OLD-GROWTH WOODED PASTURE IN THE OZARKS

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Abstract—Forests in the Ozarks are ancient: the dominance and density of their various arboreal and herbaceous species have fluctuated over time in relation to climatic change and cultural influences. This study examines the nature of the pre-European forest composition in the Ozarks through studies of geology and soils, General Land Office surveys, archeology, and dendrochronology. Examples and a case study on the Wedington Unit are drawn from the Ozark-St. Francis National Forest, where, in some areas, old-growth oak forests remain adjacent to former agricultural fields that are regenerating naturally. This paper also identifies forest management practices that aid in the maintenance of diverse old-growth ecosystems.

INTRODUCTION

Landscapes and vegetation communities are in constant change. The disciplines of geography and archeology, which deal with human-land relationships, can provide us with ecological models of plant change related to human use of the available natural resources. This paper identifies archeological and historical data that can be used to confirm or disprove changes in ecosystem models of the Arkansas Ozarks. Such changes are relevant to our understanding of the cycling of species with different life spans in response to climatic drought episodes, insect infestations, and fire regimes. A case study is provided on the Wedington Unit, Boston Mountain Ranger District, Ozark-St. Francis National Forests.

STUDY AREA

The Wedington Unit (fig. 1) lies west of Fayetteville in the extreme northwestern corner of Arkansas, where Ozark Plateau remnants of the Boston Mountains form outlying ridges over the Springfield Plateau. The Unit falls on the divide between Benton and Washington Counties, and is bounded on the north and east by the Illinois River. Wedington Mountain, an erosional remnant of the Ozark Plateau, runs generally north-south through the study area.

GEOLOGY AND SOILS

The rocks of the Ozarks are primarily sedimentary in origin, formed by deep sea and near-shore sediments laid down during the Paleozoic era (Sabo and others 1982). The Wedington Unit consists of the northward extension of the sandstone formations of the Boston Mountains onto the limestone-dominated Springfield Plateau. The Boston Mountains are capped by the Mississippian era Wedington sandstone unit of the Fayetteville shale formation (Haley 1976). These generally level-bedded strata are warped by domal uplift and deeply incised by streams, giving the region a mountainous relief.

The Springfield Plateau consists of gently sloping Mississippian limestones and contains the Boone limestone/chert formation. This formation is important for the readily available chert that was heavily exploited by Native Americans for the manufacture of stone tools. Dickson (1991) divides chert from the Boone formation into St. Joe, Reeds Spring, Keokuk, and Moorehead varieties.

The dominant soils of the Wedington study area were developed under hardwood vegetation (Harper and others 1969, Phillips and Harper 1977). In the uplands, the soils are Allegheny, Apison, Enders, Hector, Mountainburg, Steprock, and Nella—all primarily stony and gravelly sandy loams. Soils on the mountaintops are generally < 3 feet deep, while soils on slopes and benches may range to 7 feet deep. Soils on the lower uplands of the Springfield Plateau in the study area are primarily Captina, Nixa, Pickwick, and Tonti. These are silt loams and cherty silt loams that range from 3.5 to 5.5 feet deep. Soils in the flood plains of the study area include Britwater, Captina, Razort, and Secesh. These are silt loams and gravelly silt loams that range from 4 to > 7 feet deep.

No typical mollic (black surface horizon, thickened) prairie soils (Carytown, Jay, Mayes, Newtonia, Sogn, Taloka) have been mapped within the Wedington study area (Phillips and Harper 1977). In fact, the nearest known soils in Benton County that developed under prairie vegetation (Jay) are at least 2 to 3 miles north of the area. In Washington County, Taloka soils have thickened surface epipedons typical of prairie soils and are found south of the study area (Harper and others 1969). These soils are frequently found in association with the Captina soils that do surround the Wedington study area; however, Captina soils have shallower surface horizons and are thought to have developed under hardwoods (Phillips and Harper 1977).

