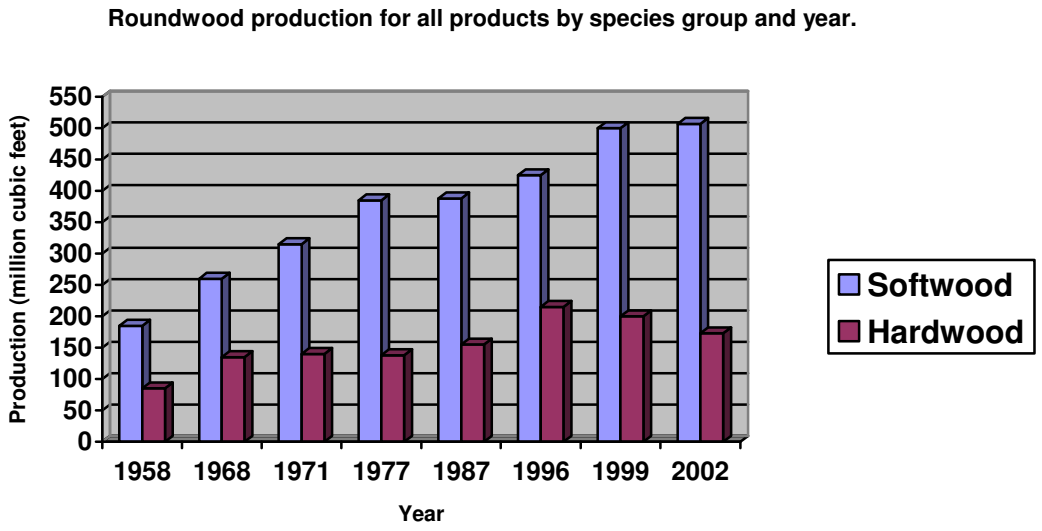

Figure 1

b. Arkansas' Forest: Current Conditions

Since 1995, land ownership patterns have remained relatively constant. However, The Arkansas Forest Status and Change Report pointed out significant changes in forest composition. At that time, forest plantations increased by 600,000 acres in less than a

decade. Half of the increase was in the forest industry sector and most of the remainder in the non-industrial private forest sector. Combined with conversion and parcelization, large blocks of current forestlands are increasingly threatened by landcover changes and non-forest interests. The recently released Southern Forest Resource Assessment confirms these trends, and predicts more for the future.

• **Geology, Climate**

Arkansas is roughly evenly divided between lowlands and highlands, with elevations ranging between approximately 50 feet above mean sea level in the southeast to 2,823 feet at the top of Mt. Magazine. The state is located between 33º and 36º 30' North latitude, and 89º 41' and 94º 42' West longitude. Between 1961 and 1990, maximum and minimum temperatures for Little Rock, the state capital, were recorded as high as 112º in July and as low as -5º in February, with an annual average precipitation of 50.86 inches. Growing seasons range from 180 days in the high northwestern Ozark Plateau to as long as 240 days in the eastern Delta region.

• **Geologic Features**

Ecologist and managers have identified six natural divisions in Arkansas, including: (1) the Ozark Mountains; (2) the Ouachita Mountains; (3) Crowley's Ridge; (4) the Gulf Coastal Plain; (5) the Arkansas River Valley; and (6) the Mississippi Alluvial Plain. For this AON these divisions have been condensed into four, with the Crowley's Ridge natural division being merged with the Mississippi Alluvial Plain and the Arkansas River Valley appended to the Ouachita Mountains. Figure 2 shows the Ecoregions of Arkansas.

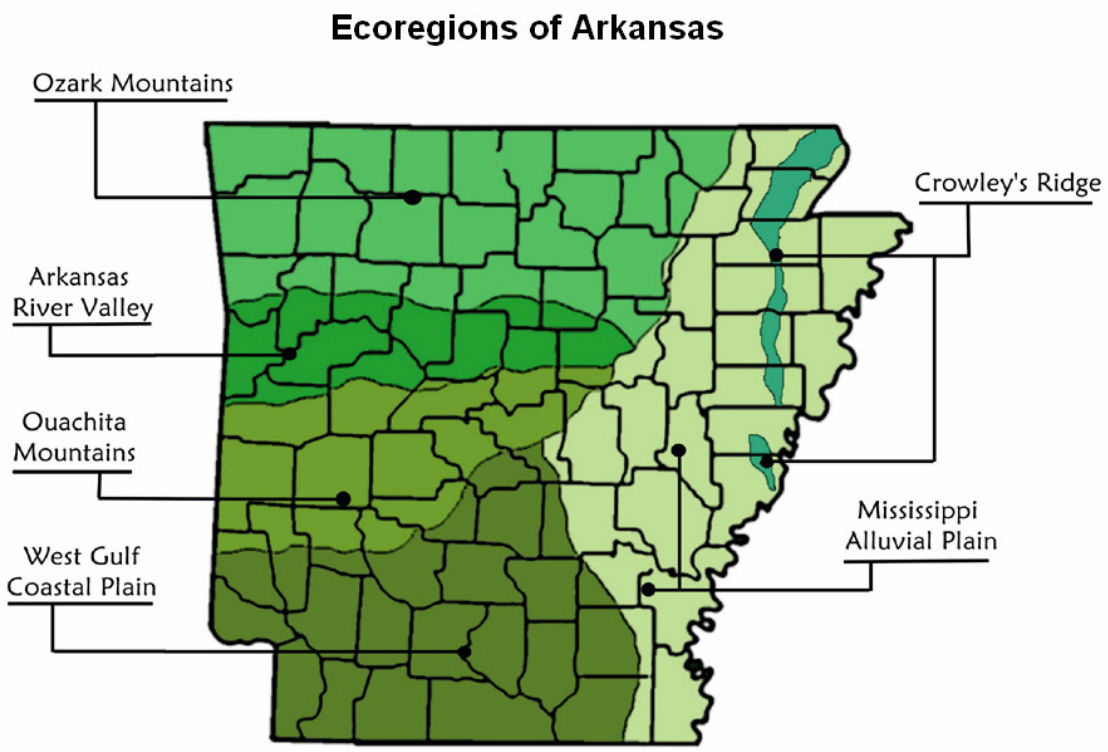

Figure 2

• **Forest Coverage and Composition**

Over half of the forestlands in Arkansas are oak and other hardwoods and 41% are softwoods dominated by pine. Arkansas is an important wood producer, contributing 3.5% of the total production in the United States. Arkansas' forests provide a number of benefits in addition to the obvious economic proceeds. They support a diverse system of values that reach beyond scenic beauty and outdoor recreation to encompass critical wildlife and biodiversity concerns and the maintenance of clean air and water. Figure 3 shows the Arkansas Landcover types.

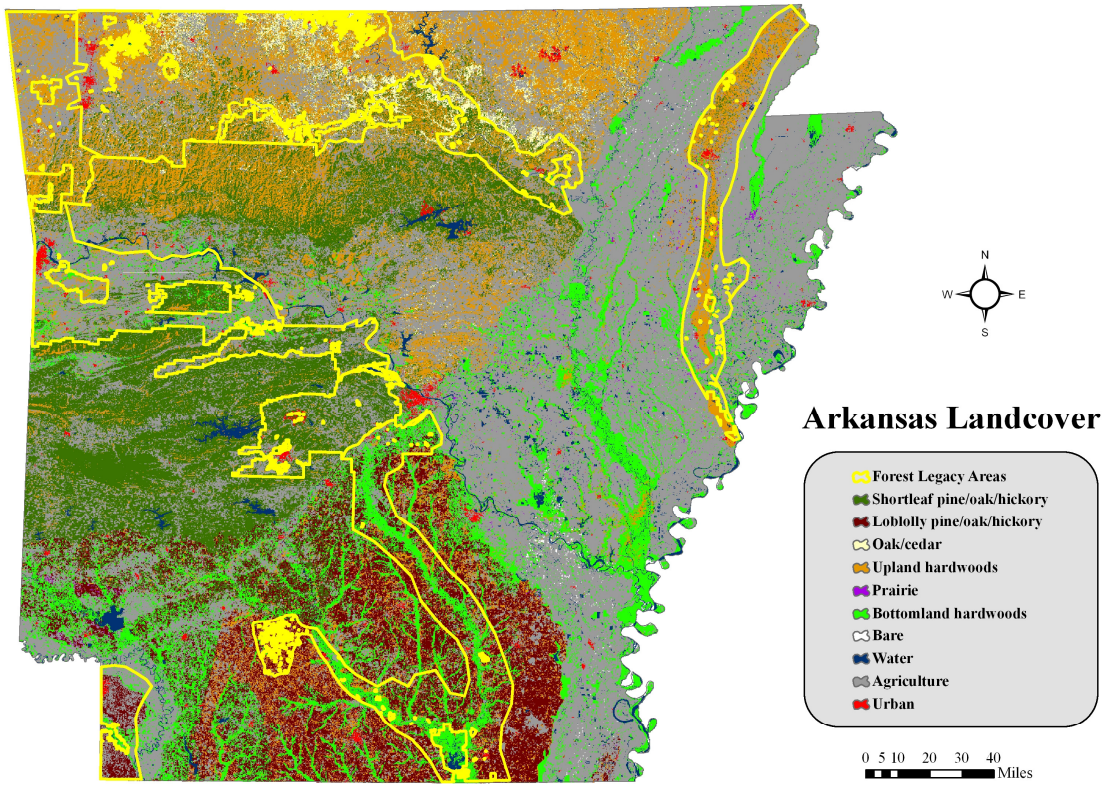

Figure 3

• **Arkansas Forest Ownership and Control**

Arkansas Forestry Statistics reported on the National Association of State Foresters website reflect that forested land covers 18.4 million acres (55%) of the 33.3 million acres in Arkansas. Figure 4 shows the Arkansas Forest Land Ownership by landowner category.

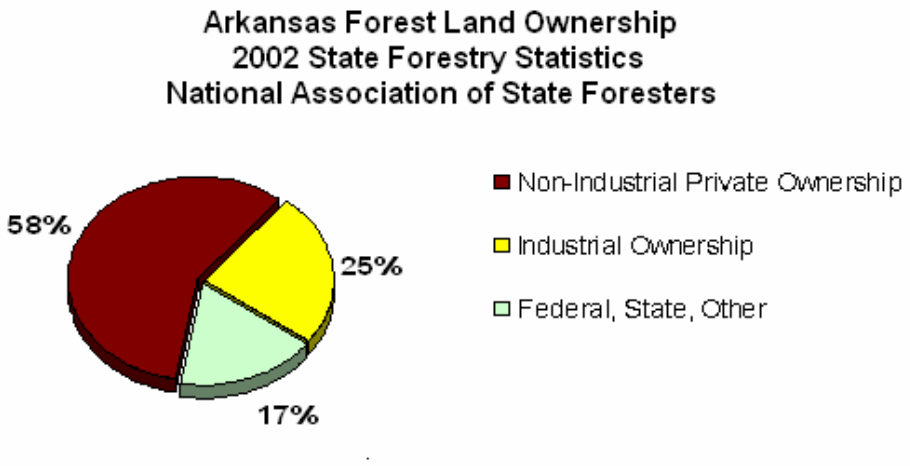

Figure 4

Arkansas' forest ownerships are categorized in three groups: government, forest industry, and non-industrial private forest owners. Non-industrial private forest owners own most of Arkansas' forestlands, and almost half of them live in the Ozarks region. The forest industry controls about one-fourth of Arkansas timberland, primarily in the southern half of the state. With combined acreage exceeding two million acres, the Ozark-St. Francis and Ouachita National Forests comprise the largest portion of publicly owned land. Other public lands include parks, wildlife refuges and management areas, military bases, state natural areas and forests, and some county and municipal lands.

ARKANSAS FOREST RESOURCE VALUES

• **Timber/Wood Products**

"Arkansas' Timber Industry – An Assessment of Timber Product Output and Uses, 2002" reports that out of a total 707 million cubic feet of round wood produced, 49% came from non-industrial private forests, 46% came from forest industry, and the remaining 5% were from public lands. The Assessment also points to regional trends within the State that indicate areas of increase and decrease of roundwood and saw log production. Figure 5 depicts the total timber harvested by county.

In general areas that are mostly forested versus agricultural or other land uses depend more on timber production and have more wood processing facilities. Of the four ecoregions, the Ozark, Ouachita, and Upper West Gulf Coastal Plain (UWGCP), are the primary wood producers in the State with the UWGCP producing 70% of the total roundwood. Since 1999, UWGCP and the Delta regions show decreases in all types of wood produced. While the Ozark and Ouachita experienced increases. Forest resources in the Ozark region are becoming more valuable as real-estate becomes less available. The trend towards vacation and retirement homes and a growing population make natural resource conservation more important.

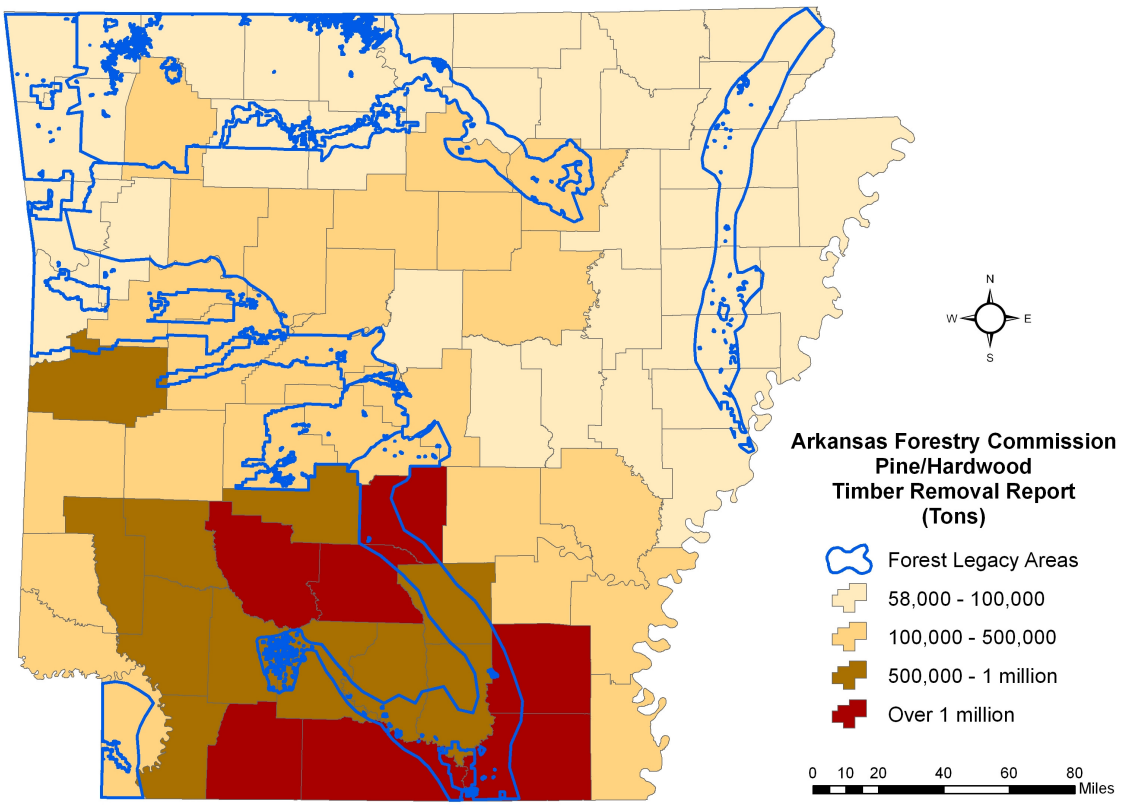

Figure 5

• **<u>Watersheds</u>**

Arkansas' abundant aquatic resources include a myriad of streams and standing-water environments ranging from ponds and large natural lakes to man-made lakes. Within or along its borders are found 9,740 miles of streams and 453,868 acres of lakes, with a total surface area exceeding 1,100 square miles. Aquatic ecosystems tend to mirror the character of the natural divisions in which they are found. In the Coastal Plain and the Delta, lowland streams meander freely over flat alluvial bottoms composed of silt, organic debris, and, rarely, gravel. In the Ozark and Ouachita mountains, where stream gradients are steeper, the clear water flows over bedrock, boulders, gravel, and sand. Crowley's Ridge has small springs and clear upland streams with substrates of silt, gravel, clay, and sand.

Pressure on this vital resource has increased dramatically. Over a recent 20-year period, water use in Arkansas increased by 200 percent, with expectations to increase by another 140 percent by the year 2030. The Arkansas Department of Health has documented the major sources of public water in the state including lakes, rivers, wells, and wells affected by ground water. It is estimated that there are 1,650 public sources of water, of which 266 of these sources are affected by ground water. Forty-three percent of these affected by ground water are captured in Forest Legacy Areas. All this brings focus to the watershed protection functions and relationships within forests. Figure 6 shows the watershed boundaries. Clean

water is an important resource produced by our forest legacy areas. A set of voluntary "Best Management Practice Standards" aim to minimize non-point source pollution of lakes and streams from logging and other forest operations under provisions of the Clean Water Act of1972.

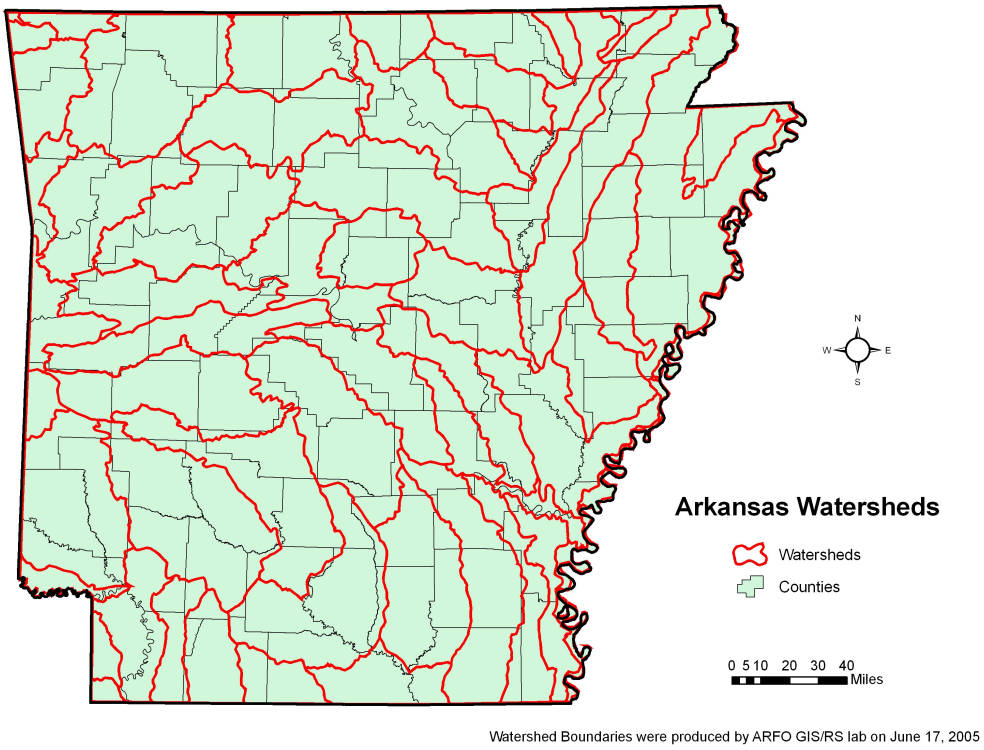

Figure 6

Figure 6a shows the FLA's in relation to the Arkansas Priority Watersheds. The Priority Watersheds were defined by the Arkansas Non-point Source Pollution Management Program. Priority Watersheds are watersheds where there are known impairments or significant threats to water quality from present and future activities.

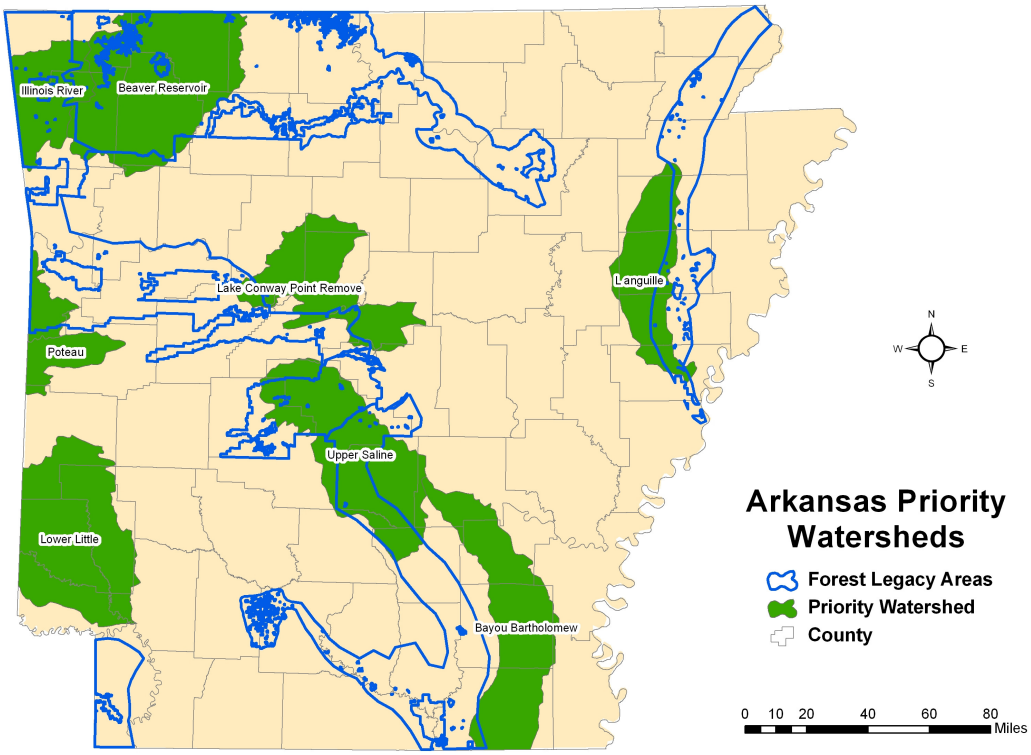

Figure 6a

The Extraordinary Resource Water (ERW) designation protects a water body by recognizing its distinct combination of chemical, physical, and biological attributes characterized by scenic beauty, aesthetics, scientific values, recreation potential and intangible social values. Figure 7 shows the ERWs. Significant physical alterations of the habitat within these waterways are not allowed.