GENERAL LAND OFFICE RECORDS

Today, there are only a few areas of the Ozarks that still contain the full range and proportion of plant and animal species that flourished prior to European settlement. Land managers need statistically sound models of presettlement plant distributions over entire landscapes to understand vegetation potential and historical changes in vegetation (Foti and Glenn 1991, Warren 1984, Warren and O'Brien 1984). The original land surveys made when the public

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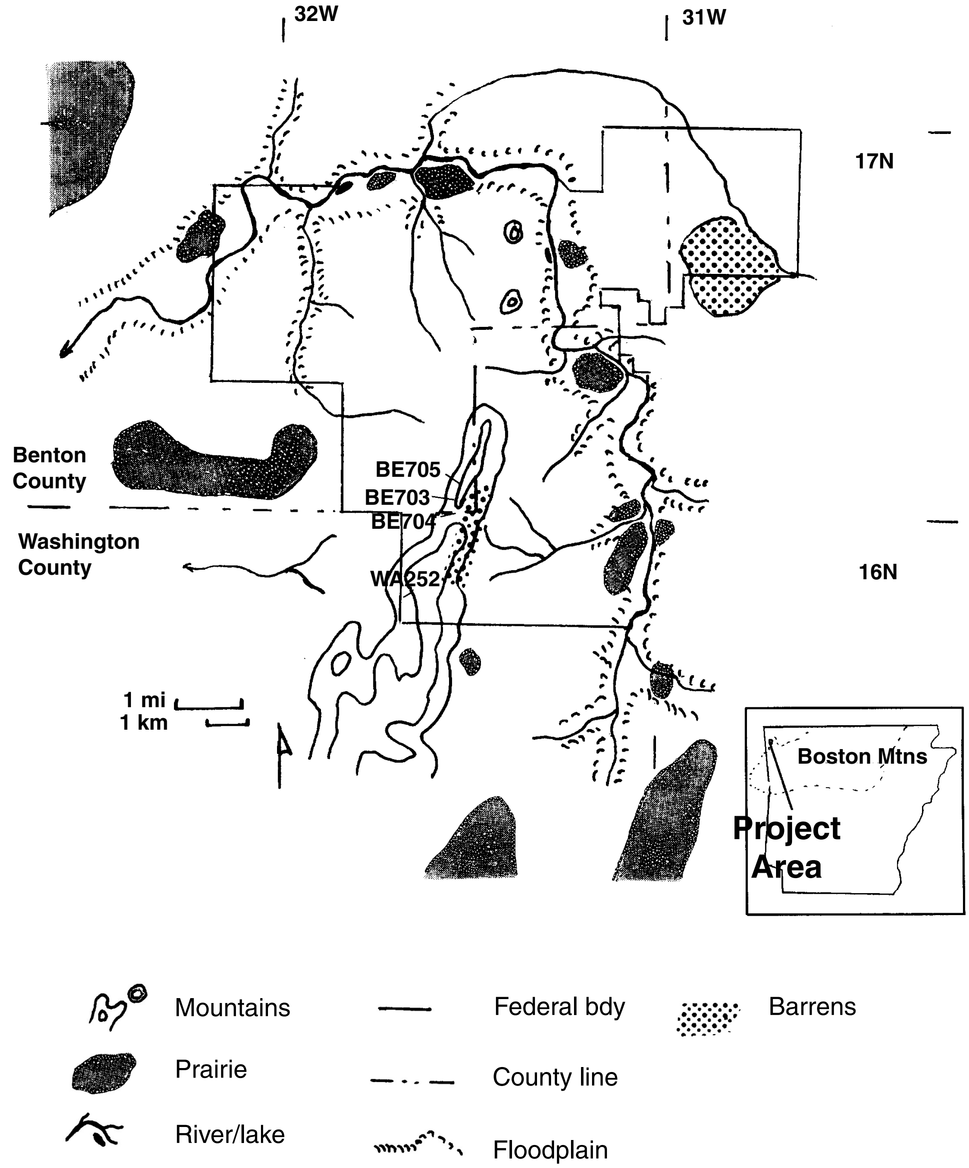

Figure 1—Wedington Unit prairie and forest reconstructed from Government Land Office surveys, 1832 to 1833.

domain was sold or given to private individuals or entities are excellent sources of these data. In these surveys, the observations of prairie-forest boundaries and witness trees recorded at each land tract corner provide quantitative information that can be used to reconstruct arboreal communities and their interfaces with prairies (Bourdo 1956; Curtis 1959; Delcourt 1976; Delcourt and Delcourt 1974, 1977; Jurney 1982, 1987; Sears 1925).

Surveyor bias has been analyzed by several researchers (Bourdo 1956; King 1978, 1984; Sears 1925; Warren 1984) and appropriate methods developed to address these biases (Jurney 1982, 1987; Siccama 1971). Since land surveys are legal documents, General Land Office (GLO) surveyors were instructed to record the nearest tree to each corner of a tract as a witness tree, so that the corner itself could be relocated over time (Dodds and others 1943, McKitrick 1918, McMahon 1941, Shine 1969). As early as 1806, witness trees were required to be as close as possible to the land tract corner (White 1982), and in 1831 this was specifically mandated in Tiffin's instructions to all Federal land surveyors (Dodds and others 1943). In the 20th century, this stipulation was changed toward selection of more permanent corners (Bragg 2002, Stewart 1935). Tharp (1941, 1948) presents discussions on the tree-ring dating of witness trees in order to provide legal witness for land tract corners and "follow the footsteps of the surveyor." Generally speaking, the closer the tree to the corner, the easier it is to locate again by subsequent surveyors laying out land grants from the public domain. It was also easier and more cost effective for the field crews of the original surveyor to mark nearby trees rather than selecting certain species at greater distances.

GLO surveyors noted and marked from one to four trees at each corner of a tract, describing each tree, its diameter, and the direction and distance to it from the corner. When land lines were being run, trees falling on a line were also noted and marked, and the boundaries between forest and prairie recorded; all of which provide evidence for the extent of fire-dependent ecosystems. Occasionally, observations such as "burned over," "barrens," or "burned tree" provide direct evidence of fire in the forests (Weniger 1984, 1996). In Texas, these direct observations were recorded in Hill and Falls Counties (Weniger 1984), and tree sizes and densities have been used to determine fire return effects on community development along the interface of Blackland Prairies and the Post Oak Savannah (Jurney 1987, 1988a, 1988b, 1988c). In Arkansas, the term "barrens" appears to reflect a fire-dependent ecosystem; the term has also been found in notes from Johnson, Benton, and Washington Counties (Lockhart and others 1995, Miller 1972, Sabo and others 1982). This term is definitely correlated with "burned over" areas in Jackson County, MO, where prairie fires had burned into forested areas and killed former witness trees (Jurney 1982).

The usefulness of correlating GLO witness tree distributions to soil and topographic settings is demonstrated by two studies in the Ozarks: Chaney (1990) on the Middle Fork of the White River in Washington County, and the Arkansas Archeological Survey on the Lee Creek Unit of the Boston Mountain Ranger District in Crawford County (Lockhart and others 1995). Both studies observed that although post oaks (*Quercus stellata*) favored moderately to well-drained soil, they were absent from poorly drained soils. White oaks (*Q. alba*) were distributed across the foothills and upper slopes and nearly absent from the flood plains of the interior Ozarks. Red oaks (*Q. falcata, Q. pagoda*) were more frequent on well-drained slope soils and the flood plains. Black oaks (*Q. velutina, Q. schumardii*) and hickories (*Carya* spp.) were evenly distributed across all soils. Historic settlement has disrupted the vegetation patterns, introducing red cedars (*Juniperus virginiana*) and pines (*Pinus* spp.) into many areas and allowing the spread of other species such as maple (*Acer* spp.), sycamore (*Plantanus occidentalis*), walnut (*Juglans nigra*), cottonwood (*Populus deltoides*), and hackberry (*Celtis laevigata*) in all areas.

The GLO studies have direct relevance to historic vegetation regimes, and the U.S. Department of Agriculture (USDA) Forest Service is currently developing a witness tree geographic information system (GIS) layer for all the Ozark-St. Francis National Forests. Until this is completed, individual study areas have been selected to demonstrate the potential for land management. One of these is the Wedington Unit.