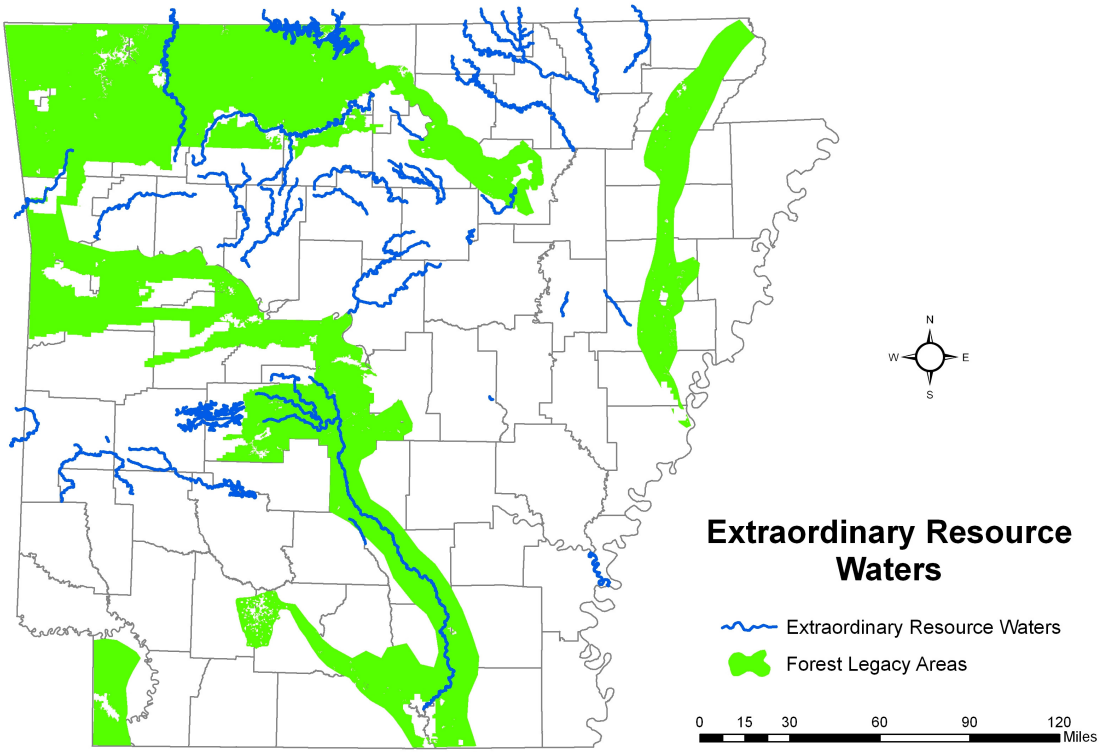

Figure 7

Generalized areas throughout the State that potentially influence aquifer recharge. Figure 8 depicts the generalized areas indicating potential for aquifer recharge. It is difficult to accurately depict all areas, especially in the western portion of the state where there are no appreciable aquifers to speak of, only small, sporadic pockets. An aquifer is considered any area that consistently produces a usable supply of water. In areas with heavy rock and/or clay that inhibit the movement of water, supplies of water from wells come from unreliable sources that form between layers of rock. As the demand for clean, useable water continues, these sources will become less reliable, placing more demand on infrastructure in rural areas and increased pressures on water sources elsewhere. Although there are wells in the area symbolized in red, the water in this area comes from water located in the alluvium found near river valleys or in crevices between rock layers and soil types that tend to run dry at some point during the year. There are, however, significant areas where groundwater can pass through layers of soil and rock to influence a particular aquifer. Generally these areas are located along the diagonal fault line that occurs from the northeast to the southwest. It is here that water has the greatest potential to influence aquifers located in the lowlands to the east. These well-defined aquifers in the Mississippi delta lowlands and karst aquifers in the mountainous portions of the state are being depleted of important water resources. These FLAs would protect forests which provide clean water.

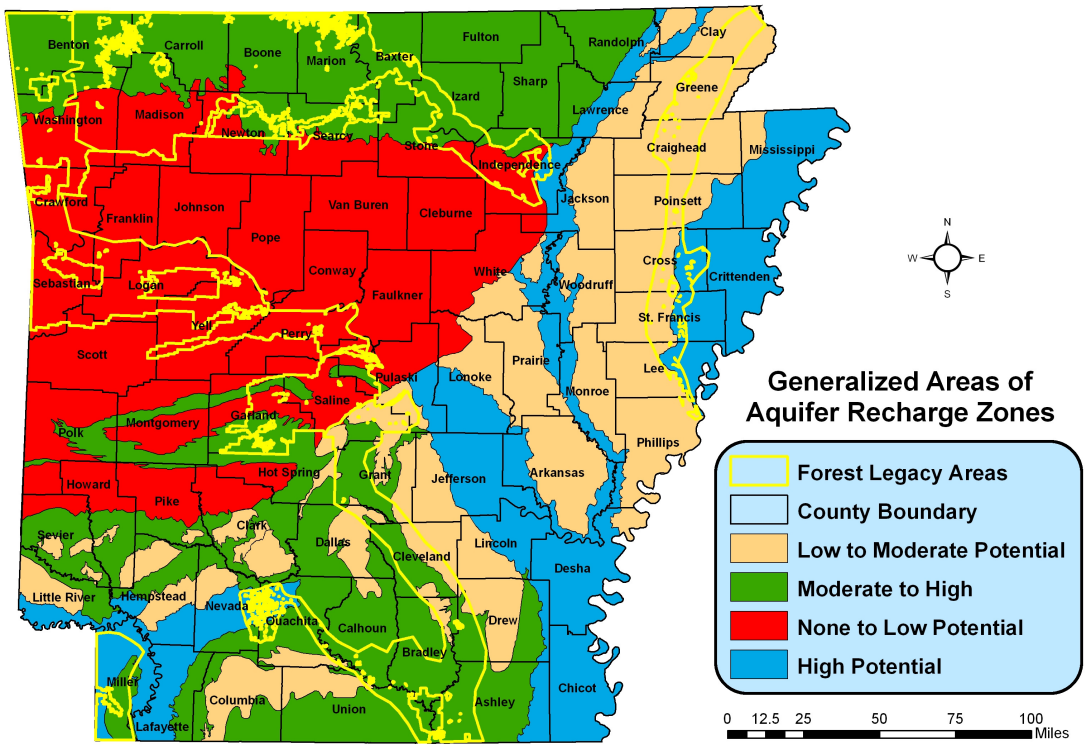

Figure 8

• **Wildlife**

In 1541 – 1542, a member of DeSoto's expedition noted in his journal that bison, deer, turkey, wild cats, panthers, bear, waterfowl, and fish were abounding. In 1829, two hunters were noted to have killed 69 deer in one day at Bayou Meto. Although some species were hunted to very low numbers, most have made successful comebacks and are now thriving. For instance, Arkansas is world-renowned for its ducks and deer. As pointed out in the Recreation section, current sales of hunting licenses point to the abundant deer, turkey, and duck populations in Arkansas. Habitat is vital to the survival of all animals, especially forest habitat for some species.

Successful elk and black bear restoration projects are currently in progress in Arkansas. The elk restoration project is concentrated along the Buffalo National River in the Ozark region. The black bear restoration project consists of relocating bears from White River National Wildlife Refuge in the Delta region to the area in and around Felsenthal National Wildlife Refuge in the West Gulf Coastal Plain region. Both elk and black bear are forest-dependent species that will benefit by protecting the state's forest heritage. A vast majority of State and Federal wildlife management areas and refuges are either adjacent or within Forest Legacy Areas.

• **Threatened and Endangered (T/E) Animal and Plant Species**

Arkansas is home to numerous federally listed threatened or endangered animal and plant species and candidates for listing (See Appendix B). Foremost among these is the

endangered Ivory-billed woodpecker, thought to be extinct but recently discovered in the Big Woods of the Delta region. Other federally listed or candidate species include eleven freshwater mussels (seven endangered, one threatened, three candidate), six fish (one endangered; three threatened, one of which is of historic occurrence and probably extirpated in Arkansas; two candidate), two cave crayfish (both endangered), one snail (endangered), four mammals (all endangered, one of which is of historic occurrence), one amphibian (candidate), four birds (three endangered, one of which is of historic occurrence; one threatened), one insect (endangered), and five plants (four endangered, one of which is of historic occurrence; one threatened).

The majority of these species are either forest-dependent or are aquatic species indirectly affected by conditions maintained and/or enhanced by forests, and thus will benefit by protecting forests from conversion to non-forest or incompatible uses.

• **Diversity (Rare Species and Natural Communities)**

The Research Section of the Arkansas Natural Heritage Commission is responsible for building, maintaining, and refining the Natural Heritage Inventory, known as the "Arkansas Heritage Program." The aim of ANHC research is to locate high-quality examples of each type of natural community in the state, determine which species of native plants and animals most need habitat protection, and where the best habitats for these species are located. The research component of inventory work includes surveys of scientific literature, museum collections, and herbaria specimens combined with examination of maps, aerial photographs, and satellite imagery. On-the-ground field surveys locate and assess the condition of rare species and high-quality natural communities across the state. Coordination with other state agencies, universities, and resource professionals has brought the list, which totals 11,275 site-specific records, great acceptance and high regard. The map of their locations is pictured in Figure 9.

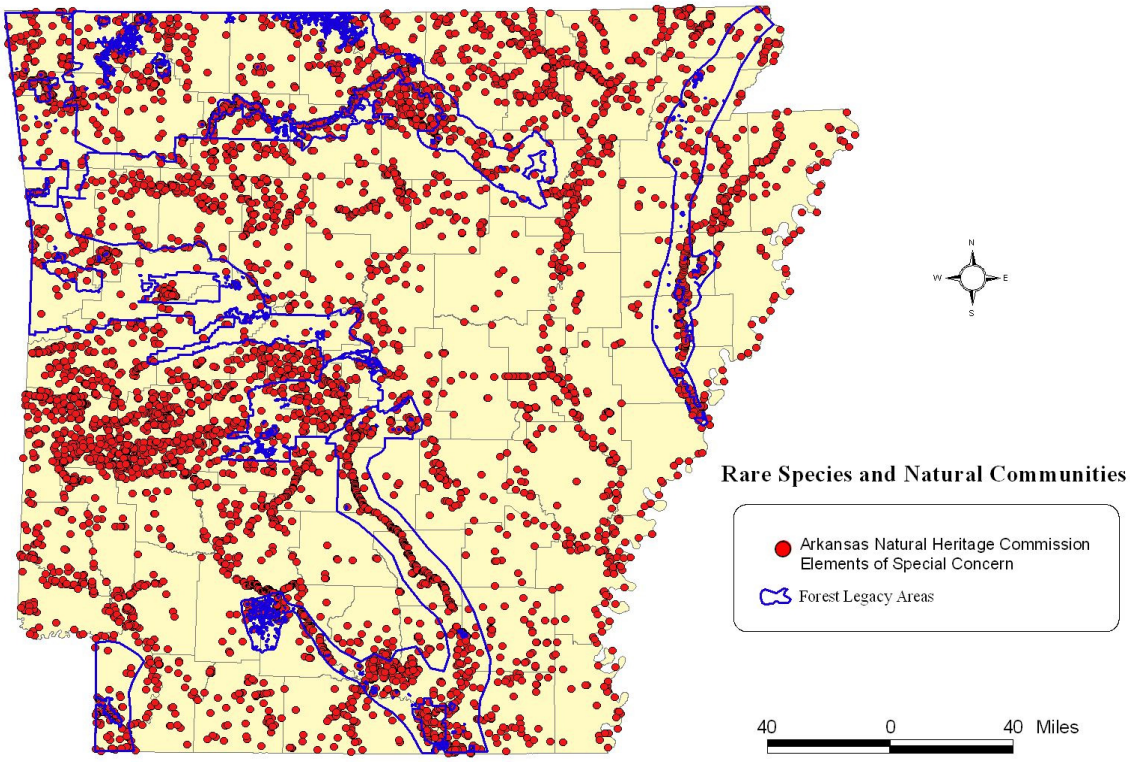

Figure 9

- **<u>Locations of Unique Natural Features or Communities, as Currently Identified for the State of Arkansas.</u>**

Where these "elements" are concentrated, locations are identified that hold exceptional importance for the state's natural diversity. A systematic analysis of natural heritage data identified areas of significant biodiversity in Arkansas, pictured in Figure 10.

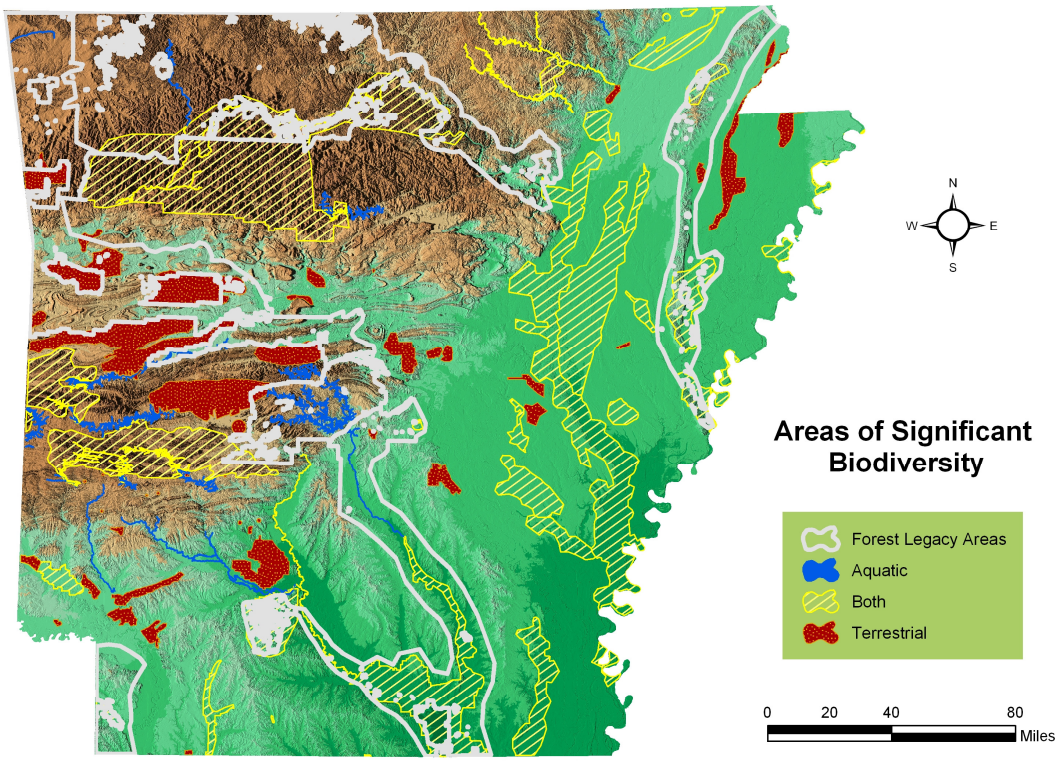

Figure 10

Lands Currently Under Conservation Protection

It is estimated that there are 4.4 million acres of forest land currently being protected in Arkansas, of which 59% is in the two National Forests. Figure 11 depicts the location of these lands and the different ownership classes that manage them. 14.5% of these protected lands are located within designated Forest Legacy Areas. It should be noted that land trust organizations, however small and scattered, are present in Arkansas and account for less than 1,000 acres of protected land. These lands were not added to the map in Figure 11 due to their small size. A list of active land trusts in the state is provided in Appendix F. It is a strategic goal of Arkansas' Forest Legacy Program to connect these conservation areas to forested lands that are currently not being protected for long term benefits to the public.

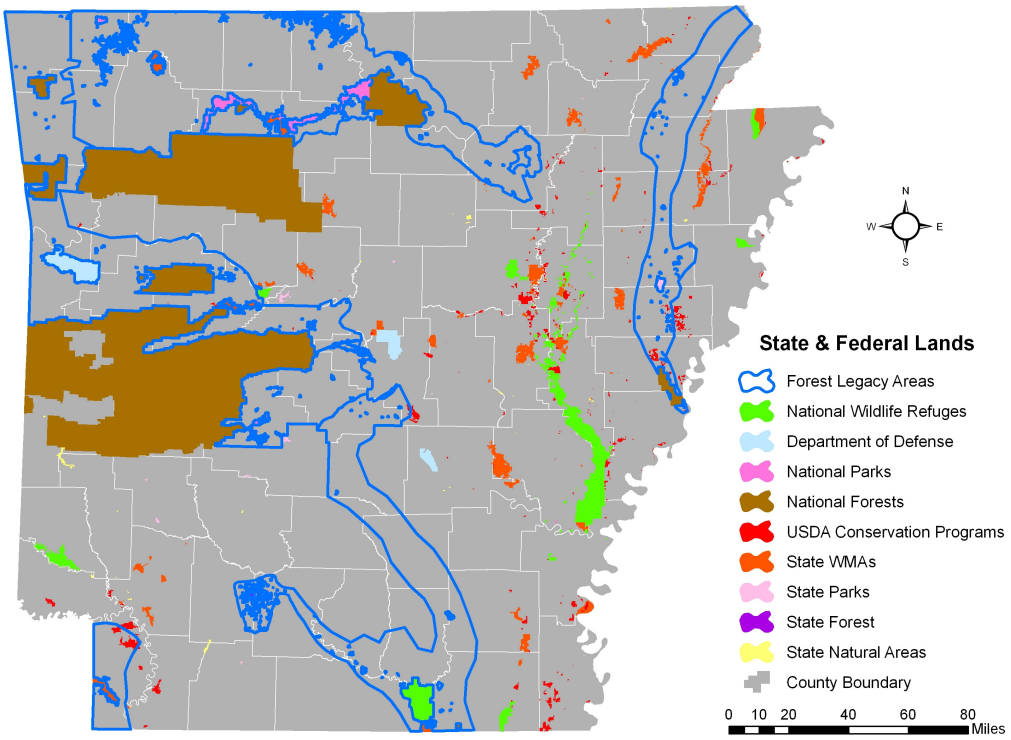

Figure 11

- **<u>Aesthetics and Scenic Resources</u>**

The four ecoregions of Arkansas offer a variety of experiences ranging from a view from the top of an Ozark or Ouachita mountain to the fragrance of pine forests which abound in the rolling hills of South Arkansas' Gulf Coastal Plain to the Delta flatlands leveled by the Mississippi River. Towering pines, lush hardwoods, large lakes, flowing waterways, fertile delta highlands, abundant wildflowers and a variety of wildlife provide many opportunities for outdoor enthusiasts who enjoy experiencing Arkansas' beauty by exploring the state's plentiful natural resources.

Arkansas highways offer some incredibly scenic views of The Natural State. Along those routes are forests aplenty to explore the history and heritage, as well as the great outdoors, of Arkansas' diverse geographical regions.

Arkansas scenic highway 7 traverses the north-south length of the state from Harrison to Louisiana, offering spectacular views as it passes through the Ozark and Ouachita mountains en route to the state's "oil boom" region. The Boston Mountains Scenic Loop consists of two state scenic byways -- U.S. 71 and Interstate 540 -- that provide two very different experiences of the Boston Mountains, the highest portion of the Ozarks.

Figure 12 Scenic view of the Ozark Mountains

Higher still reaches the Mount Magazine Scenic Byway, which travels across the state's highest peak at 2,753 feet, and the Talimena Scenic Drive, new scenic byway, which rides the forested ridge of the state's second highest peak and stretches from Mena, Arkansas, to Talihina, Oklahoma.

Eastern Arkansas lies within the nation's largest alluvial plain, a vast flatland leveled over eons by the erosive floods, depositions of silt and course changes of the Mississippi River and its tributaries. Known in the region as "the Delta," the plain covers in eastern Arkansas alone more than 15,000 square miles, including all or part of 27 of the state's 75 counties. The agricultural Delta of eastern Arkansas is home to two national scenic byways: the Great River Road (Arkansas) and Crowley's Ridge Parkway.

For much of its length, the Great River Road (Arkansas) journeys through those agricultural lands, passing remnants of the original wetlands and traveling through towns whose histories and economies were influenced by the river. From Marianna to Helena, however, the route penetrates the woodlands of the St. Francis National Forest on Crowley's Ridge.

• **Potential Mineral Resources & Outstanding Geological Features**

Arkansas' geology is divided into a highland area in the northwest and a lowland region in the south and east. It stretches from the Mississippi River on its eastern edge, where historic movement of the riverbed has left behind the original state borderlines, to the more settled Paleozoic rocks of the Ouachita Mountains on the west and the Ozark Mountains to their north.

A diagonal boundary that crosses the heart of the state, from the northeast to the southwest as seen in Figure 13, is the edge of the Mississippi Embayment, a wide trough

in the North American craton where the continent tried to split. The crack has remained seismically active ever since. Just north of the state line along the Mississippi River is where the great New Madrid earthquakes of 1811–12 occurred.