We reconstructed the presettlement vegetation for the entire Wedington Unit of the Ozark-St. Francis National Forest and peripheral areas surrounding the unit, comprising 24,320 acres (9 846.2 ha). Figure 1 illustrates the interface of prairies and forests in the Wedington study area. Some areas, such as barrens, identify fire-prone areas, in addition to the prairie areas. Since many of the areas shown as prairies are located on soil types developed under forests, it is assumed that most of these prairies were produced by wildfires. A long linear prairie is located along the road from Fayetteville to Rogers, while others appear to be associated with agricultural fields. Prairies are found in upland, slope, and flood plain settings.

Table 1 lists 25 canopy species and 5 understory species observed by 3 individual surveyors in the Wedington Unit and adjacent forests and prairies during 1833 and 1834. The witness tree matrix consists of 334 trees (table 1). The original surveys were plotted on U.S. Geological Survey 7.5-minute quadrangles and were sorted according to six physiographic/topographic zones (flood plain, flood plain prairie, slope, slope barrens, upland, upland brushy prairie). Common names for trees were used by the land surveyors. Exact scientific nomenclature cannot be determined with confidence for all species, but the best-guess scientific names are presented in table 1.

The flood plain contained 52 witness trees. The dominant species included post oak (15.4 percent), black walnut (13.5 percent), hickory and sycamore (9.6 percent each), and white oak and blackjack oak (*Q. marilandica*) (5.8 percent each). The next most common species were black oak, elm (*Ulmus* spp.), hazel (*Corylus americana* or *Hamamelis virginiana*), sumac (*Rhus* spp.), and locust (*Gleditsia* spp. or *Robinia pseudoacacia*) with 3.8 percent each. Incidental species (1.9 percent each) included overcup oak (*Q. lyrata*), black gum (*Nyssa sylvatica*), cherry (*Prunus serotina*), hackberry, honey locust (*Gleditsa* spp.), box elder (*Acer negundo*), ash (*Fraxinus* spp.), red bud (*Cercis Canadensis*), and spicewood (*Lindera benzoin*).

The flood plain prairie contained nine trees, dominated by hickory (44.4 percent) and blackjack oak (22.2 percent). Incidental species included plum (*Prunus* spp.) and cane (*Arundinaria gigantea*).

The slope contained 122 trees, dominated by black oak (31.9 percent), blackjack oak (27 percent), post oak (23.7 percent), and white oak (7.3 percent). Incidental species included hickory, black gum, cherry, hazel, sumac, vines, and briers. The only red oak tree in the Wedington Unit was recorded in the slope zone. The slope barrens contained single observations of white oak, black oak, blackjack oak, chinquapin (*Castanea pumilia*), and hazel.

The upland contained 144 trees, dominated by black oak (33.3 percent), post oak (27.7 percent), blackjack oak (25 percent), and white oak (5.5 percent). Incidental species included hickory, elm, maple, hazel, sumac, whortleberry (*Vaccinium* spp.), huckleberry, vines, and briers. The brushy upland prairies included single observations of elm and plum.

No pines or cedars were recorded in the original notes. Both species have regenerated naturally in an early 20th century field on the top of Wedington Mountain. The cedars were introduced by settlement, the pines by the USDA Forest Service.

The distance from the land tract corner to the witness tree provides a point-specific distance index that is highly variable. We used these data to calculate an average density

Table 1—Listing of General Land Office witness trees[a] from the Wedington Unit, Boston Mountain Ranger District, Ozark-St. Francis National Forest (T16-17 N, R 31-33 W), surveyed in 1832-1833