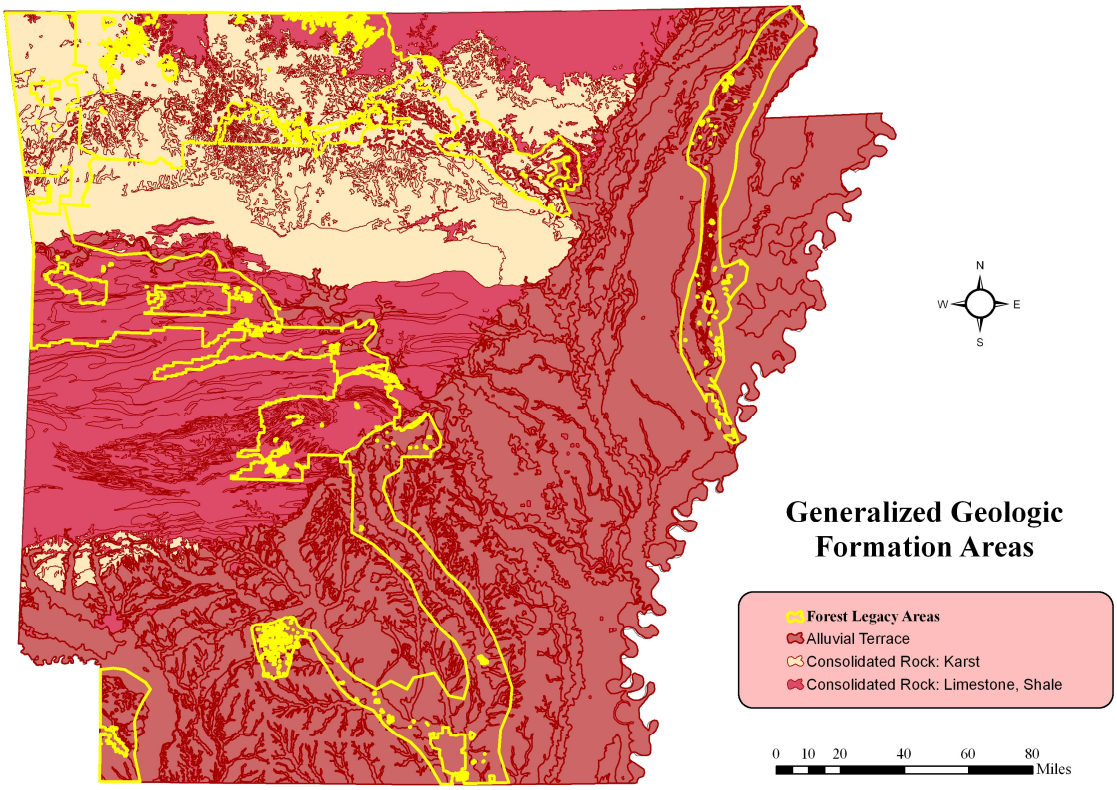

Figure 13

The Ouachita Mountains are actually part of the same foldbelt as the Appalachian range, separated from it by the Mississippi Embayment. Like the Appalachians, these rocks produce coal and natural gas as well as various metals. The southwestern corner of the state yields petroleum from its early Cenozoic strata. And just on the border between these two regions, a rare body of lamproite is the only diamond-producing locality in the United States. Arkansas' rocks, minerals, fossils, fossil fuels, and its water resources resulted from prolonged episodes of deposition, mountain building, and erosion. The interaction of these and other processes was variable throughout Arkansas. Long-term changes in climate were also significant.

• **Cultural Resources**

Contact between Native-Americans and European explorers were sporadic until the French founded the Arkansas Post in 1686. Between the late eighteenth and early twentieth centuries, the influx of mainly Anglo-American settlers from states east of the Mississippi River had gradually supplanted the existing French and Native American cultures. The Arkansas Historic Preservation Program has surveyed and recorded more than 23,700 historic resources in the state, while the Arkansas Archaeological Survey has files on more than 30,000 archaeological sites. Large concentrations of archaeological sites have been

recorded in the northwest portion of the state and in several Delta counties as shown in Figure 14.

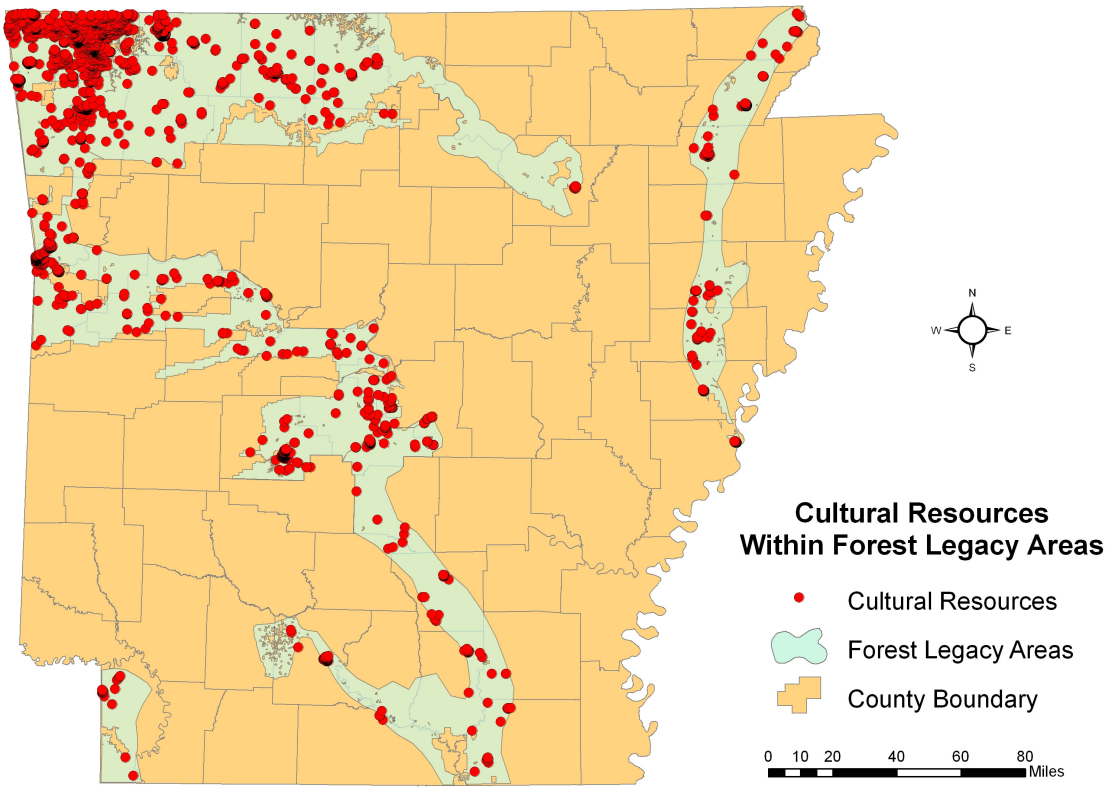

Figure 14

Examples of prehistoric archaeological sites in Arkansas include earthen mounds, rock quarries, fishing weirs, and burial plots. Examples of historic sites that exist in or beside Arkansas' forests include Civil War battlefields, German and Italian prison-of-war camps, subsurface evidence of former landscape features, and urban farmsteads, mines, and house sites, as well as underwater types such as sunken ships, river crossings, and remains of piers and wharves. Not all sites were added to the map in Figure 14 due to the vast number and the ability to adequately symbolize those features in an organized fashion. Only those sites that are located within an FLA were chosen to represent a portion of Arkansas' cultural resources. It is estimated that 18% or 4,171 sites, have been recorded in a designated FLA.

• **Recreation**

Arkansas' natural beauty and abundant natural resources attract residents and visitors alike to participate in recreational uses, generating considerable revenue for the State. National forests, refuges, and wildlife management areas occupy nearly 3.3 million acres throughout the state. More than 9,000 miles of rivers and streams and 600,000 acres of lakes are found in Arkansas. The State is renowned for it's bass fishing tournaments, world famous duck hunting, one of the largest concentrations of cave systems in the

country, and a large area of relatively intact bottomland hardwoods in the Lower Mississippi Alluvial Valley.

Non-consumptive uses such as hiking, boating, camping, bird watching, rock climbing, and caving are popular activities, as are consumptive uses such as fishing, small-game hunting, and waterfowl hunting. The 1995 Arkansas State Wide Comprehensive Recreation Plan (SCORP) reported that 1993 retail of outdoor recreation products, which includes expenses related to travel and equipment, in the State totaled $246 million. Of that total, sales of products used for typical activities on Federal and State public lands included $79.8 million for boating, $52.1 million for hunting and fishing, $13.4 million for mountain biking, $11.9 million for walking, and $5.5 million for camping. Figure 15 shows the total retail sales for outdoor recreation products in 1993.

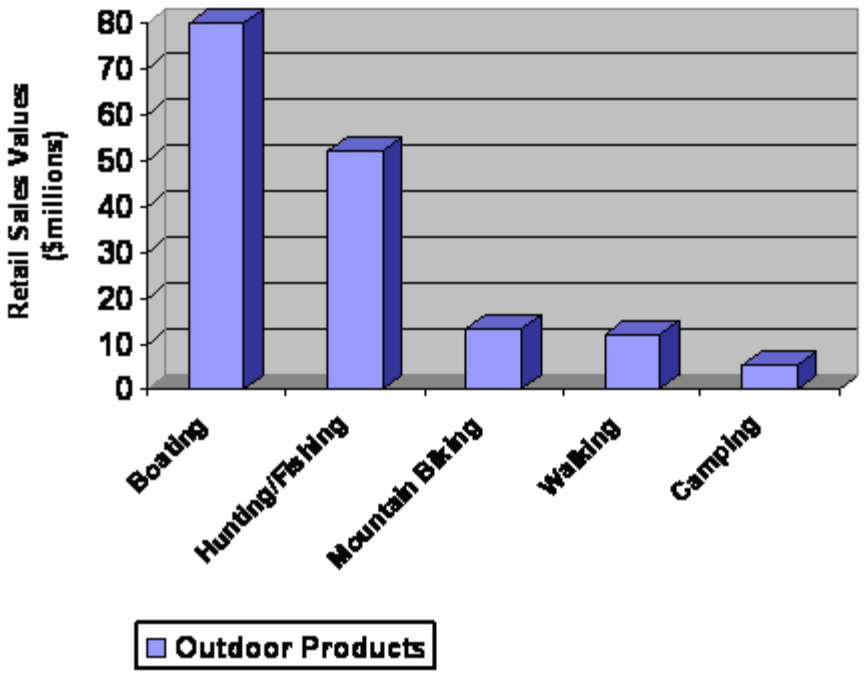

Figure 15

Hunting opportunities also abound for whitetail deer, elk, black bear, wild turkey, northern bobwhite, and numerous small game species. These opportunities generate considerable income to the state. In 1996 total expenditures for all wildlife–related recreation was estimated around 1.6 million dollars (Ozark Highlands Assessment, 1999). During the 2003-2004 hunting season there were 1.1 million hunting and fishing licenses sold generating over $20 million in sales. The 1995 National Private Landowners Association (NPLOA) found that 47% of an average tract of private land is either completely closed to public use for recreation or is open only to leaseholders or available to family and friends of the landowner. Less than 8% of the private land was identified by owners as available for use by the general public; the trend is that access to private land is decreasing emphasizing the importance of public lands for meeting the demand for outdoor recreation.

All of these recreational uses directly or indirectly depend on protecting forests from conversion to non-forest conditions or incompatible forest uses.

5. THE NEED FOR FOREST LEGACY IN ARKANSAS

Threats to Arkansas' Forest Landscapes and Forest Resources

The Arkansas Forest Stewardship Committee recognizes the following threats to forestlands in Arkansas: fragmentation, parcelization, urban and exurban sprawl. These threats are interrelated and all lead to conversion to non-forest uses.

a. Fragmentation

Throughout the US, forest fragmentation has been a major concern of conservationists for many years, with areas of forests converted to farming, ranching, development and other non-forest uses leaving isolated patches of forest habitat. Fragmentation threatens forest land in three ways.

1. Breaks up the connectivity of forest land

2. Loss of forest canopy creates barriers for wildlife, isolating species to even smaller habitats and eventually causing decrease in population density

3. Causes loss of continuity and interrupts landscape-scale ecosystems

As trees are removed there is the potential for erosion and runoff into streams and other bodies of water. Groundwater recharge areas are no longer productive because of increased surface runoff and soil moisture evaporation which slow or diminish aquifer recharge potential.

b. Parcelization

Parcelization is the division of large tracts of forest into smaller tracts, which are in greater danger of conversion to non-forest uses. Private forest landowners own nearly 58% of the 18 million acres of forestland in Arkansas. The divestitures of land holdings by large timberland owners impact the expanse of forestlands in Arkansas. Often these land transfers extend ownerships to many, and each one has its own management strategy. Another factor driving forest parcelization in Arkansas is urban out-migration. Increases in real incomes caused increase demand for larger homes and more people moving to rural areas, where land is cheaper. Former urban residents are purchasing more rural lands for second home development and retirement homes. The trend towards larger home sites uses more forestland to shelter fewer people. Parcelization makes forestlands more susceptible to conversion to other uses.

c. Urban & Exurban Sprawl

Overall, the state's population grew from 1.92 million in 1970 to 2.75 million in 2004. Rather than being evenly distributed, this growth has concentrated in areas around central and northwestern Arkansas. In regions that are experiencing dramatic increases in human population, forestlands are being converted to related infrastructure, commercial and residential development. This trend is forecasted to accelerate with the addition of increased industrial development and interstate transportation routes.

Even in areas which are not growing in population, conversion of forest land is often occurring rapidly as a result of people in urban centers relocating beyond the suburbs. Arkansans are willing to accept a significant daily commute for the opportunity to live in lightly settled, less regulated locations, buffered from the direct influence of neighbors. Typical exurban homestead size is 10 to 100 acres. Such properties typically have a residence along with garden, pasture, and chicken house. These homesteads may often have a small woodlot, but such a small area provides few functions of larger contiguous forest. In a state like Arkansas with modest overall growth and few population centers, this form of sprawl impacts more area than typical suburban development.

Figure 16 shows the primary areas where populations are concentrated in the state.

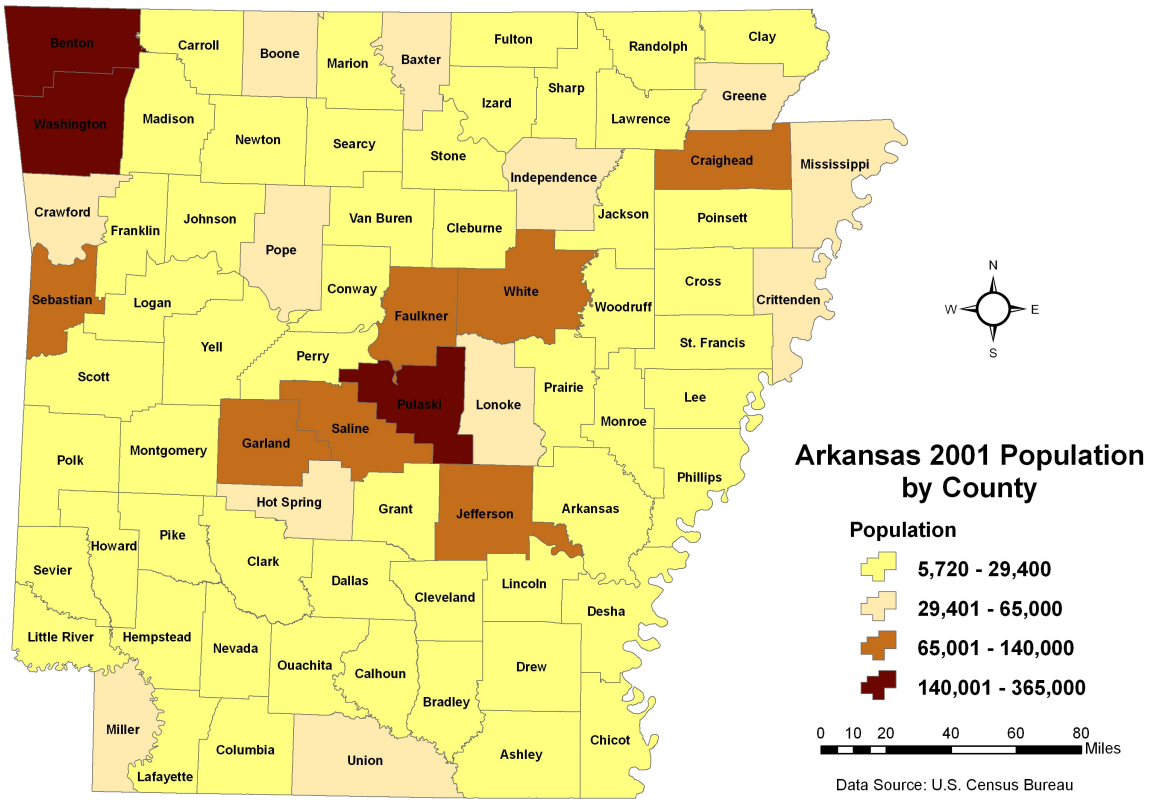

Figure 16

Figure 17 shows the population changes by county from 1990 to 2001 and FLAs.

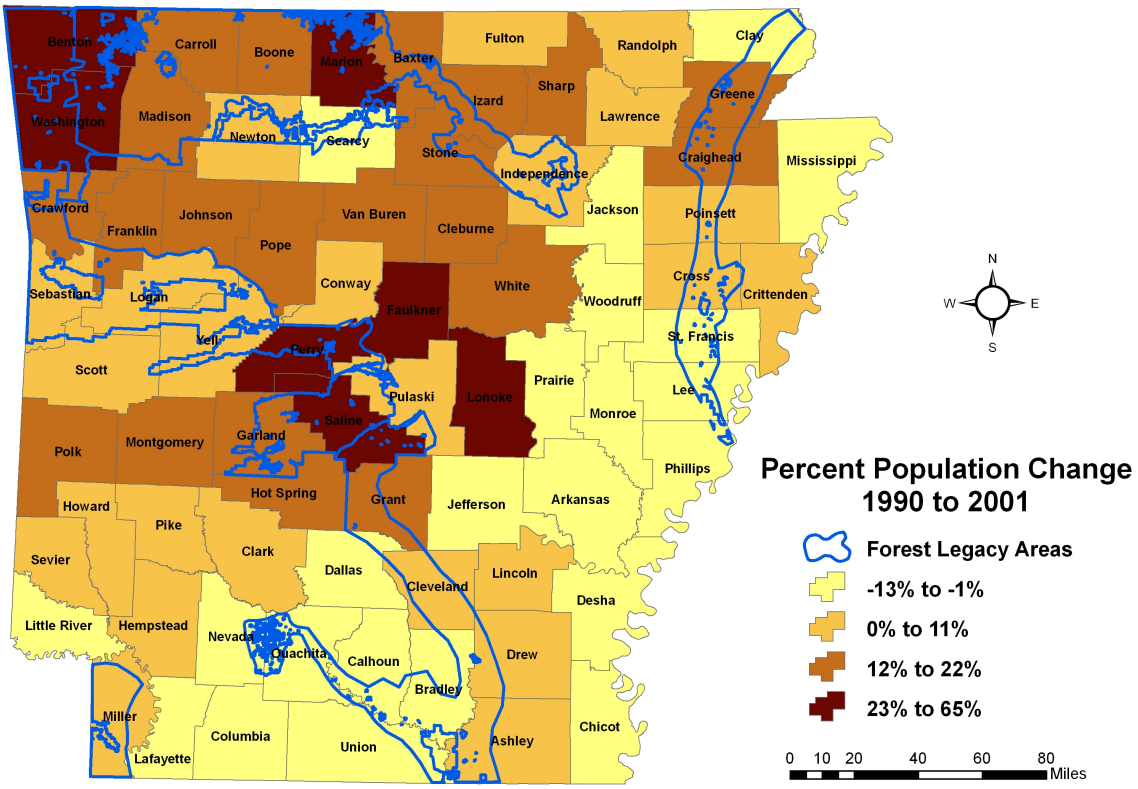

Figure 17

According to the U. S. Census Bureau, among the 50 states, Arkansas is projected to have 5th highest proportion of elderly in 2025. Figure 18 depicts the Projected Retirement Destination Counties (Demographic and Economic Profile Arkansas, Rural Policy Research Institute, USDA Economic Research Service, July 2006)

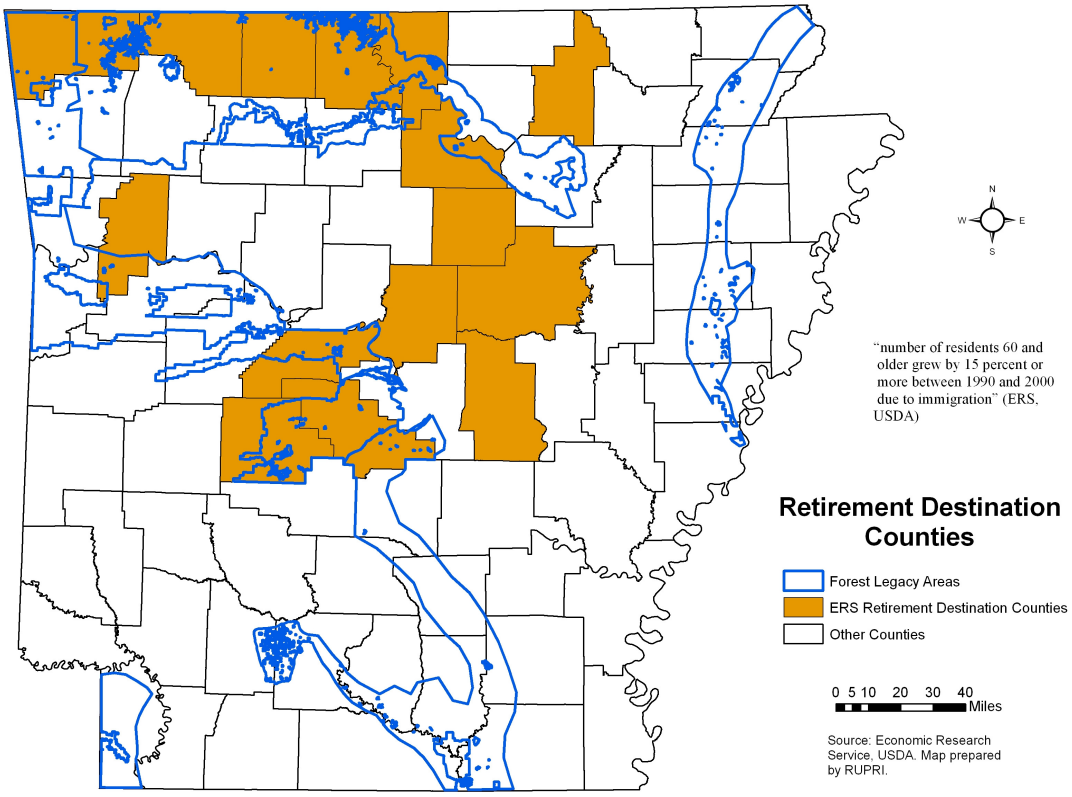

Figure 18

Figure 19 depicts the Projected Wildland Urban Interface in the year 2050 (Dr. Richard Kluender, UA Monticello).

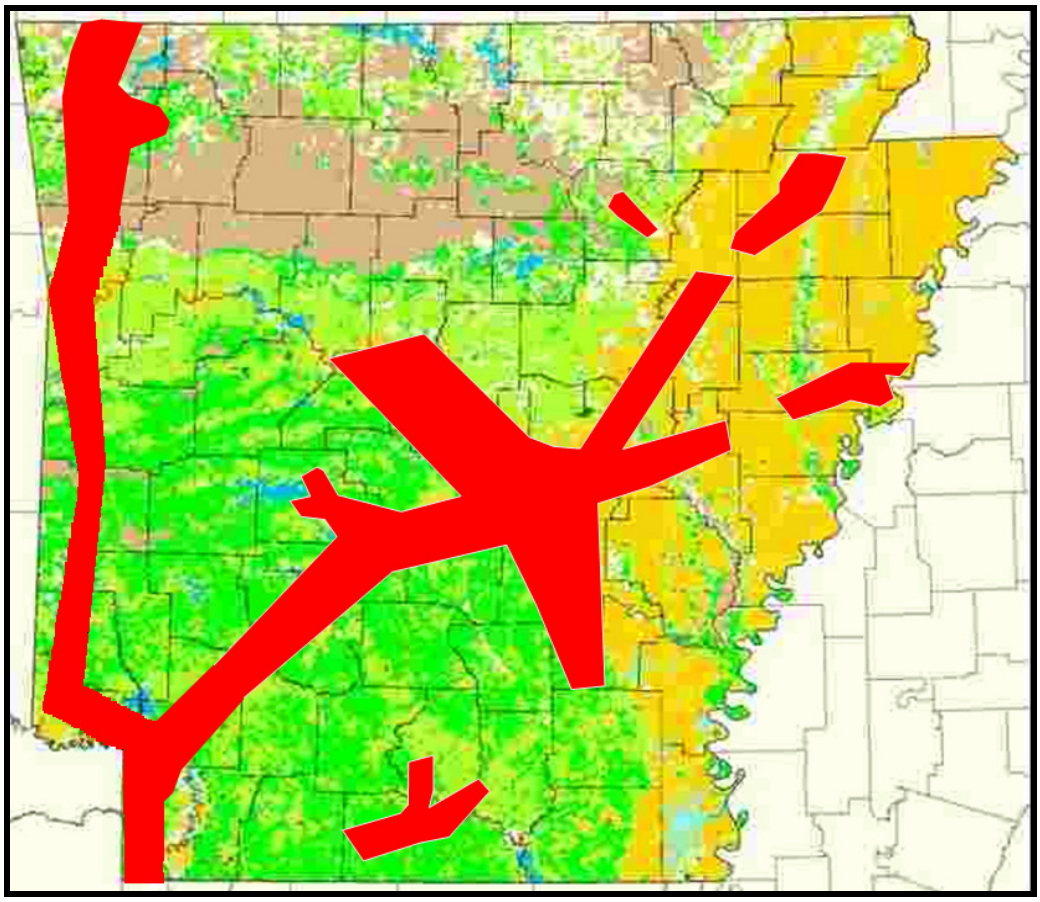

Figure 19

Figure 20 depicts the Projected Housing Density Change on private forests by the year 2030 (USDA Forest Service, Pacific Northwest Research Station, General Technical Report, PNW-GTR-636, May 2005).

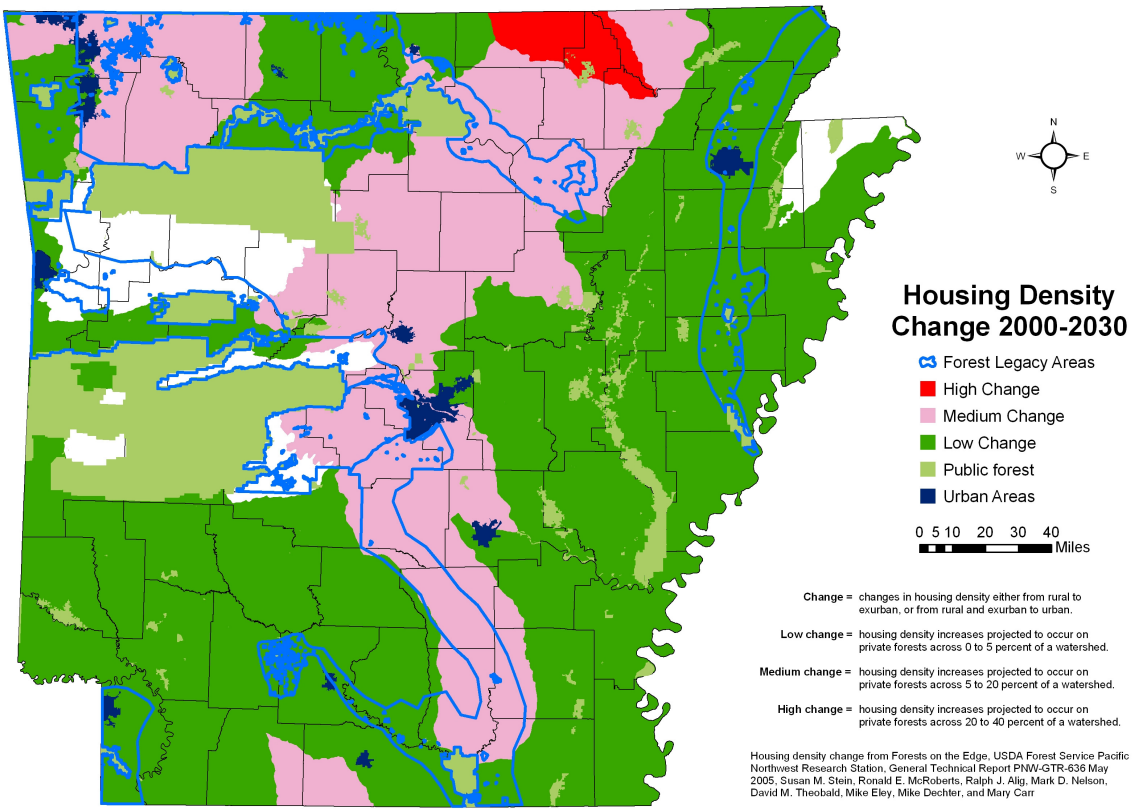

Figure 20

6. DESCRIPTION OF ECOREGIONS & THEIR CORRESPONDING FLAS

Arkansas' Forest Stewardship Committee adopted an ecoregional approach to planning and implementation of the Forest Legacy Program in Arkansas. Figure 21 illustrates the four main ecoregions used for organizing forest legacy planning in Arkansas. Implementation of the Forest Legacy Program will help sustain Arkansas' claim as "The Natural State" and be of great public benefit to all Arkansans now and for future generations.

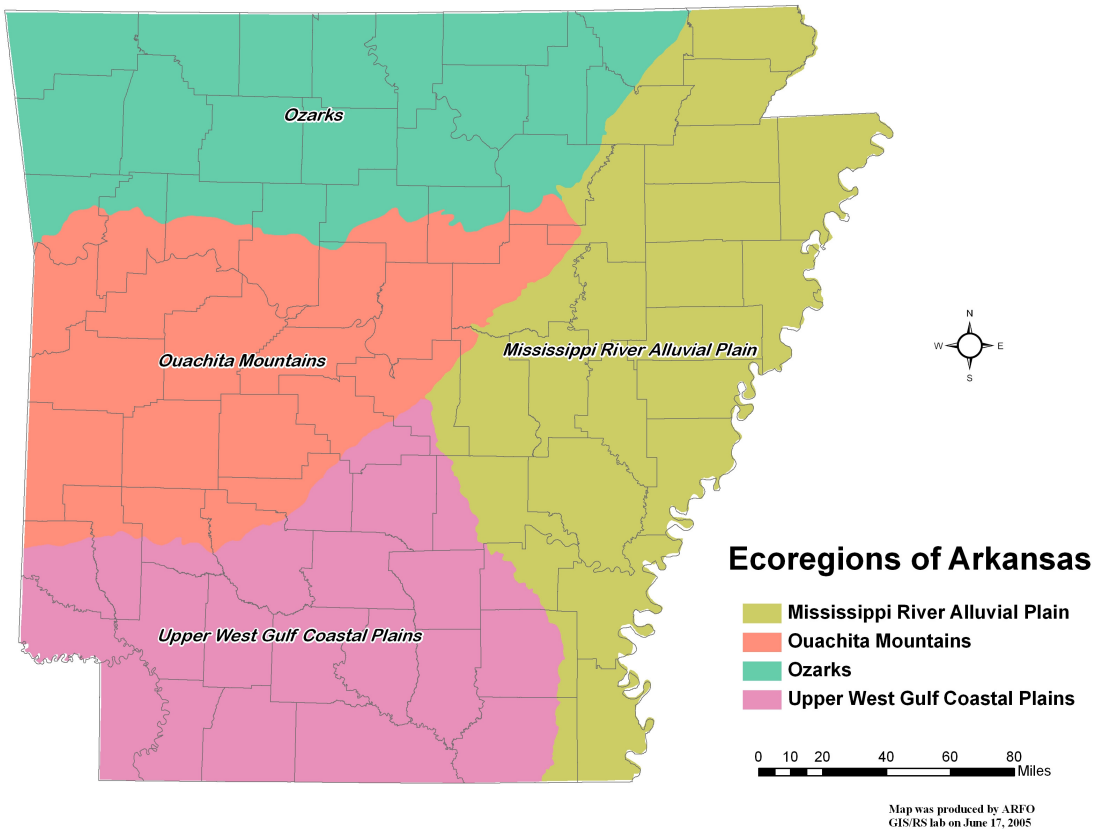

Figure 21

FOREST LEGACY AREA BOUNDARIES (FLAs)

Forest Legacy Areas were identified for each of the four major Ecoregions of the state. Forest values and their significant threats vary from one FLA to another. Each FLA was identified based on environmentally important working forest lands which have the values identified under the goal on page eight such as significant water resources, important aesthetics such as viewsheds, recreation resources, fish, wildlife, threatened and endangered species, and their associated threats (such as urban sprawl or fragmentation). Regardless of the particular value or relative threat to the identified FLAs, the Arkansas Forest Stewardship Committee recognized each as important to Arkansas' forest conservation efforts. The FLAs have been strategically located to complement important environmental or conservation areas already identified in the state. Figure 22 identifies the location of FLAs in the state, which covers less than 8.24 million acres total.

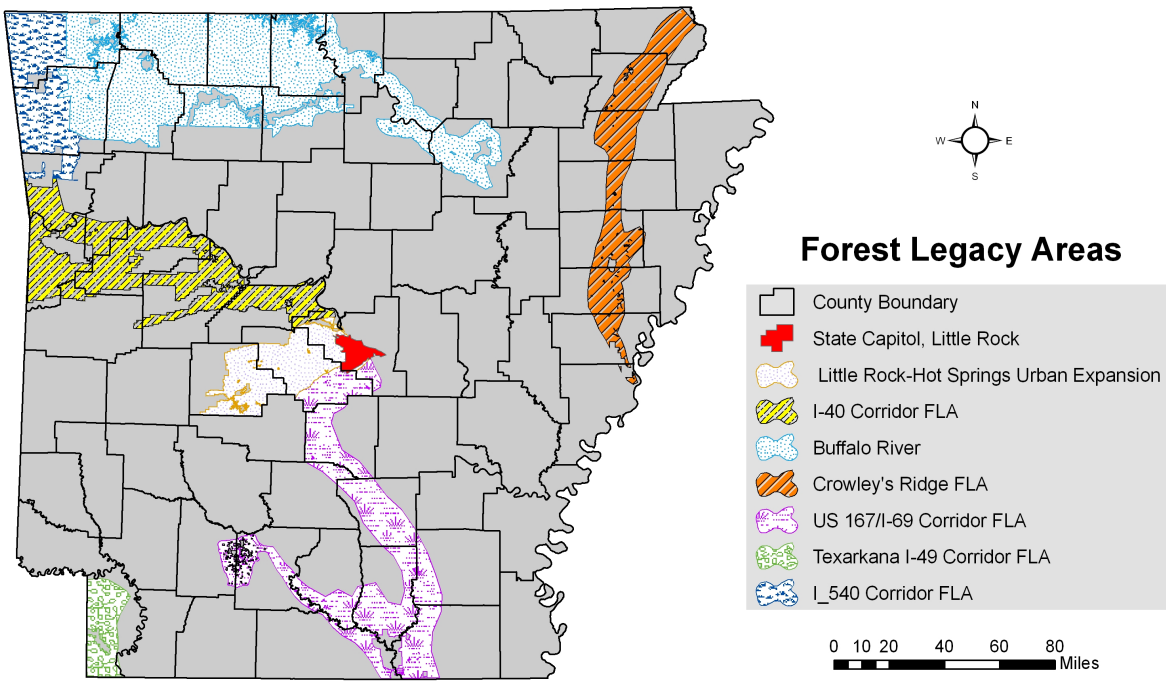

Figure 22

Ozark Mountains Ecoregion:

The Ozarks ecoregion is located in the northern and western parts of Arkansas, encompassing some 9.4 million acres. It is bounded by Missouri to the north and Oklahoma to the west. This ecoregion is characterized by a diversity of terrestrial, aquatic and karst (cave) habitats, ranging from glades and tall grass prairies, to coniferous and deciduous woodlands, as well as fens, sinkholes, sloughs, and a number of clear-flowing streams and rivers fed by an abundance of springs. It supports outstanding biodiversity resources, and is mostly covered with oak-hickory upland forests. Two exceptions are an area of increasing population and development in the northwest corner and north central areas of the state; in the north central area of the state, vacation/retirement property development acquisitions are rapidly increasing along waterfronts and where scenic and recreational resources are abundant.

Geologic attributes

High levels of topographic, geologic, soils and hydrologic diversity exist throughout the Ozarks, resulting in a wide range of habitat types. This is a region of rugged uplands with abundant exposed rocks and variable soil depths. The landscapes in various subsections of the Ozarks range from extensive areas of karst terrain on irregular plains, to highly dissected regions with steep hills and deeply entrenched valleys. There are also smaller, linear areas of alluvial terrain and large-scale riparian features

Biologic attributes

A major factor theorized by some to contribute to the region's notable biological diversity is that parts of the Ozarks have been habited by plants and animals for over 200 million years, constituting perhaps the oldest continuously exposed land mass in North America, and one of the oldest on earth. The Ozarks also constitute a center of endemism for temperate biota in divergent organism groups including vascular plants, lichens, fish, mollusks and crayfish.

Recreation

This region of the state offers a wide range of forest based activities that include mountain biking, hiking, camping, horseback riding, many forms of hunting, canoeing, swimming, and fishing. Other less obvious activities include collecting crystals, and a variety of mushrooms and other edible plants from the forest.

Aesthetics

North Central and Northwest Arkansas are one of the most scenic places in the state. It offers great scenery, abundant wildflowers, numerous fall festivals and craft fairs, and Arkansas' beautiful fall foliage. Expansive view sheds are plentiful throughout the Ozark Mountains which are accented by crystal clear waterways.

Forestland status

The Ozark Mountains Ecoregion is primarily forested (60%, 2003 FIA) with the exception of two counties in the extreme northwest corner of the state, where pasture and urban areas dominate.

Forest ownership

According to U.S. Forest Service Forest Inventory and Analysis (FIA) data, the Ozark Mountain forests were 19.8% publicly held, 3.1% forest industry held, and 77.1% private non-industrial held in 1988. In 2003 these percentages changed to 18.8% public, 2.6% industry, and 78.7% private non-industrial. The data indicates that Ozark forests are primarily held by private non-industrial owners. The private non-industrial ownership class is slowly growing. Although not presently documented, it is believed that the average parcel size of the Ozark private non-industrial ownership class is smaller than in other areas. The large majority of the public ownership lies in the Ozark National Forest and the Buffalo River National Park.

Census data and populations changes

Between 1990 and 2000, the Ozark region of the state experienced a population growth rate of 24.1%, reaching a total population of 641,386. This rate of growth continued through 2004, when population numbers totaled 693,215 or a 7.5% increase over the 2000 population.

Timber economy

The history of timber use in the Ozarks spans over one and a half centuries. For instance, as railways expanded across the Great Plains in the late1800's, and as the barrel industry peaked from 1860-1930, white oak timber was targeted throughout this region to supply the staves and ties. Throughout the 1940's and 1950's "groundhog" sawmill operations represented a major economic contribution to the mountainous communities. Currently, sawmills remain scattered throughout this region providing crossties and lumber from the oak-dominated forests, but as production plateaus in southern portions of the state more emphasis on pine timber production and hardwood pulpwood production is being shifted to

this region. The effect of this emphasis is to shift oak-hickory stands and oak-pine stands to pine plantation.

Severance taxes collected for hardwood and pine harvested in these counties have been extracted from each county tax collector's report. Reports indicate how much wood has been harvested for whole counties. For those counties partially included in the ecoregion, data for the whole county has been included. Figure 23 graphs the tons of timber harvested subject to severance taxes for the Ozark Ecoregion.

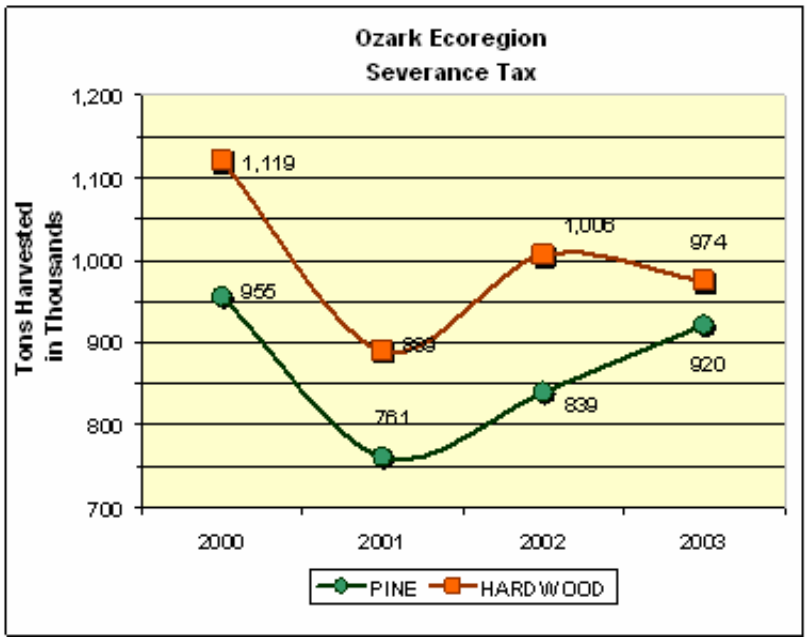

Figure 23

Of all of the ecoregions, the Ozark has the least timber harvested. This ecoregion contributes 13% to 18% of all the hardwood harvested in Arkansas, while about 5% of the pine for the State is harvested here. Figure 24 graphs the Ozark Ecoregion's percent of the total severance tax for the state for pine and hardwood.

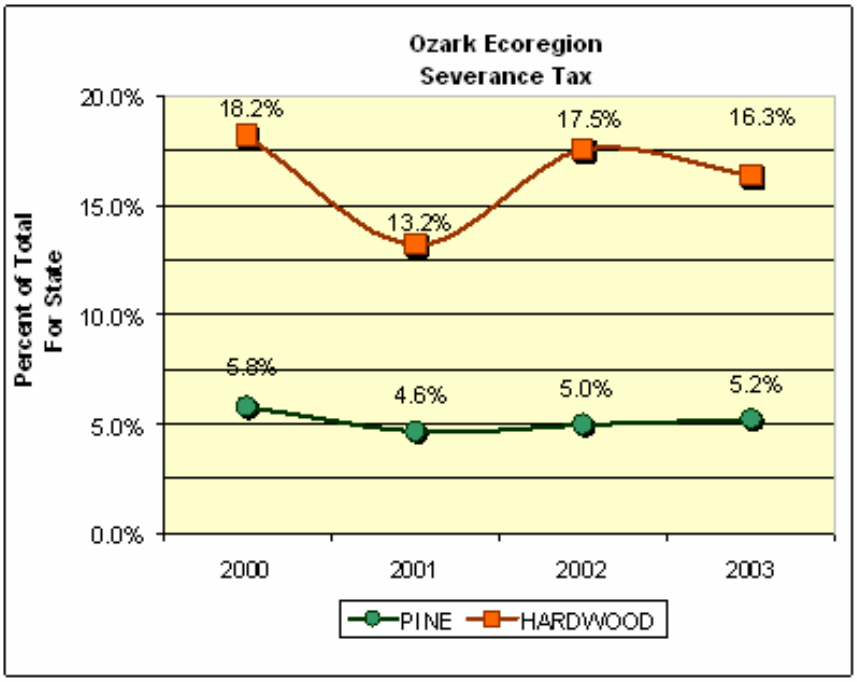

Figure 24

Most sawmills in this area are small. Approximately 130 primary wood-using plants were operating in this area in 2002, which is down from around 160 in 1999. Since 1999, saw-log production has increased 2% and pulpwood production increased 16%. Saw-logs account for 68% of the region's output.