		Zone						
Species common name	Scientific name	Flood plain	Floodplain prairie	Slope	Slope barrens	Upland	Brushy prairie	Total
Ash	*Fraxinus*	1	0	0	0	0	0	1
Black gum	*Nyssa*	1	0	1	0	0	0	2
Black oak	*Quercus veluntina*	2	0	39	1	48	0	90
Black walnut	*Juglans nigra*	7	1	0	0	0	0	8
Blackjack oak	*Q. marilandica*	3	2	33	1	36	0	75
Box elder	*Acer*	1	0	0	0	0	0	1
Cherry	*Prunus*	1	0	0	0	0	0	1
Chinquapin	*Castanea*	0	0	0	1	1	1	3
Elm	*Ulmus*	2	0	0	0	1	0	3
Hackberry	*Celtis*	1	0	0	0	0	0	1
Hazel	*Corlyus*	2	0	1	1	1	1	6
Hickory	*Carya*	5	4	3	0	4	0	16
Honey locust	*Gleditsia*	1	0	0	0	0	0	1
Locust	*Robinia*	2	0	1	0	0	0	3
Maple	*Acer*	0	0	1	0	0	0	1
Overcup oak	*Q. macrocarpa*	1	0	0	0	0	0	1
Pawpaw	*Asiminia*	1	0	0	0	0	0	1
Plum	*Prunus*	0	1	0	0	0	0	1
Post oak	*Q. stellata*	8	0	29	0	40	0	77
Red bud	*Cercis*	1	0	0	0	0	0	1
Red oak	*Quercus* spp.	0	0	1	0	0	0	1
Spicewood	*Linderia*	1	0	0	0	0	0	1
Sumac	*Aralia*	2	0	1	0	1	0	4
Sycamore	*Plantanus*	5	0	0	0	0	0	5
White oak	*Q. alba*	3	0	9	1	8	0	21
Understory								
Briers		0	0	1	0	1	0	2
Cane	*Arundinaria*	1	1	0	0	0	0	2
Huckleberry	*Vaccinium* spp.	0	0	0	0	1	0	1
Vines		0	0	1	0	1	0	2
Whortleberry	*Vaccinium* spp.	0	0	1	0	1	0	2
Total		52	9	122	5	144	2	334

[a] Witness trees were noted and marked to facilitate subsequent location for dispersal of public domain, and denotes their legal status as a court witness.

index in each physiographic/topographic zone. The densest area is the flood plain (17.7 feet), followed by the slope and upland (25.3 feet each). The brushy upland prairies yielded a point density index of 104 feet, followed by the flood plain prairie (105.6 feet) and the slope barrens (119.1 feet). The slope barrens correspond to the old-growth post oak stands along the benches and intact uplands of Wedington Mountain. This yields an estimate of 72 trees per acre during the 1832–33 period. Due to fire suppression, the stands are denser today, averaging up to 148 trees per acre (see Tom Foti, in press).

PREHISTORIC ARCHEOLOGY

Archeological surveys of approximately 25 percent of the Ozark-St. Francis National Forests have yielded the 1,472 prehistoric sites shown in table 2 (Jurney 2001). The largest single category is undifferentiated prehistoric lithic scatters (73.6 percent), followed by undifferentiated Archaic (9 percent), Woodland (4.8 percent), Mississippian (3.7 percent), and Late Archaic (3.5 percent). All other categories are represented by few sites.

The majority (14.5 percent) of the identified cultural components date to the Archaic (1,500+ YBP). This indicates a relatively low intensity of human occupation and use of the Ozarks throughout most of prehistory. Sedentary populations are represented by the Mississippian, Woodland, and phase categories (11.1 percent). Sedentary groups are marked by semipermanent villages, mound building, and incipient agricultural practices (Davis and Limp 1994).

Native Americans lived light-on-the-land in the Ozarks for nearly 9,000 years. During this time, the primary hunting strategy was the group surround; fire may have been used to drive game or alter local habitats. Some wild plants were domesticated near the end of this era, probably due to

Table 2—Prehistoric sites on the Ozark-St. Francis National Forest compiled from the Automated Management of Archeological Site Data in Arkansas (AMASDA) database kept by the Arkansas Archeological Survey