Major threats to forestland acreage

Probably the greatest threat to Ozarks forests is the surge in population in Northwest and North Central Arkansas. Urban and exurban sprawl into previously forested lands outside the major communities is expected to continue to increase. This area of the state is in the path of a planned interstate highway (I-49) connecting New Orleans and Kansas City, increasing development along its route.

Northwest and North Central Arkansas are very attractive areas for retirement. According to the U. S. Census Bureau, among the 50 states, Arkansas is projected to have 5th highest proportion of elderly in 2025. Based on 2006 USDA demographics and economics research (see Figure 18), 9 out of the 15 Arkansas counties projected to be Retirement Destination Counties are in the Ozark Mountains Ecoregion. It is a popular area for tourism with its abundant outdoor recreation opportunities. Arkansas ranks among the top three poultry producing states in the United States. North Arkansas is the poultry hub for Arkansas with large processing facilities and a high density of poultry and egg production houses. Arkansas also ranks 17th among the beef cattle producing states. Eight of the State's top ten beef cattle producing counties are in the Ozark Ecoregion. Conversion of forestlands to pasture is a constant threat in North Arkansas.

The generational ownerships of Ozark forests have often resulted in "high-graded" stands having a higher proportion of less valued growing stock. Until now, there have been few

economic options to forest landowners for improving forest conditions. While available markets can be viewed as having a positive benefit for improving the quality of these forests, many landowners are electing to utilize the markets to convert their forestlands into pastureland and poultry production.

In the early 1990's this region experienced two outbreaks of gypsy moths, one in the Hardy area of Sharp County and one in the Compton area of Carroll, Newton, and Boone counties. As a result of quick actions by the state partners, both of these outbreaks were contained by aerial applications of approved insecticides on tens of thousands of acres. Through the State Plant Board, there is continual monitoring taking place to monitor this threat through trapping. According to state officials, the Ozarks region is the most likely point of entry for the next gypsy moth outbreak due to both tourism and human migration to the north.

In 1999, the state recorded an explosion in the red oak borer population from which almost a million acres of upland oak forests were negatively affected. Although the Ozark National Forest experienced the greatest forest mortality, private lands have also been affected.

Ozark Mountains
I-540 Corridor - Forest Legacy Area

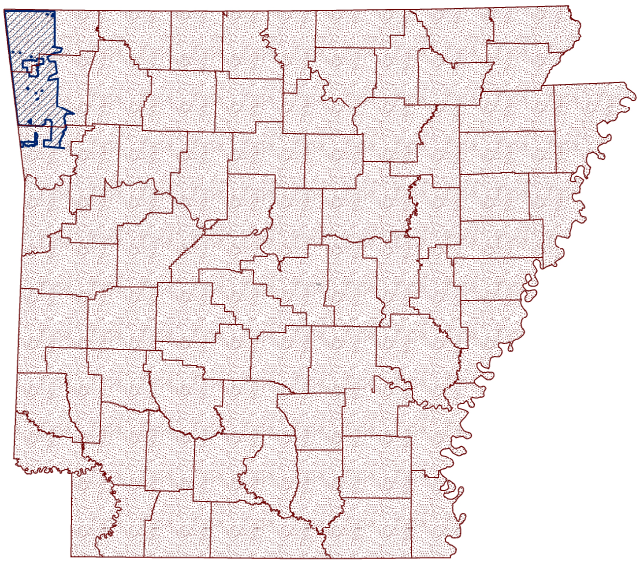

Figure 25

- **General description**
  The I-540 Corridor FLA includes parts of Crawford, Washington and Benton counties, and is located in both the Ozark Highlands and Boston Mountains sections of the Ozarks ecoregion. Figure 25 depicts the I-540 Corridor. The northern boundary of the FLA ends at the Missouri State line to the north and at the Oklahoma State line to the west, and encompasses approximately 657,639 total acres and an estimated 228,240 forested acres. This area is underlain by calcareous limestone which is dissolved by acid water, forming solution caves under ground and solution features at the surface such as

sinkholes and disappearing streams. Water moves from these surface features into the caves which may harbor endangered species and/or serve as water sources for rural populations. Landscapes with these features are referred to as karst. The FLA has karst and aquatic conservation values along Spavinaw Creek; and terrestrial and karst landscape conservation values at Garrett Hollow. A number of very important karst conservation areas are also included, associated with the Springfield and White River karst areas of the Ozarks.

As a part of the revised forest plan of the Ozark National Forest, the US Forest Service's Wedington Unit, just outside Fayetteville, is planned to be managed as an "urban forest" in keeping with current US Forest Service urban-interface planning guidelines. This forested acreage is essential towards providing the increase in outdoor recreational opportunities needed in this portion of the state. It will also serve as a conservation education center for the expanding population, along with the Hobbs State Park Conservation Area.

- **Why this area was chosen as an FLA**
  The I-540 Corridor FLA is chosen for its connection to the Wedington Unit of the Ozark National Forest in order to expand the USFS plan for urban forestry. The FLA has important oak/hickory forests under heavy development pressure. The I-540 Corridor FLA includes the western portion of the Illinois River Watershed. Figure 6a shows the Arkansas Priority Watersheds and the I-540 Corridor FLA. The Illinois River Watershed is threatened by sediment due to construction from the rapid urban development in Washington and Benton counties. Agricultural activity is causing the introduction of animal waste into streams that is affecting aquatic life as well as human health. These forests are needed as karst water recharge areas, to protect water quality, for recreation value, for wildlife value, and education purposes

- **FLA Priority Strategies (ranked)**
  1. Protect forested karst recharge watersheds from development
  2. Protect forested riparian zones especially in the Illinois River Watershed from conversion to agriculture and residential development.
  3. Enlarge and solidify protection within and adjacent to publicly owned areas through fee acquisition and easements.

- **Forested attributes**
  A suite of cave systems in the I-540 Corridor FLA harbor several globally imperiled species, including cave crayfish, Ozark big-eared bat, and Ozark cavefish, as well as many related conservation targets of global significance. These systems were identified during the Ozark ecoregional assessment conducted by many agencies under the leadership of The Nature Conservancy.

  The I-540 Corridor FLA is primarily oak/hickory forests interspersed with pastureland and small streams. The forests in the FLA are fragmented remnants of the forest cover found in the time of European settlement.

- **Ownership**
  Identified karst concentrations include Bentonville (4,530 acres, no public lands), and Bella Vista (on the Missouri State line, 1,500 acres in Arkansas, no public lands). Devil's

Den karst is 5,090 acres, of which 2,035 acres are included in Devil's Den State Park. Spavinaw Creek (on the Oklahoma State line, 1,500 acres in Arkansas, no public lands) has karst and aquatic conservation values, including some 15 aquatic species.

Garrett Hollow is a landscape conservation area on the western edge of the Boston Mountains, principally in the Ozark National Forest, with additional public ownership at Devils Den State Park.

The Cave Springs karst area is the most ecologically important of the karst areas delineated in the FLA. It comprises 44,000 acres west of Springdale with extensive subterranean aquatic habitats and many globally rare species. This karst area is almost all in private ownership, with small publicly owned lands near the entrances of Cave Springs (Arkansas Natural Heritage Commission) and Logan (USDI Fish and Wildlife Service) caves. Much of the upland recharge area for the Cave Springs karst system is grazed pasture and developing rural residential neighborhoods that threaten underground water quality.

- **Threats**

  The greatest threat to this FLA is the surge in population being experienced in northwest Arkansas. Urban and exurban sprawl into previously forested lands outside the major communities is expected to continue current expansion rates. Along with urban sprawl, parcelization and fragmentation will continue to threaten natural resources and pressure existing landowners to develop forested land. This development will increase losses of forest values such as access to outdoor recreation areas, wildlife habitat, water quality, and biodiversity.

- **Solutions**

  1. Prioritize the purchase of both fee title and conservation easements of lands adjacent to the Wedington Unit of the Ozark National Forest and other public properties within the FLA to further protect forest from conversion.
  2. Prioritize the purchase of conservation easements within the riparian corridors of the White River, the Illinois River Watershed, and other major streams, ensuring against forestland conversions.
  3. Purchase conservation easements on private lands that contain known cave structures, sinkholes, and other openings to groundwater recharge.

Ozark Mountains
Buffalo River - Forest Legacy Area

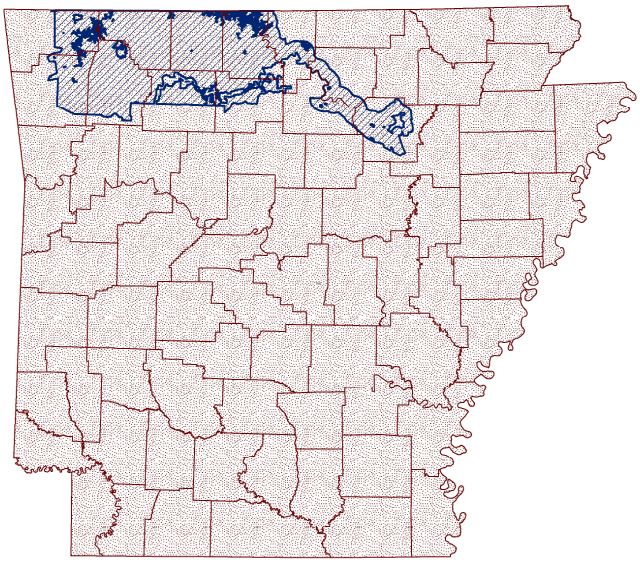

Figure 26

- **General description**
  The Buffalo River FLA includes parts of Baxter, Benton, Boone, Carroll, Madison, Marion, Newton, Stone, Searcy, and Washington counties, and is located in both the Ozark and Boston Mountains sections of the Ozarks Ecoregion. Figure 26 depicts the Buffalo River FLA. The northern boundary of the FLA ends at the Missouri State line to the north and at the I-540 Corridor FLA boundary to the west. The Buffalo River FLA encompasses approximately 2,940,161 total acres and an estimated 1,645,036 forested acres. Approximately 48% of the Ozark karst ecological system within Arkansas is contained in the FLA. This area is underlain by calcareous limestone which is dissolved by acid water, forming solution caves under ground and solution features at the surface such as sinkholes and disappearing streams. Water moves from these surface features into the caves which may harbor endangered species and/or serve as water sources for rural populations. Landscapes with these features are referred to as karst. A number of very important potential karst conservation areas are included in the FLA. The FLA has scenic and aquatic conservation values along the Buffalo River National Park, Buffalo National Wilderness Area, and the Kings River. The Highway 7 State Scenic Byway is enclosed in the FLA and runs north from the Ozark National Forest, through the Buffalo River National Park ending in Harrison, AR. Beaver Lake supplies water for the Fayetteville, Springdale, Rogers, and Bentonville metropolitan area, the fastest growing population center in Arkansas.

- **Why this area was chosen as an FLA**
  The Buffalo River FLA is chosen for its connection to the Ozark National Forest, Buffalo River National Park, Buffalo River National Wilderness Area, State Wildlife Management

Areas, and State Parks. Protecting the forests ensure that quality drinking water will be available for residents of North Arkansas, Eastern Oklahoma, and Southern Missouri. The Buffalo River FLA encompasses the Beaver Reservoir Watershed and the eastern portion of the Illinois River Watershed. Figure 6a shows the Arkansas Priority Watersheds and the Buffalo River FLA. The Beaver Reservoir and Illinois River Watersheds are threatened by sediment due to construction from the rapid urban development in Washington and Benton counties. Agricultural activity is causing the introduction of animal waste into streams that is affecting aquatic life as well as human health.

The FLA encompasses a large portion of the State's Extraordinary Resource Waters (ERW). Refer to Figure 7 to see a map of the ERW's. The ERW designation protects a water body by recognizing its distinct combination of chemical, physical, and biological attributes characterized by scenic beauty, aesthetics, scientific values, recreation potential and intangible social values. The FLA encloses a significant portion of the Areas of Significant Biodiversity as designated by the Arkansas Natural Heritage Commission shown in Figure 10. The areas enclosed are significant for both aquatic and terrestrial biodiversity.

The FLA has important oak/hickory forests under heavy development pressure from residential and agricultural lands expansion. The forests are needed as karst water recharge areas, for recreation value, to protect public drinking water supplies, to protect extraordinary waters, to protect priority watersheds, for wildlife value, to protect national and state designated scenic areas, and to secure habitat for endangered species.

- **FLA Priority Strategies (ranked)**
    1. Protect priority watersheds that are critical for public drinking water supplies and aquatic life.
    2. Protect the scenic National River and scenic state byway for public use.
    3. Protect forested karst recharge watersheds from development.
    4. Protect forested riparian zones from conversion to non-forest agriculture uses.
    5. Enlarge and solidify protection within and adjacent to publicly owned areas through fee acquisition and easements.

- **Forested attributes**

  Two important karst ecological sites are the Bear Hollow Cave and the Smith Creek Nature Preserve which protects Sherfield Cave. Sherfield Cave is where the largest colony of the federally endangered Indiana bats in the state, hibernate each winter. A suite of cave systems in the Buffalo River FLA harbor several globally imperiled species, including cave crayfish, Ozark big-eared bat, and Ozark cavefish, as well as many related conservation targets of global significance. These systems were identified during the Ozark ecoregional assessment conducted by several agencies under the leadership of The Nature Conservancy.

  The Buffalo River FLA is primarily oak/hickory forests interspersed with pastureland and small streams. The forests in the FLA are fragmented remnants of the forest cover found in the time of European settlement.

- **Ownership**

According to the 2005 FIA data, 6% was held by forest industry and 87% was in private non-industrial ownership. Public forest lands enclosed but not included in the FLA make up 7% of the ownership and are the Buffalo National River, Pea Ridge National Military Park, Bull Shoals and Ozark Folk Center state parks, Baker Prairie Natural Area (NA), Bear Hollow NA, Devil's Knob-Devil's Backbone NA, Hell Creek NA, Kings River Falls NA, Searless Prairie NA, Slippery Hollow NA, Sweden Creek Falls NA, Gene Rush Buffalo River Wildlife Management Area (WMA), Hobbs WMA, Loafers Glory WMA, and Madison County WMA. Natural Areas are properties of the Arkansas Natural Heritage Commission and Wildlife Management Areas are properties of the Arkansas Game & Fish Commission.

- **Threats**
  The greatest threat to this FLA is the surge in population being experienced and projected for north Arkansas. Urban and exurban sprawl into previously forested lands outside the major communities is expected to continue to increase. Along with urban sprawl, beef cattle and poultry production, parcelization, and fragmentation will continue to threaten natural resources and pressure existing landowners to develop forested land. This development will increase losses of forest values such as access to outdoor recreation areas, wildlife habitat, water quality, and biodiversity.

- **Solutions**
  1. Prioritize the purchase of both fee title and conservation easements of lands adjacent to the Buffalo National River, Buffalo National Wilderness, Ozark National Forest, the Highway 7 State Scenic Byway, and other public properties within the FLA to further protect forest from conversion.
  2. Prioritize the purchase of conservation easements within the riparian corridors of the Illinois River and Beaver Reservoir Watersheds, Extraordinary Resource Waters, and other major streams, ensuring protection against forestland conversions.
  3. Purchase conservation easements on private lands that contain known cave structures, sinkholes, and other openings to groundwater recharge.

Upper West Gulf Coastal Plain Ecoregion (UWGCP):

The Upper West Gulf Coastal Plain (UWGCP) ecoregion is located in the southern and western parts of Arkansas, encompassing some 8.3 million acres. It is bounded by Louisiana to the south, Oklahoma and Texas to the west, the Ouachita Mountains to the north and the Mississippi Alluvial Plain to the east. This ecoregion is characterized by a diversity of terrestrial and aquatic habitats, dominated by pine-hardwood forests and woodlands on rolling hills and flat Pleistocene terraces, bottomland hardwood forests and cypress swamps along watercourses, and tall grass prairies, saline soil barrens, blackland prairies and groundwater seepage communities in specific physical settings. Streams and rivers are generally of moderate or better water quality as a result of forested watersheds and have relatively wide bottomlands. The UWGCP has outstanding biodiversity, wildlife habitat, soils, and high growth forests.

This ecoregion is characterized as a landscape of gently rolling hills and slow-moving rivers and streams. The streams and bayous support outstanding aquatic biodiversity, including

several species that are only found here. Pine and pine-oak woodlands are the forests that are mostly commercial forestland. Parcelization is occurring as populations around the metropolitan areas of Little Rock and Texarkana move into the surrounding countryside.

Geologic attributes

In the UWGCP, topographic, geologic, soil and hydrologic diversity result in a wide range of habitat types. The typical character of the region is rolling hills formed in Tertiary marine and near-shore deposits of the Gulf of Mexico. These hills are typically sandy, but with silt, clay and gravel common. Areas with deep, excessively drained sands are distinguished as "sandhills". Small areas of sandstone or calcareous clays occur. Cretaceous hills of sand or gravel occur in the extreme northwestern part of the ecoregion. Belts of Cretaceous chalk, limestone or marl (calcareous clay) create the Blacklands, related to the Blackland Prairies of Texas and the Black Belt of Mississippi and Alabama. Streams vary from small sandy headwaters streams to moderate-sized rivers with long-duration flooding and a few large rivers, most prominently the Ouachita and Red rivers. All have relatively wide alluvial floodplains because of the relative ease of reshaping the unconsolidated sediments that form the substrate. Large areas of Quaternary (Pleistocene) terraces form flats, intermediate in character between the Holocene floodplains and the Tertiary or Cretaceous hills. These flats are usually above current floodplains but typically have a dense subsoil and poor internal and surface drainage, leading to substantially different ecosystem characteristics.

Biologic attributes

Terrestrial systems in the UWGCP include both mesic to hydric bottomlands and upland dry-mesic and hydric areas. Bottomlands are dominated by hardwood communities, primarily oak species, and more deeply flooded areas frequently have cypress and cypress-tupelo swamp vegetation. Upland areas are dominated by shortleaf and loblolly pines and mixed pine-hardwood communities with various glades sandhills and woodlands. Local geology and soils conditions provide small patch diversity, supporting many globally significant plant communities. The Blackland region is dominated by woodlands, forests, and small prairies associated with calcareous substrates. These are examples of small patch communities of global importance, which are very critical for conservation of Arkansas' diversity.

Sandhills woodlands, and barrens associated with deep, sandy soils also add community and species diversity to the UWGCP in Arkansas. Flatwoods on Pleistocene terraces are dominated by loblolly pine and hardwoods. These communities are different from upland pine-hardwood communities by being wetter, having a different fire regime, and greater dominance of loblolly pine relative to shortleaf pine.

Aquatic habitats in the UWGCP include low-slope, medium-to-high order streams and riverine systems. Streams are sheet, surface, and groundwater fed. Larger rivers that originate in Arkansas' Ouachita ecoregion flow through the UWGCP and are home to diverse mussel and fish communities. Rivers are the predominant aquatic system in the UWGCP, and contain a diverse assembly of mussels and fish. Substrates range from gravel, sand-gravel, to mud and silt.

The UWGCP is home to 15 endemic species and 59 species with limited ranges. Six federally listed endangered species and two listed threatened species occur in the

ecoregion. Many of the endemic species are crayfishes and mussels. There are at least 10 terrestrial plant communities endemic to the ecoregion.

Forestland status

Much of the UWGCP is forested, with most of that under commercial management by the timber industry. Additional uses include grazing and agriculture. Habitat fragmentation caused by urban growth and suburban sprawl occurs throughout the region. Following the national trend, urban and suburban land uses are increasing, though not as intensely as in other ecoregions.

Forest ownership

According to U.S. Forest Service Forest Inventory and Analysis (FIA) data, the UWGCP region was 2.6% publicly held, 50.6% forest industry held, and 46.8% private non-industrial held in 1988. In 2003 these percentages changed to 3.5% public, 45.3% industry, and 51.1% private non-industrial. The data indicates that in 1988 UWGCP forests were slightly more than half owned by forest industry. Currently, industry owners are selling lands to the two other sectors making private non-industrial owners the largest ownership class. For decades the forest products industry has dominated ownership and management of the UWGCP forests.

Most of the 4.5 million acres owned by industry in Arkansas is concentrated in the Coastal Plain where soils are productive and growing seasons are long. At the regional scale, these industrial forestlands provide important connectivity and habitat. Additionally, because of the close proximity of large industrial mills and industrial influence, private lands in this region have exhibited the same forestry driven structure. From a forest products standpoint, this region represents the "bread basket" of Arkansas. Programs like the Tree Farm program have been very popular among private forest owners since the investment and marketability is so tied to the availability of industry. Public ownership remains a very small percentage and influence in this ecoregion.

Census data and populations changes

Between 1990 and 2000, this area of the state experienced a population growth rate of 6.1%, reaching a total population of 522,016. The population in 2004 remained relatively constant at 524,204, which is a 0.4% increase.

Timber economy

Severance taxes collected for hardwood and pine harvested in these counties have been extracted from each county tax collector's report. Reports indicate how much wood has been harvested for whole counties. For those counties partially included in the ecoregion, data for the whole county has been included. Figure 27 graphs the tons of timber harvested subject to severance taxes for the UWGCP Ecoregion.

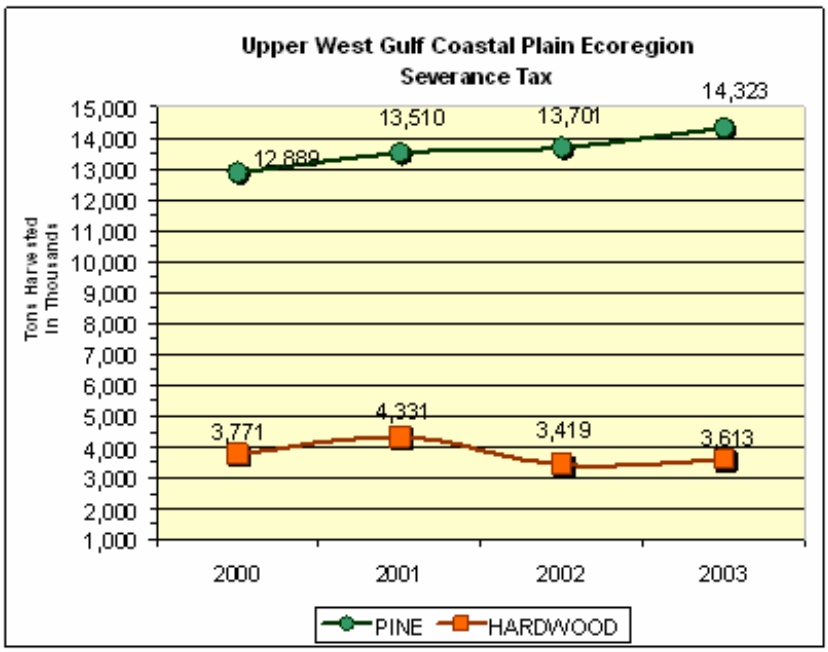

Figure 27

Far and away, timber industry has its largest presence in this ecoregion. Approximately, 60% of all the hardwood and 80% of the pine harvested in Arkansas is harvested here. Figure 28 graphs the UWGCP Ecoregion's percent of the total severance tax for the state for pine and hardwood.

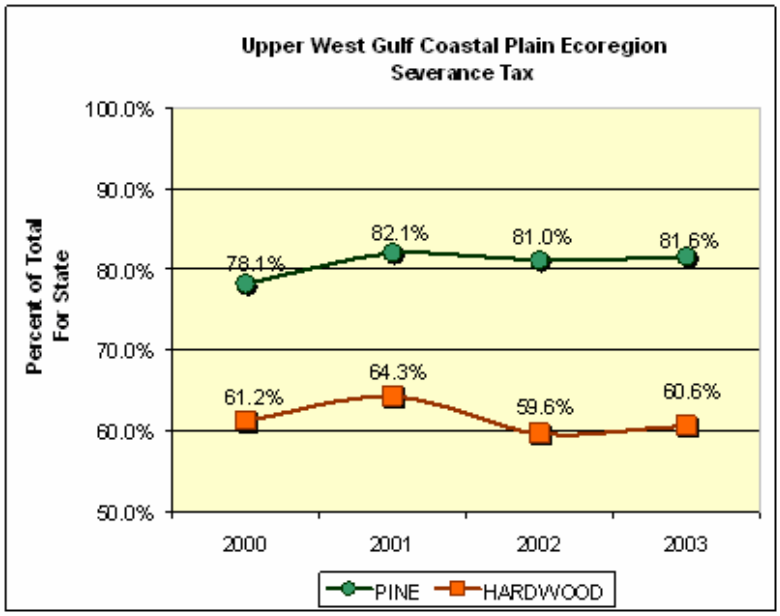

Figure 28

Sawmills and paper mills in the area are usually very large facilities. Approximately, 75 primary wood-using plants were operating in this area in 2002 which is down slightly from

about 85 in 1999. Since 1999 saw-log production has increased 10 % and pulpwood production decreased 29 %. Saw-logs account for 47% of the region's output and 66% of the State's saw-log production.

Major threats to forestland

The primary threat to forests of the UWGCP is that private landowners, both corporate and non-corporate, are selling forest lands as they become more valuable for development. If these lands are located near active real estate markets there is a tendency for industry to sell in order to maximize company profits (Luloff, 2000). Timber Investment Management Organizations (TIMOs) are buying and managing timberland for pension and investments funds with a high rate of turnover of property, since their interests are primarily financially based (Sampson, 2000). Moreover, small private investors are acquiring industrial lands in blocks of a few hundred to a few thousand acres. These investors are reselling the land in very small parcels (often 10 to 20 acres) to exurban owners who will convert part of the land to pasture, small crop farms, and home-sites. Thus, the threat is parcelization, fragmentation, and conversion to non-forest uses.

For example, Georgia Pacific Corporation divested its entire forest land holdings, which included over a million acres in Arkansas, into a Real Estate Investment Trust (REIT), Plum Creek Timber Company, which has recently sold 60,000 acres which is being re-sold in small tracts. More recently Anderson-Tully Company announced the sale of their assets, with approximately 350,000 acres of timber land within a three state area, to a TIMO, Forestland Investment Group, and International Paper Company announced the restructuring of their assets which includes divestiture of all their remaining timber land which includes about 700,000 acres in Arkansas after previously divesting approximately 1 million acres.

The remaining forests in the UWGCP are stressed by wildlife habitat destruction and conversion, as well as fragmentation and alteration of natural fire regimes. These stresses are caused by improper forestry practices and fire suppression. Aquatic systems are stressed by incompatible land use practices leading to sedimentation and runoff, and non-point source pollution.

Upper West Gulf Coastal Plain
Texarkana I-49 Corridor - Forest Legacy Area

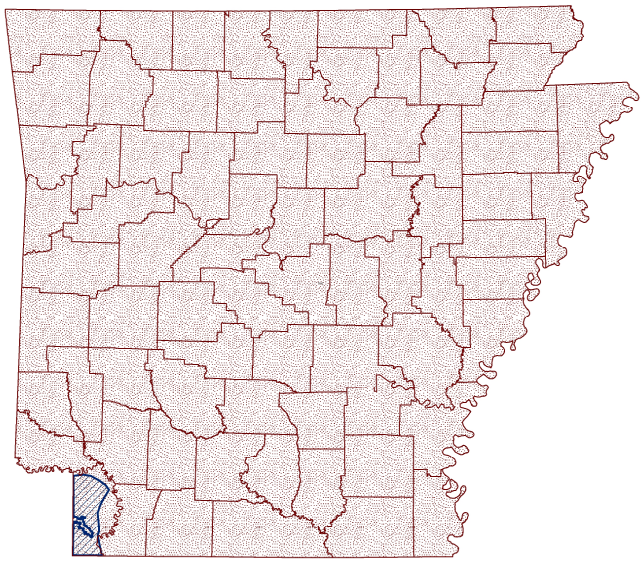

Figure 29

- **General description**
  Texarkana I-49 Corridor Forest Legacy Area is located in extreme southwestern Arkansas between the Red River bottomlands on the east and north, the Texas state line on the west, and the Louisiana state line on the south. Figure 29 shows the Texarkana I-49 Corridor Forest Legacy Area. It encompasses 249,916 total acres which are about half forested or approximately 123,306 forested acres.

- **Why this area was chosen as an FLA**
  This FLA was chosen because of its unique plant communities, biodiversity, outstanding terrestrial and wetland conservation values, outdoor recreation opportunities, and timber production, among those listed on page 8. The FLA includes the Sulphur River and its associated hardwood bottomlands as well as the city of Texarkana. The close proximity to a metropolitan area and the fact that this area supports a wide range of wildlife game species, make it a popular region for outdoor recreation. Therefore, Texarkana I-49 Corridor FLA was chosen to protect these environmental, economic, and social values.

- **FLA Priority Strategies (ranked)**
  1. Protect at landscape scale, best examples of deep sandy soil forests from conversion to suburban and exurban development or pasture.
  2. Buffer and connect larger protected ownerships, if possible.

- **Forested attributes**
  The dominant land cover for this FLA is upland pine-hardwood forests and woodlands. Areas of deep excessively well-drained sand are dominated by sandhill woodlands with tree species such as bluejack oak, margaretta oak, and shortleaf pine. Typically these

hardwoods are stunted at less than thirty feet tall. A diverse herbaceous understory occupies the ground layer. Along the Sulfur River is a wide bottomland with extensive stands of swamp privet and water elm along with some bottomland hardwood and cypress swamps.

- **Ownership**
  Texarkana I-49 Corridor FLA is primarily held by private non-industrial owners (83%, FIA). However, forest industry has some ownership. Two publicly held areas enclosed but not included in the FLA are the Sulphur River WMA, owned by the Arkansas Game & Fish Commission, and Miller County Sandhill Natural Area, owned by the Arkansas Natural Heritage Commission and The Nature Conservancy.

- **Threats**
  The conversion of forests to residential, pasture, and other developed areas has occurred for decades in this FLA. The ecological effects of fragmentation, which is accelerating, threaten remaining forested areas. As I-49 is completed through this area associated commercial and residential development will increase still further and threaten remaining forested areas. The sandhill communities depend on fire to maintain their species diversity and structure, along with wildlife habitat. Fire in sandhill barrens and open woodlands has been suppressed in the past century due to safety concerns within the wildland urban interface and this trend will continue.

- **Solutions**
  1.) Protect forests threatened by conversion to pasture and exurban/suburban development, using easements or acquisitions.
  2.) Expand and, if possible, connect publicly owned landholdings.

Upper West Gulf Coastal Plain
US 167/I-69 Corridor – Forest Legacy Area

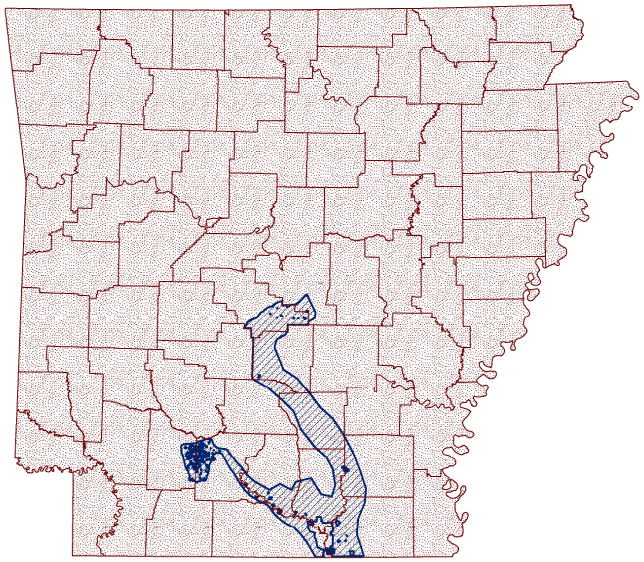

Figure 30

- **General description**
  The US 167/I-69 Corridor FLA is located in the southeastern part of Arkansas' Upper West Gulf Coastal Plain ecoregion. Figure 30 depicts the US 167/I-69 Corridor FLA. It includes reaches of the Ouachita and Saline rivers, and the associated Pleistocene terraces along both rivers. The FLA includes parts of Saline, Grant, Hot Spring, Dallas, Cleveland, Calhoun, Bradley, Drew, Ashley, Ouachita, and Union counties. Several cities and towns (El Dorado, Camden, Benton, and Little Rock) are close by, but only Crossett is in the FLA. The FLA ends at the Louisiana state line, and encompasses approximately 1,559,551 acres with and estimated 1,359,551 forested acres.

- **Why this area was chosen as an FLA**
  This area was chosen as an FLA because it supports exceptional aquatic and terrestrial forest conservation values as listed on page 8. The Saline River has been designated by the Arkansas Department of Environmental Quality as an Extraordinary Resource Water. It contains the last and largest stands of Loblolly/Shortleaf pine dominated flatwoods (a very unique plant community). Red-cockaded Woodpeckers occur within and use the area. The Audubon Society has identified much of the FLA as an Important Bird Area (IBA) and The Nature Conservancy has identified the FLA as part of a key conservation area in the UWGCP ecoregion.

  This FLA is legendary in Arkansas and surrounding states for its timber production and hunting. Much of the FLA is a moderate to high potential aquifer recharge area. The FLA is contiguous with one other FLA: Little Rock-Hot Springs Urban Expansion.

- **FLA Priority Strategies (ranked)**
  1. Protect at landscape scale best examples of Ouachita terrace forests and wetlands including Pine/Oak flatwoods from conversion to exurban homesteads consisting of pastures, small farm crops, chicken houses, home sites and other non-forest uses.
  2. Provide additional public access opportunities for outdoor recreation.

- **Forested attributes**

  The US 167/I-69 FLA is still largely forested and undisturbed hydrologically, and its ecosystem functions are relatively intact. This landscape complex includes big rivers (the Ouachita and Saline), bottomland hardwood forests, terrace pine-hardwood forests and upland pine-oak woodlands and pine-grass savannas. Terrace communities are functionally distinct from the pine-hardwood communities of the uplands, having different moisture and fire regimes and corresponding differences in the flora, fauna, and vegetation. The Ouachita and Saline river reaches of the FLA support ten globally imperiled mussels, including the Ouachita rock-pocketbook (*Arkansia wheeleri*), Arkansas fatmucket (*Lampsilis abrupta*), and winged mapleleaf (*Quadrula frangosa*), as well as some 25 other mussel taxa. Eight globally imperiled fishes including crystal darter (*Crystallaria* asprella) and western sand darter (*Ammocrypta* clara) occur in the Saline and Ouachita. The two rivers support 120 species of fish and 40 species of mussel total.

  The majority of the FLA is forested (84%, FIA), most of which is used in the production of forest products. Pine dominated terraces occupy more of the FLA than hardwood bottomlands. The extensively vegetated wetlands and uplands help maintain water quality for aquatic systems, and provide habitat for several avian guilds of conservation priority. Terrestrial habitats of concern include upland pine/grass, required by red-cockaded woodpecker and important to several high priority bird species. Local geology and soil conditions provide small patch diversity, including saline soil barrens such as Warren Prairie, that support globally significant plant communities, and the listed plant geocarpon (*Geocarpon minimum*). Other forest values include outstanding wildlife habitat which provides many hunting and fishing opportunities.

- **Ownership**

  FIA data shows that industrial ownership is by far the largest class with 58.5% of the forests in the FLA. Private non-industrial ownership is 34.5%. Industrial ownership is declining and private ownership is increasing.

  Public lands enclosed but not included in the FLA account for about 8% of the total ownership. Enclosed public lands are the Felsenthal National Wildlife Refuge, Crossett Experimental Forest of the Ouachita National Forest, Beryl Anthony Lower Ouachita Wildlife Management Area including Coffee Prairie Natural Area (easement held by ANHC), Warren Prairie Natural Area, Poison Springs State Forest, and Moro Bay State Park. The Army Corps of Engineers owns some lands along the Ouachita River.

- **Threats**

  Fragmentation and parcelization are occurring in the US 167/I-69 Corridor FLA. Corporate owners are divesting some, if not all, of their land. Often it is being sold again in parcels of 1,500 acres or less as “higher and better use properties”. These smaller

parcels, even when they remain as timberland, have inconsistent and sometimes unsustainable management.

Although overall population is not growing within the FLA, there is a consistent market for exurban homestead farms of about 10 to 100 acres. Much of the terrace area that is not in industrial forest ownership is in this homestead farm type. Such landholdings may include a wood lot, but in general are in non-forest uses, such as chicken houses, tomato farms, and pasture. Many Arkansans are willing to accept a significant daily commute for the opportunity to live in lightly-settled, less regulated location buffered from the direct influence of neighbors. Interstate 69, proposed to cross about 50 miles of this FLA will increase access to nearby rural areas and encourage commercial development at interchanges, accelerating the current exurban migration.

High-intensity pine management, with herbicides, bedding and dense pine plantations, greatly reduces the viability and restorability of the native flora on the river terraces of the FLA. Fire suppression reduces the quality and quantity of pine/grass habitat for red-cockaded woodpecker, and for a suite of other fire-dependent plants and animals. Overly dense natural stands also stress the terrace communities.

Scattered oil and gas development has taken place on the Ouachita River adversely impacting localized areas. Also, the dam on the Ouachita River within Felsenthal National Wildlife Refuge has altered the hydrologic regime in the vicinity of Felsenthal. Water control structures in Louisiana may also be causing hydrologic stresses in the FLA along to the state line.

As forest is lost to increasing development, forest related functions such as: timber production enhanced water quality, groundwater recharge, and forest wildlife habitat are impaired or lost.

- **Solutions**
  1.) Using easements or acquisitions protect forest lands from conversion to pasture and exurban homesteads.
  2.) Using easements and acquisitions solidify and, if possible, connect existing public landholdings.
  3.) Take action at landscape scale (e.g. target lands that connect or are adjacent to existing conservation areas).

Ouachita Mountains Ecoregion (Including the Arkansas River Valley):

The Ouachita Mountains Ecoregion is located in the west central part of Arkansas. It encompasses both the east-west range of the Ouachita Mountain and associated foothills to the south plus the Arkansas River Valley to the north. The largest land holding in this ecoregion is the Ouachita National Forest, which is 1.2 million acres. The most concentrated populated areas of the ecoregion are major cities including Hot Springs, Conway, Russellville, Ft. Smith, and portions of Little Rock.

Outstanding aquatic and terrestrial biodiversity, ranging from rugged novaculite ridges and sandstone glades, to mountains supporting the world's most extensive native shortleaf pine

woodlands characterize this ecoregion. Clear streams, rivers and wetlands, because of their excellent water quality, support diverse assemblages of fishes and mussels, including many endemic and globally rare species. The region is mostly forested (74%, FIA 2003) except for growing population centers.

Geologic attributes

The Ouachita Mountains include folded Paleozoic sedimentary ridges and rolling lowland river valleys; subsections of the ecoregion include Cherokee Prairies, Arkansas River Valley, Fourche Mountains, Central Ouachita Mountains and Athens Plateau. The ecoregion offers an abundance of upland game species, exceptional scenic ridge top views, and a fascinating and diverse geology.

Biologic attributes

Natural tall grass prairies in the Arkansas River valley offer outstanding displays of native wildflowers. With the exception of pasture operations in broad valleys and cropland on most of the major floodplains, the ecoregion is largely vegetated with forests or woodlands, ideally suited for woodland migratory and breeding birds.

The Ouachitas support outstanding aquatic and terrestrial biodiversity, with 48 endemic species, 104 globally critically rare to rare species and communities, and 44 species listed or potentially listed as threatened or endangered. Streams, rivers, and wetlands support assemblages of fishes and mussels, including endemic and globally rare species. Streams and small rivers in the Ouachitas are exceptional, and are home to endemic or rare Ouachita madtom *(Noturus lachneri*), paleback darter (*Etheostoma pallididorsum*), panther darter (*Percina pantherina*), Arkansas fatmucket (*Lampsilis powelli*), and the Ouachita kidneyshell (*Ptychobranchus occidentalis*). Ouachita riverine and wetland habitats provide aggregation and breeding grounds for a variety of game and large-river guild fish as well.

There are a number of rare or endemic plant species and terrestrial plant communities in the Ouachitas as well; the Oak and Pine-Oak upland groups include five rare or endemic communities; and tall grass prairies include three rare or endemic communities. Ouachita rare plants include twistflower (*Streptanthus obtusifolius*), harperella (*Ptilimnium nodosum*) and geocarpon (*Geocarpon minimum*). Tall grass prairies and various woodlands host extraordinary insect biodiversity, including the rattlesnake master borer moth (*Papaipema eryngii*) and the Diana fritillary (*Speyeria diana*); pine-oak woodland groups are home to the endangered American burying beetle (*Nicrophorus americanus*). Upland communities are home to three globally rare or listed threatened invertebrates; six rare to globally rare or endemic aquatic insects occur in ecoregional streams.

Forestland status

The region, with the exception of lowlands in the valleys, is substantially forested. The Ouachitas are well known for their shortleaf pine stands. Also growing with the pine in many places are typical upland hardwood species such as oak and hickory.

Forest ownership

A large portion of this ecoregion is the federally owned Ouachita National Forest comprising over 1 million acres of forested landscapes. In 1988 46.7% was public, 22% was forest industry, and 31.2% was private. By 2003 46.5% was public, 20.6% was forest industry, and

32.9 were in private ownership (FIA). The data shows very small changes between ownership classes in the Ouachitas, making this ecoregion the most stable in ownership.

Census data and populations changes

Between 1990 and 2000, this area of the state experienced a population growth rate of 13.1%, reaching a total population of 881,967. It contains some of the most densely populated areas of the state. The population rose to 912,136 in 2004, which is an increase of 3.3%. Urbanization around Little Rock and Conway has grown dramatically within the last 10 years.

Timber economy

The Ouachita area has been a major source of forest products, primarily pine, for many years. Through forest management activities on the Ouachita National Forest and forest industry lands in this region, several large capacity mills have provided a long-term contribution to local communities. The economies of several of the mountainous communities are forest products based. Schools in these areas have been very dependent upon timber taxation and in-lieu fees paid by the Ouachita N. F. Figure 31 graphs the tons of timber harvested subject to severance taxes for the Ouachita Mountains Ecoregion.

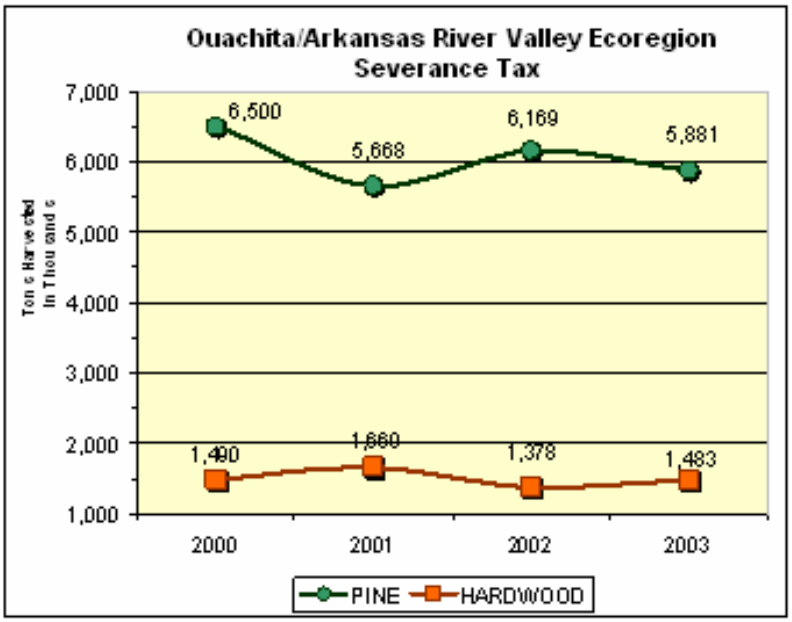

Figure 31

Severance taxes collected for hardwood and pine harvested in these counties have been extracted from each county tax collector's report. Reports indicate how much wood has been harvested for whole counties. For those counties partially included in the ecoregion, data for the whole county has been included.

This ecoregion is second only to the Upper West Gulf Coastal Plain ecoregion in timber production. Approximately, one fourth of all the hardwood harvested in Arkansas is harvested in this ecoregion, while about one third of the pine for the State is harvested in the

same area. Figure 32 graphs the Ouachita Mountains Ecoregion's percent of the total severance tax for the state for pine and hardwood.

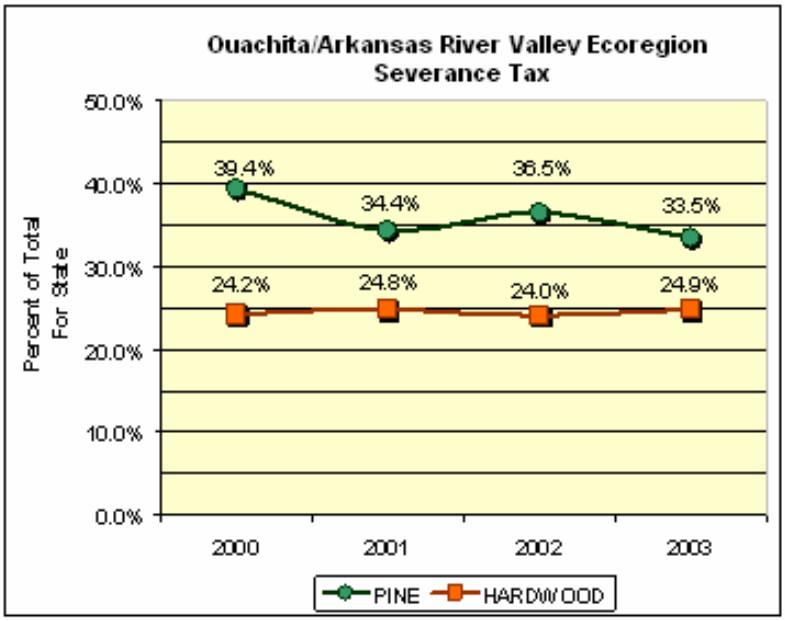

Figure 32

Sawmills in the area are fewer but on average larger than those in the neighboring Ozark ecoregion. Approximately, 40 primary wood-using plants were operating in this area in 2002, which is down slightly from about 45 in 1999. Since 1999, sawlog production has increased 5 percent and pulpwood production decreased 14 percent. Sawlogs account for 53% of the region's output.

Major threats to forestland

Conversion to urban/suburban development around population centers and reservoir watersheds is a top threat in the Ouachitas. Although undocumented, west Little Rock, Conway, and Hot Springs are examples of urban and watershed conversion creating an extensive wildland urban interface.

Parcelization of industrial holdings represents a threat to the future of forestlands within this ecoregion. The sale of industrial lands as "higher and better use" properties that break large tracts of forestland is a common occurrence which leads to suburban and exurban development. Extensive development of formerly forested hillsides threatens water quality of many upland streams.

Forest health issues such as oak decline constitute a significant threat to oak forest sustainability in the Ouachita region. Red oak borer has moved south out of the Ozarks into the Ouachitas. This combined with over-stocked, over-mature, and drought stricken trees leads to the oak decline problem.

Ouachita Mountains
Little Rock-Hot Springs Urban Expansion – Forest Legacy Area

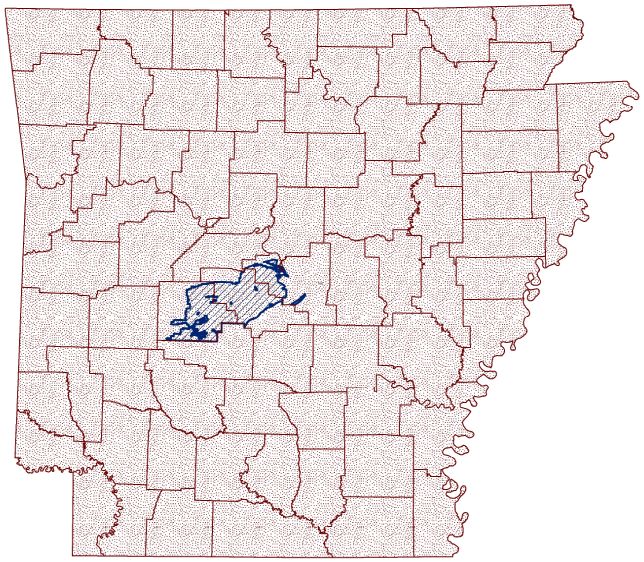

Figure 33

- **General description**
  The Little Rock-Hot Springs Urban Expansion FLA, shown in Figure 33, includes the entire watershed of the upper Saline River in parts of Garland, Pulaski, and Saline counties. The FLA joins the US 167/I-69 Corridor FLA to the south and the I-40 Corridor to the north. A small part of the FLA in western Pulaski County is in the Maumelle River watershed. This FLA is completely contained in the Ouachita ecoregion and occupies approximately 586,343 acres in central Arkansas with an estimated 405,983 forested acres.

- **Why this area was chosen as an FLA**
  This area was chosen for its aquatic conservation values that are associated with the four forks of the upper Saline River and for forest values, as listed on page 8, throughout the watershed. The FLA contains the western sprawl of Little Rock with Lake Maumelle, a municipal water source, and major developments associated with Hot Springs such as Hot Springs Village. Water quality is one of the most critical and valuable resources of concern in the FLA.

- **FLA Priority Strategies (ranked)**
  1. Protect forested riparian zones and watersheds from conversion to agriculture and development
  2. Buffer and connect larger protected ownerships, if possible

- **Forested attributes**

The Little Rock-Hot Springs Urban Expansion FLA is mostly forested (74%). Shortleaf and Loblolly pines are abundant mixed with upland hardwoods. Some smaller areas of bottomland hardwoods exist along the usually small stream courses. The Upper Saline forests are well used for many types of recreation including: hunting, fishing, hiking, mountain biking, and wildlife viewing, and camping. Wood products are regularly produced from this area and have been for many decades.

The Little Rock-Hot Springs Urban Expansion FLA also includes one of the most diverse stream systems in the Ouachitas. The Saline River as a whole is considered by some experts to be the most diverse aquatic system in the southeastern United States. It is also one of Arkansas' last major undammed rivers. As a result, the Arkansas Department of Environmental Quality has designated the Saline River as an Ecologically Sensitive Waterbody and Extraordinary Resource Waters (ERW). The ERW designation protects a waterbody by recognizing its distinct combination of chemical, physical, and biological attributes characterized by scenic beauty, aesthetics, scientific values, recreation potential and intangible social values. The upper Saline harbors at least six aquatic species with Federal Endangered Species Act listing status or State Special Concern status, including the Arkansas fatmucket mussel, the pink mucket mussel, and the Western fanshell mussel.

The Ouachita ecoregional assessment led by The Nature Conservancy identified 25 conservation targets for the upper Saline River, including 14 globally rare insects and several natural communities found only in the Ouachitas.

- **Ownership**

The Little Rock-Hot Springs Urban Expansion FLA is owned approximately 43% by forest industry and 47% by private non-industrial owners. Many owners in the private non-industrial sector are thought to be absentee and second home/estate owners.

The public land ownership enclosed by the FLA but not included accounts for 10% of the ownership and is a portion of the Ouachita National Forest in the western and northern parts of the area and the Middle Fork Barrens Natural Area.

- **Threats**

Threats to the Little Rock-Hot Springs Urban Expansion FLA include parcelization, fragmentation, exurban, suburban, and urban development. The forests and their water courses are stressed by sedimentation, nutrient loading, and runoff from development and incompatible land use practices. Residential areas are being developed in the west Little Rock and Hot Springs urban areas. Possibly even more threatening is the trend of private owners to buy small acreages (5 to 40 acres) to develop as a second home and retirement home sites. Once these people retire, second homes will become primary residences and exurban dispersed development will become more densely populated suburban areas.

High-intensity pine management, using herbicides, ripping, bedding, and then planting dense pine plantations, is also a source of stress throughout the upper Saline watershed. Finally, overly dense natural stands may be affecting forest health in the FLA. All this diminishes other forest values such as aesthetics, recreation, water quality, and wildlife habitat.

- **Solutions**
  1. Identify reserves within urban sprawl areas to be retained as forested lands.
  2. Purchase, through fee title or conservation easements, forest lands as identified in number 1.
  3. Continue to pursue conservation easements with both private and industrial forest landowners to protect forests from conversion or fragmentation.
  4. Enlarge, solidify ownerships and, if possible, connect public landholdings.

Ouachita Mountains
I-40 Corridor – Forest Legacy Area

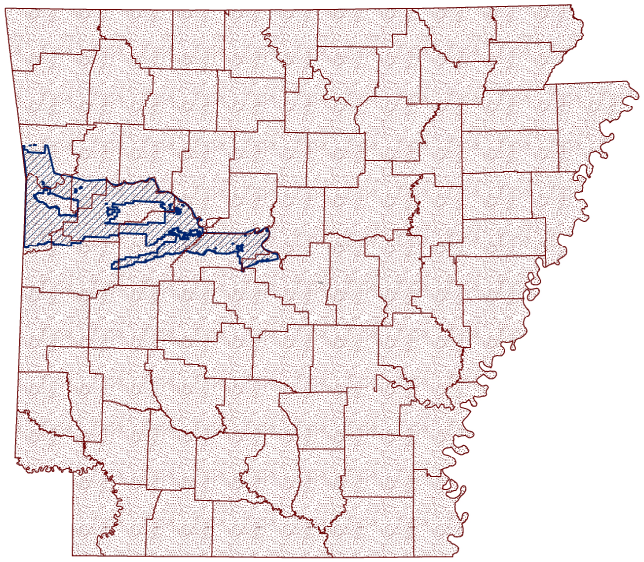

Figure 34

- **General description**
  The I-40 Corridor FLA, shown in Figure 34, is located in the northwestern part of the Ouachita Mountain ecoregion. It includes parts of Crawford, Sebastian, Franklin, Logan, Johnson, Yell, Pope, Perry, Pulaski, and Conway Counties, and encompasses approximately 1,354,798 total acres with an estimated 654,798 forested acres.

- **Why this area was chosen as an FLA**
  Rugged portions of the FLA are predominantly forested, having the full range of values listed on page 8. Several of the most scenic mountains of the state occur within the corridor including Mt. Magazine, the highest in Arkansas, and Petit Jean Mountain. Several of the areas support extensive working forests. Natural tall grass prairies in the more level portions of the Arkansas River Valley provide considerable biological diversity to the otherwise forested landscape. The Audubon Society has identified portions of the FLA as Important Bird Areas (IBAs) and The Nature Conservancy has identified portions of the FLA as key conservation areas in the Ouachita Mountain ecoregion.

- **FLA Priority Strategies (ranked)**
  1. Buffer and connect larger protected forested ownerships such as Ouachita N.F.
  2. Protect native woodland buffers of natural prairie.

- **Forested attributes**
  The forests of the FLA are marked by dramatic topographic, wildlife, and plant community diversity. The eastern end contains level areas of bottomland hardwoods along the Arkansas River, and small, meandering upland streams such as Palarm Creek, Galla Creek, Fourche La Fave River, and the Petit Jean River. The middle portion of the FLA includes the Magazine Mountain range (the highest point in Arkansas), which is the dominant forestland in this region. The topography of the western half is mostly gently to moderately rolling hills, with some higher elevations. This part of the FLA supports shortleaf pine forests, post oak woodlands, pastures, and prairies. The steep terrain and high elevations of Magazine Mountain are home to seven rare plants, seven rare invertebrates, and some twenty rare plant communities. The forests and woodlands also support forest-dependent breeding bird species. The Arkansas River Valley forests represent a transition northward from the pine dominated Ouachita Mountains and contain a narrow band of bottomland hardwood forests in the lower elevations transitioning into upland hardwood and pine mixed forests in the higher elevations and northward into the Ozarks. Due to its proximity between these two east-west ranges, the river valley is quite diverse in the range of species occurring along the river corridor.

- **Ownership**
  According to the 2004 FIA data 5% was forest industry held and 55.5% was in private ownership. Public lands enclosed but not included in the FLA make up 39.5% of the ownership and are the Magazine Mountain Ranger District on the Ozark National Forest, Magazine Mountain and Mt Nebo state parks, Ft. Chaffee and Army Corps lands (Department of Defense); Cherokee Prairie and Flanagan Prairie (Arkansas Natural Heritage Commission), Holla Bend National Wildlife Refuge, Blue Mountain WMA, Petit Jean WMA, Galla Creek WMA, and Ed Gordon/Point Remove WMA.

- **Threats**
  The primary threats to forestlands in the I-40 Corridor FLA are conversion of forests to urban and exurban development and pasture on private holdings. Primary growth areas are around the main cities and towns along the Interstate 40 corridor, leading to increases in human populations and the need for infrastructure, causing forest fragmentation. Most affected are the areas around the communities of Conway, Russellville and Ft. Smith.

  The rural lands along the Arkansas River Valley are primarily private-owned farms and ranches. With the adequate transportation network and forest products industries present, it is affordable to clear additional lands for agricultural uses.

  The bottomland hardwood forests along the main tributaries are impacted by the navigational manipulations of the Arkansas River. The McClellan-Kerr Navigation project along the Arkansas River, developed in the early 1960s, has resulted in drastically changed hydrologic regimes within the forested bottoms. With prolonged inundation into the growing season in the bottomland hardwood forests, forest health problems are a great threat to sustainability of these oak-dominated sites. Along with the navigation

project, intermittent streams and creeks became permanent waterways for an influx of beaver populations. Beaver populations have dramatically increased throughout the FLA due to the increase in available habitat. This threat is most evident on public lands throughout the river valley.

Additional threats within the FLA include inactive mines and active gas wells.

- **Solutions**
  1. Use fee title and easements to protect forest land from conversion to urban/suburban/exurban areas.
  2. Enlarge, solidify ownership and, if possible, connect existing public lands.

Mississippi Alluvial Plain Ecoregion (MAP), including Crowley's Ridge:

The Mississippi Alluvial Plain (MAP) ecoregion is located in the eastern part of Arkansas. Its most defining features are the Mississippi River and the lowland rivers that enter the Mississippi in Arkansas. The area encompasses 9.4 million acres.

This ecoregion is characterized by a diversity of terrestrial, wetland, and aquatic habitats ranging from terrace prairies, to bottomland hardwoods and old growth cypress swamps, as well as oxbows, sloughs, and interdunal sandponds. Crowley's Ridge supports seepage areas and rich loess-based hardwoods. The MAP also supports world-renowned waterfowl hunting.

Geologic attributes

The Mississippi River helped forge this geologically complex area, cutting through and reworking Coastal Plain sediments deposited by a retreating Gulf of Mexico during the Tertiary Period of the Cenozoic Era, while simultaneously depositing new materials from lands further north. Alluvium left by annual floods and the migration of river channels further shaped the MAP ecoregion, during the Pleistocene Era when glacial outwash, sand and silt deposition and during the Holocene Era when modern rivers deposited the wide bottomlands of sand, silt, and clay.

Crowley's Ridge rises up to 200 feet above the floodplain and is comprised primarily of Tertiary deposits at its base, with well-drained and highly erodible wind-blown deposits (loess) forming a cap in places, especially at the south end.

Biologic attributes

The bottomland hardwood forest is the dominant natural plant community of the MAP. It is maintained by regular flood events and localized ponding on poorly drained soils. Headwater or mainstream flooding results from rainstorms over the watersheds of the Mississippi and its tributaries, and produces the large-scale annual springtime inundation characteristic of the ecoregion. Backwater flooding is a phenomenon in which high water stages on the Mississippi River create a damming effect, preventing tributary drainage into the mainstream and at times reversing tributary flow upstream. As a result, long-duration flooding accompanied by sediment and nutrient deposition occurs through many of the lower reaches of tributaries, such as the White and St. Francis rivers.

The diversity of forests and other communities characterizing the historic landscape provided extraordinary habitat for a range of species utilizing the MAP. River floodplain systems are highly productive and provide exceptional habitat for a variety of vertebrates including fish, amphibians, reptiles, birds, and mammals, as well as many invertebrates. Over 240 fish species, 45 species of reptiles and amphibians, and 37 species of mussels depend on the river and floodplain system of the MAP. In addition, 50 species of mammals and approximately 60 percent of all bird species in the contiguous United States currently utilize the Mississippi River and its tributaries and/or their associated floodplains. A number of MAP species are federally listed as Threatened or Endangered, including the interior least tern, the fat pocketbook and pink mucket mussels, pondberry, Red-cockaded Woodpecker, and the Ivory-billed Woodpecker, formerly thought to be extinct.

Habitat and patch diversity are also contributed by several distinct landforms in the MAP. These include the Grand Prairie, a Pleistocene terrace remnant that was vegetated by tall grass prairie until it was converted to agriculture. Pleistocene dune systems, with interspersed interdunal sandponds, support pondberry at several places in the Arkansas MAP. Saline soil barrens are associated with areas of Lafe and Bonn soils. The loblolly pine-post oak flatwoods also add diversity to the MAP vegetation, and one remnant supports nesting Red-cockaded Woodpeckers.

The deep loess sites on Crowley's Ridge support forests of rich, mesophytic hardwoods such as cucumber magnolia, beech, butternut, and various hickories and oaks, over rich shrub and herbaceous layers. The only native stands of yellow poplar in Arkansas are also part of these forests. Where loess is absent, drier site oaks and hickories and shortleaf pine-hardwood plant communities are present. Seepage areas add diversity in the northern end of Crowley's Ridge.

Forestland status

Over 80% of natural vegetation in the Mississippi Alluvial Plain is converted to other uses, primarily agriculture.

Forest ownership

According to FIA data for 1988 15.3% was in public ownership, 12.7% forest industry, and 72% private non-industrial. By 2003 18.2% was in public ownership, 11.3% in forest industry, and 70.4% was in private non-industrial ownership. It is the only area in the state showing increase in public over private ownership. However, public ownership is enclosed, but not included in the FLA. Most forested blocks have a substantial component of publicly owned land. The Arkansas Game and Fish Commission has 161,859.5 acres, with a total of 244,692.8 acres owned by the US Fish and Wildlife Service, the US Forest Service, and the Arkansas Natural Heritage Commission. The forests of Crowley's Ridge are for the most part privately owned.

Census data and populations changes

Between 1990 and 2000, this area of the state experienced a population growth rate of 3.2%, reaching a total population of 628,152. By 2004, this area of the state's population decreased to 623,068, or -0.8%. As opportunities for the local communities within this region continue to decrease, it is likely that the population will also, except in locally strong areas such as Jonesboro and Memphis, on and near Crowley's Ridge.

Timber economy

This region is focused upon the quality hardwood sawtimber products remaining from the fragmented bottomland hardwood forests. Most of the bottomland forests in this region are publicly owned and most are engaged in some form of forest management that provides an economic contribution to local communities.

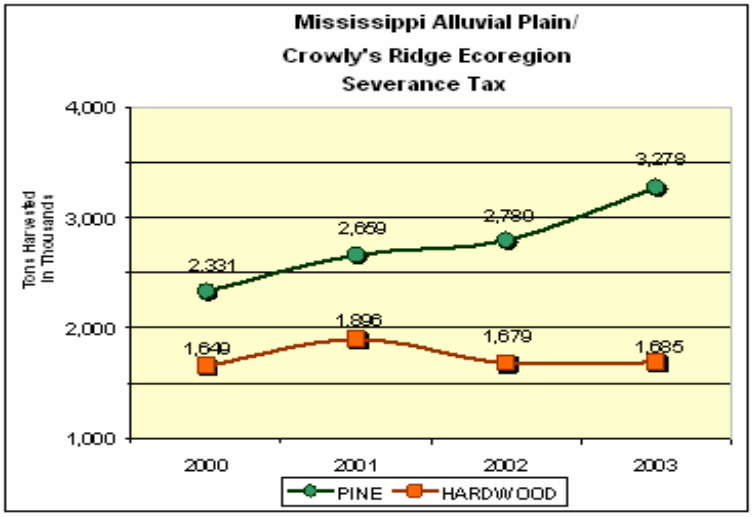

Figure 35

Severance taxes collected for hardwood and pine harvested in these counties have been extracted from each county tax collector's report. Reports indicate how much wood has been harvested for whole counties. For those counties partially included in the eco-region, data for the whole county has been included. Figure 35 graphs the tons of timber harvested subject to severance taxes for the Mississippi Alluvial Plain/Crowley's Ridge Ecoregion.

Approximately, 28% of all the hardwood and 19% of all the pine harvested in Arkansas is harvested in this ecoregion. Approximately, 42 primary wood-using plants were operating in this area in 2002 which is down slightly from approximately 49 in 1999. Since 1999 saw-log production has declined 5 percent and pulpwood production decreased 37 percent. Saw-logs account for 58% of the region's output. Figure 36 graphs the Mississippi Alluvial Plain/Crowley's Ridge Ecoregion percent of the total severance tax for the state for pine and hardwood.

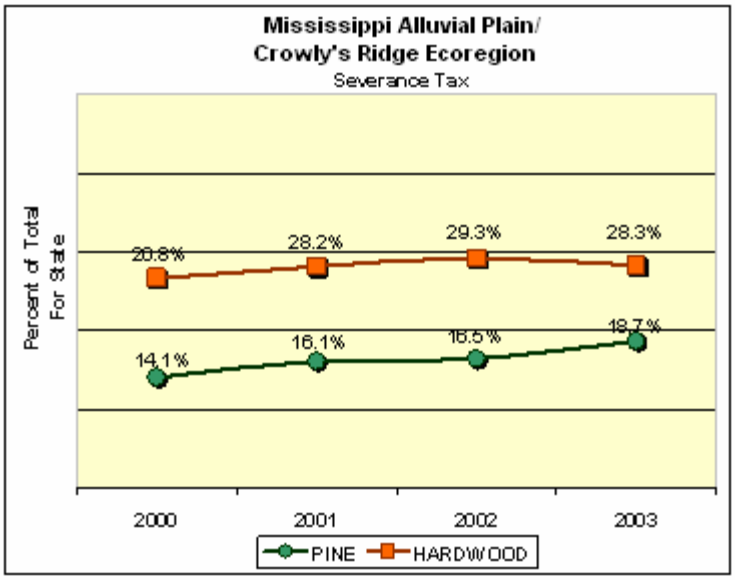

Figure 36

Major threats to forestland

The historical and current threat in the delta region is clearing and draining. Many agricultural fields are being precision leveled to conserve water use while eliminating natural drains, which in combination with release of irrigation water makes the existing remnant forests wetter. As hydrology continues to become altered, the persistence of historical forest is threatened.

Federal environmental programs under the Farm Bill, such as Wetland Reserve Program have had dramatic benefits for this region, but with the large number of hardwood plantations that have been established, it will be important for forest management to be implemented in the future. This establishment of new tracts of bottomland hardwood in no way reduces the biotic importance on the remaining natural bottomland hardwood stands that are privately owned. Incentives provided to private owners to manage these natural forests on a sustained-yield basis would benefit the region. WRP, CRP and other efforts could provide the connecting forests required to increase tract sizes. Because of these programs, net forest land is probably increasing in the Mississippi Alluvial Plain.

A higher frequency of prolonged flooding during growing season months poses a threat to forests along the White River. This results from upstream dam releases along many smaller streams and drainage field water from rice farms. As a result, bottomland hardwoods are being subjected to stresses that cause decreased growth and vigor which lead to canopy loss, and increased insect and disease activity.

Mississippi Alluvial Plain
Crowley's Ridge – Forest Legacy Area

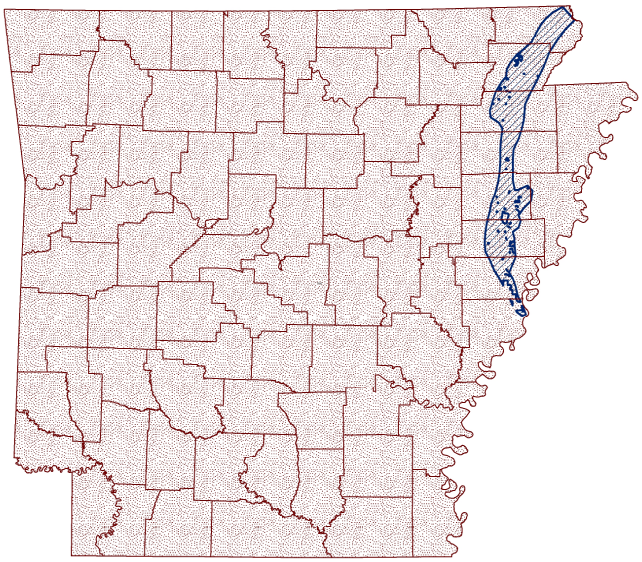

Figure 37

- **General description**
  The Crowley's Ridge FLA, shown in Figure 37, ranges from ½ to 12 miles wide, and rises up to 200 feet above the surrounding alluvial plain, encompassing approximately 882,389 total acres with an estimated 227,719 forested acres. Crowley's Ridge is an erosion-formed remnant, formed when the Mississippi changed course to the east, leaving the isolated ridge of Tertiary deposits which were later mantled with wind-blown loess. At many points the terrain is gently rolling. The southern end has somewhat steeper topography and some striking views to the east across the alluvial plain where the Mississippi is close to the foot of the Ridge. This portion also has the deepest loess deposits.

- **Why this area was chosen as an FLA**
  Crowley's Ridge FLA supports terrestrial conservation values, including a number of rare plants. Localized seepage wetlands are known from the northern part. It is a mixture of forestlands, agricultural lands, and urban/suburban areas. Crowley's Ridge has the only native population of yellow poplar in Arkansas. Its unique soils are highly erodible and need forest cover. The southern portion of the FLA is publicly owned, but privately owned (and much developed) to the north.

- **FLA Priorities Strategy (ranked)**
  1. Protect the most extensive areas of loess soil hardwood forest

  2. Buffer and connect larger protected ownerships, if possible

- **Forested attributes**

In many places, the deep loess sites on Crowley's Ridge support forests of rich, mesophytic hardwoods such as cucumber magnolia, beech, butternut, and various hickories and oaks, over rich shrub and herbaceous layers. Native stands of yellow poplar are also part of these forests. Where loess is absent, drier site oaks and hickories and shortleaf pine-hardwood plant communities are present. Seepage areas add diversity in the northern end of Crowley's Ridge.

- **Ownership**
  According to 2004 FIA data 0% industry, and 82.5% privately owned. Public lands enclosed but not included in the FLA make up 17.5% of the ownership and are the St. Francis National Forest; Lake Poinsett, Crowley's Ridge, Lake Frierson, and Village Creek State Parks; Chalk Bluff and Wittsburg Natural Areas; and W.E. Brewer/Scatter Creek and Lee County Wildlife Management Areas. A new State Park is being developed within the St. Francis National Forest, under a special use permit between Arkansas State Parks and the USDA National Forest Service.

- **Threats**
  Urban development is extensive in the vicinity of Jonesboro, but is also occurring around other urban areas such as Helena, Forrest City, and West Memphis. The greatest threats to forests of the ridge come from gravel mining. The only substantial deposits of gravel in northeastern Arkansas occur in the Tertiary deposits that make up the base of the ridge. Access to these deposits requires removal of underlying soil and vegetation. Since the gravel deposits are relatively thin, large areas are mined. Adjacent areas are affected because of landslides and erosion, as well as disruption of the local water table.

- **Solutions**
  1. Acquire forestland easements that include mineral rights and preclude other forms of conversion as well.
  2. Provide extensive buffers to public lands that preclude mining as well as other forms of conversion.

7. PUBLIC PARTICIPATION

The Arkansas Forestry Commission will solicit involvement and comments on the AON from the public including state and local governments. In addition to public hearings, the AON will be made available for viewing on the Arkansas Forestry Commission's website where any interested persons can find a link to the document and view it in pdf format. Public meetings will be held in each of the four regions of the state, Fayettville, Jonesboro, Little Rock, and Camden. A list of the newspapers that will publish the notice of public hearings is provided in Appendix D. Public comments will be recorded and included in Appendix E. On April 25, 2007 to May 2, 2007, a public notice for the Buffalo River FLA amendment and the removal of public lands/lakes from existing FLAs amendment was published in a statewide circulation newspaper, the Arkansas Democrat/Gazette, according to procedures in Appendix C. No comments or requests for public hearing were received.

8. PROJECT EVALUATION & PRIORITIZATION

This guidance outlines the approach to be used to evaluate and prioritize individual Forest Legacy Projects submitted to the Arkansas Forest Stewardship Coordinating Committee for

consideration. Recommendations will be made by the Committee to the State Forester who must approve projects to be submitted to the U.S. Forest Service.

Objectives are:

- Provide a clear and defensible ranking process
- Insure fair, equitable and thorough review of all projects by the entire Arkansas Forest Stewardship Coordinating Committee

Proposed projects must:

- Be based on Arkansas' Assessment of Need
- Be located within a designated Forest Legacy Area
- Meet the goal and objectives of Arkansas' Assessment of Need
- Be at least 75% forested
- Must be privately owned
- Have a ranking of high, medium, or low for each national core criterion
- Have an indication of the level of project readiness
- Indicate if the project is to be phased (if so, how many phases are anticipated to completion)
- Indicate if the project can possibly be phased
- Indicate if the project must be funded in its entirety (would less than full funding be accepted)

The Arkansas Forestry Commission will insure all data for selected projects (to be submitted for funding) will be accurately entered into the Forest Legacy Information System (FLIS) by November 1st in order of priority. No more than three projects will be submitted. Combined projects will not exceed $10 million, and no single project will exceed $7 million.

RANKING (Guidelines for determining priority of interests in lands to be acquired)

The Arkansas Forest Stewardship Coordinating Committee will base project selection on the following national core criteria. Points have been assigned to each of the three criterions. There is a possible 30 points for each criterion with a combined maximum score of 90 points. Highest scoring applications will be accepted and passed on to be reviewed at the national level for possible funding.

The points assigned to the criterion below the maximum 30 point level may be given points between those lines of demarcation, but must be accompanied with comments justifying those variations. For example, a "Threatened" score between Likely and Imminent can be given 25 points as long as there are comments justifying the score.

Importance - <u>The public benefits gained from the project and management of the property.</u>

- <u>Outstanding/Exceptional value</u> – 30 Points – A national scale community of interest;
- <u>Very Good</u> – 20 Points – A regional scale community of interest (multi-State or within State);

- Medium/Average – 10 Points – A local scale community of interest; or
- Poor – 0 Points – No clear community of interest.

This criterion reflects the ecological assets and the economic and social values conserved by the project and the scale of the people's interest in its protection. It is meant to assess the attributes to be conserved and the size of the community receiving those benefits.

Examples of high quality attributes (order of attributes does not imply an importance):

- Scenic – In the viewshed of a designated scenic area
- Fish & Wildlife Habitat – Important fish or wildlife habitat exists
- Threatened or Endangered Species Habitat – Site has known habitat for rare, threatened or endangered plants and animals or includes unique forest types and communities
- Watershed Protection – Contiguous riparian area, sensitive watershed lands, lakefront, buffer to public drinking water supply
- Forestry – Integral in supporting the local resource-based economy for a community or region and the tract is a foundation to maintain the economically viability of forestry for the community or region
- Recreation – The property is a public access location or acts as a gateway to increased public access
- Cultural – Known culturally and historically significant values are located on site

Threatened – Conversion to non-forest uses or conditions is possible to imminent and will result in a loss of forest values and public benefits.

- Imminent – 30 Points
- Likely – 20 Points
- Possible – 10 Points
- Unlikely any time soon (within 10 years) – 0 Points

This criterion reflects an estimate of the urgency of the threat of conversion. It is meant to reflect the likelihood of a conversion that would result in the loss or diminution of the assets of a larger forest area

Strategic – The project fits within a larger conservation plan, strategy, or initiative and embraces previous conservation investments.

- A key property in regional, bi state or landscape conservation effort – 30 Points
- A key property in a state plan or focused protection strategy – 20 Points
- Will lead to additional conservation action in its region or area – 10 Points
- It is an isolated tract with no known connection at this time – 0 Points

This criterion reflects the projects relevance or relationship to conservation efforts on a broader perspective.

Project Readiness – A graduated scale indicating the level of commitment and likelihood a project will be completed in a predictable timeframe.

- Level 1 – 4 items completed
- Level 2 – 3 items completed
- Level 3 – 2 items completed
- Level 4 – 1 items completed
- Level 5 – 0 or less items completed

Items to be completed include:

- Completed appraisal approved to federal standards
- Completed appraisal awaiting review to federal standards
- Final easement or fee acquisition conditions
- Completed and approved Forest Stewardship or Multiple Resource Management Plan
- Cost Share commitment
- Signed option or purchase and sales agreement
- Held by a third party at the request of the State

Project readiness is a criterion that reflects the degree of due diligence applied and the certainty of a successful FLP project. It is intended to be a guide to project selection decisions. The readiness level is determined by the cumulative progression of items completed.

Project Scoring Table

Project Name/State	*Importance (0-30 pts.)*	*Threatened (0-30 pts.)*	*Strategic (0-30 pts.)*	*Readiness (Level 1-5)*	*Score*	*Comments*

Additional considerations for each project:

- Does the project enhance federal investment?
- What is the cost share of the project?
- Does the project provide good leverage?
- When will cost share be made toward the project?

Appendix A

The following is a list of people that worked extensively together to co-author and develop the Assessment of Need for the State of Arkansas.

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Appendix B

Federally Listed Species And Candidates For Listing In Arkansas

(**LE** – listed endangered; **LT** – listed threatened; **C** – candidate for listing; **PD** – proposed for delisting
CHD – critical habitat designated for species; **H** – historic occurrence; **X** – probably extirpated in state)

Freshwater Mussels
Ouachita rock-pocketbook (*Arkansia wheeleri*) – LE
Spectaclecase (*Cumberlandia monodonta*) – C
Curtis' pearlymussel (*Epioblasma florentina curtisi*) – LE
Turgid blossom (*Epioblasma turgidula*) – LE
Pink mucket (*Lampsilis abrupta*) – LE
Arkansas fatmucket (*Lampsilis powellii*) – LT
Neosho mucket (*Lampsilis rafinesqueana*) – C
Speckled pocketbook (*Lampsilis streckeri*) – C
Scaleshell (*Leptodea leptodon*) – LE
Fat pocketbook (*Potamilus capax*) – LE
Winged mapleleaf (*Quadrula fragosa*) – LE

Fish
Ozark cavefish (*Amblyopsis rosae*) – LT
Arkansas darter (*Etheostoma cragini*) – C
Yellowcheek darter (*Etheostoma moorei*) – C
Arkansas River shiner (*Notropis girardi*) – LT-H-X
Leopard darter (*Percina pantherina*) – LT-CHD
Pallid sturgeon (*Scaphirhynchus albus*) – LE

Cave Crayfish
Cambarus aculabrum – LE
Cambarus zophonastes – LE

Snails
Magazine Mountain shagreen (*Inflectarius magazinensis*) – LE

Mammals
Ozark big-eared bat (*Corynorhinus townsendii ingens*) – LE
Florida panther (*Felis concolor coryi*) – LE-H
Gray myotis (*Myotis grisescens*) – LE
Indiana myotis (*Myotis sodalis*) – LE

Amphibians
Ozark hellbender (*Crytobranchus alleganiensis bishopi*) – C

Birds
Ivory-billed woodpecker (*Campephilus principalis*) – LE
Bald eagle (*Haliaeetus leucocephalus*) – LT-PD
Red-cockaded woodpecker (*Picoides borealis*) – LE
Interior least tern (*Sterna antillarum athalassos*) – LE
Bachman's warbler (*Vermivora bachmanii*) – LE-H

Insects
American burying beetle (*Nicrophorus americanus*) – LE

Plants
Geocarpon (*Geocarpon minimum*) – LT
Missouri bladderpod (*Lesquerella filiformis*) – LE
Pondberry (*Lindera melissifolia*) – LE
Harperella (*Ptilimnium nodosum*) – LE
Running buffalo clover (*Trifolium stoloniferum*) – LE-H

Appendix C

Procedures for Conducting Forest Legacy Public Meetings

- A notice of public hearing shall be published in a newspaper of general daily circulation for seven (7) consecutive days;

- The notice shall include a statement of the terms or substance of the intended action or a description of the subjects and issues involved, and the time, the place where, and the manner in which interested persons may present their views thereon.

- An electronic version will be made available for comment on the Forestry Commission website. Interested persons will be able to submit comments electronically to the forest Legacy Coordinator via e-mail.

- The AON shall be mailed to any person who shall have requested a copy.

- All interested persons will be afforded reasonable opportunity to submit written data, views, or arguments, orally or in writing.

- Opportunity for oral hearing must be granted if requested by twenty-five (25) persons, by a government subdivision or agency, or by an association having no fewer than twenty-five (25) members.

- The agency will fully consider all written and oral submissions

Appendix D

Daily Newspapers

Arkansas Democrat Gazette
P.O. Box 2221
Little Rock, AR 72203-2221

Banner News
P.O. Box 100
Magnolia, AR 71753-0100

The Baxter Bulletin
P.O. Box 1750
Mountain Home, AR 72654

Camden News
113 Madison
Camden, AR 71711

El Dorado News Times
111 N. Madison
El Dorado, AR 71730

Harrison Daily Times
P.O. Box 40
Harrison, AR 72602-0040

Jonesboro Sun
P.O. Box 1249
Jonesboro, AR 72403-1249

Northwest Arkansas Times
P.O. Box 1607
Fayetteville, AR 72702-1758

Southwest Times Record
3600 Wheeler Ave.
Fort Smith, AR 72901

Texarkana Gazette
P.O. Box 621
Texarkana, TX 75504-0621

Appendix E

Received Friday, October 14 2005

My name is Danny Harris. My brother and I own 1079 Acres in Cross County Arkansas on Crowley's Ridge. We are forest stewards and have been nominated for your "Forest Steward of the Year" award. I did not realize that you had the meetings on the FLP or I would have attended. If you have any more meetings scheduled, please reply with the time and date so that I can attend. I have read your entire assessment of need that is available online. I feel like this is a great program. Twenty years from now, our property could become a victim to urban sprawl due to development (There is a Wal-Mart Super Center 3 miles from our property corner). We also have over 10 million yards of confirmed gravel reserves on 192 acres of our property. The FLP gives us an option that best fits our needs and goals (Multi Use – Wildlife, Forestry, Soil and Water Conservation) and avoids urban sprawl and gravel mining. The FLP would enable us to focus on our Forestry Stewardship Plan in perpetuity. There is no other program that I have seen that potentially makes it feasible for us to protect our property in perpetuity. This program is unique to the state and would be a great addition to the other AFC and NRCS programs that are available to land owners. It is hard to believe that in the future we (our generation) could be instrumental in protecting tens of thousands of acres of land in Arkansas in perpetuity. Thanks for your consideration of my comments.

Sincerely,

Danny Harris

From: John Reidhar [mailto:jreidhar@earthlink.net]
Sent: Tuesday, October 04, 2005 9:39 PM
To: George Rheinhardt
Subject: Forest Legacy Program

Mr. Rheinhardt,

I have been looking over the draft of the FLP and think that it will be great for a lot of landowners. I have 300 to 1000 acres in Woodruff, Prairie, and Crittenden counties that could be a candidate for such a program as this.

Please keep me informed. If you send e-mail, please place the Forest Legacy Program in the subject line.

Thanks,

John Reidhar
3638 Reidhar Lane
Des Arc, AR 72040

Appendix F

Arkansas Active Land Trusts

American Wildlife Partnership
P. O. Box 350
Osage Beach, MO 65065-0350
Phone: 573-317-0906
Email: nedgoss@yahoo.com

Eleven Point River Conservancy
RR1, Box 1272
Alton, MO 65606-9743
Phone: 417-778-6897
E-mail: john.bird@elevenpointriver.org
Website: www.elevenpointriver.org

Northwest Arkansas Land Trust
P. O. Box 2211
Bentonville, AR 72712
Phone: 479-246-6745
E-mail: mail@nwalandtrust.org
Website: www.nwalandtrust.org

Ozark Regional Land Trust, Inc.
427 South Main Street
Carthage, MO 64836-1646
Phone: 417-358-0852
E-mail: orlt@ipa.net
Website: www.orlt.org

Rocky Mountain Elk Foundation
P. O. Box 8249
Missoula, MT 59807-8249
Phone: 406-523-4500
E-mail: rmef@rmef.org
Website: www.rmef.org

Source: Land Trust Alliance Website www.ltanet.org/findlandtrust

List of Figures

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ACKNOWLEDGEMENTS

- Arkansas Governor and Policy Advisors
- Arkansas Forestry Commission Staff
- Arkansas Forest Stewardship Committee, especially Data Assembly Sub-Committee
- Arkansas Game & Fish Staff
- Arkansas Natural Heritage Staff
- The Nature Conservancy-Arkansas Field Office Staff
- Arkansas Soil & Water Conservation Commission

References:

- Arkansas Forest History – By Dr. John Gray, Forestry policy consultant former dean of the University of Florida School of Forest Resources, Arkansas Forestry Association Website.
- Arkansas Natural Area Plan – December, 1974
  Arkansas Department of Planning
- Growth in Arkansas – April, 2001
  Institute of Government
  University of Arkansas at Little Rock
- 2004-2005 Arkansas Department of Parks and Tourism Annual Report
  Arkansas Department of Parks and Tourism
- Statewide Comprehensive Outdoor recreation Plan
  Outdoor Recreation Grants Section
  State Parks Division
  Arkansas Department of Parks and Tourism
- Southern Research Station General Techincal Report, SRS 31-35, Ozark-Ouachita Highlands Assessment.
- Southern Research Station, Resource Bulletin SRS-99, "Arkansas ' Timber Industry-An Assessment of Timber Product Output and Use, 2002".