Years ago	Culture/period	Count	
		no.	*percent*
12,000+	PaleoIndian	10	0.7
9,500	Dalton	6	0.4
9,499	Early Archaic	12	0.8
	Middle Archaic	8	0.5
5,000	Mid-Late Archaic	1	0.1
	Late Archaic	52	3.5
	Undifferentiated Archaic	133	9
1,800	Early Woodland	9	0.6
	Late Woodland	4	0.3
	Woodland	71	5
1,100	Middle Mississippian	1	0.1
	Late Mississippian	2	0.1
	Mississippian	54	3.7
	Kent Phase	3	0.2
	Caddo I.	1	0.1
	Caddo	1	0.1
	Neosho	1	0.1
410	Contact	3	0.2
	Contact pre-1800	1	0.1
150	Protohistoric	5	0.3
	Undifferentiated	1,077	73.6
Total		1,455	100.0

increasing land disturbances around bluff shelters and riverine base camps (Fritz 1985, 1990). Around 1,500 years ago, garden agriculture, probably using slash-and-burn strategies, intensified the human alteration of the landscape. Many flood plain forests were also cleared for villages, mound centers, and agricultural fields. Hunting strategies shifted to more solitary strategies, but there appear to have been attempts to gather food and natural resources in the interior Ozarks and transport them to regional population centers in the Arkansas River valley and the lower valleys of major streams incised into the Ozark dome (Schambach 2001).

Few major excavations and sporadic archeological surveys have been conducted in the Wedington Mountain area shown in figure 1. The most extensive excavations have been conducted at the Moss Shelter (3WA252) located on private land approximately 1 mile south of Wedington Gap (Stahle 1986), and at the Albertson site (3BE174) located on Spavinaw Creek approximately 15 miles north of the project area (Dickson 1991). Moss Shelter was formed by dissolution of shales and sandstones by water and wind action. Albertson was formed by riverine undercutting of limestone beds. Cultural manifestations at Moss and Albertson range from transitional Paleo-Indian to Mississippian (ca. 10,000 to 500 years ago). The majority of the diagnostic materials date to the Middle and Late Archaic, ca. 8,000 to 1,500 years ago (Dickson 1991, Stahle 1986).

Moss Shelter represents the typical formation of upland bluff shelters (fig. 2). The basic process begins with the dissolution of the shale beds that lie under more resistant sandstone layers. Block faulting from freeze-thaw cycles and root penetration also contribute to the formation of sediment traps along the benches of the mountains. Cultural deposits were recovered > 2 m deep at this site, and similar deposits have been found along the upper benches of Wedington Mountain. Other shelters on the northern end of Wedington Mountain were formed by block fracturing of the sandstone as well as water and wind action. Cultural deposits extend along benches and down slopes from all known rock shelters in the vicinity.

A number of archeological surveys recording prehistoric open sites and rock shelters have been conducted in the vicinity by USDA Forest Service archeologists. Two prehistoric lithic scatters were discovered and recorded during our investigation of the Wedington Unit. One (3BE703) is located on the southern point of the ridge overlooking Wedington Gap. The site consists of several bifacial thinning flakes observed on a deflated area of the sandstone outcrop. The area appears to have been used as a tool refurbishing station and provided a superb vantage point with a view to the west, southwest, and southeast on both sides of the gap. The second prehistoric site (3BE704) is located in the bottom of Wedington Gap. This area is marked by erosion of the overlying sandstone to the underlying shale; the vegetation consists of a suite of xeric plants, including blackjack oak. The site consists of a highly disturbed scatter of Boone chert debris. Artifacts collected included five chert cores, four large decortication flakes, two bifacial tool fragments, and one heat-treated lamelar flake. The site has been severely damaged by illegal off-the-road vehicle traffic.

The two prehistoric sites in the Wedington study area represent two different types of activity. One (3BE704) was a staging area for transforming chert cores imported from the adjacent Springfield Plateau into tools. Apparently heat-treatment of these cores was practiced here. The second site (3BE703) appears to be a hunting or territorial lookout, based on the vantage point that provides visual coverage of several miles. The only activity represented in the material culture here is the resharpening of tools that were manufactured in another locality. Neither site represents a habitation locus.

Plant remains, mostly acorns, from 10 sites in the dry bluff shelters of the Ozarks provide information on the cultural selection of oak species (Cande 1997, Hilliard 1986). Acorns were quantified in these studies, but carbonized hickory nut shells and other plant remains were not quantified. Of the 10 sites listed in table 3, only 3 had more acorns from white oaks than from red oaks. Comparing the archeological data with the GLO data, this relative frequency of red oaks species to white oak species (87 to 21 percent, column 3 in table 3) is to be expected.

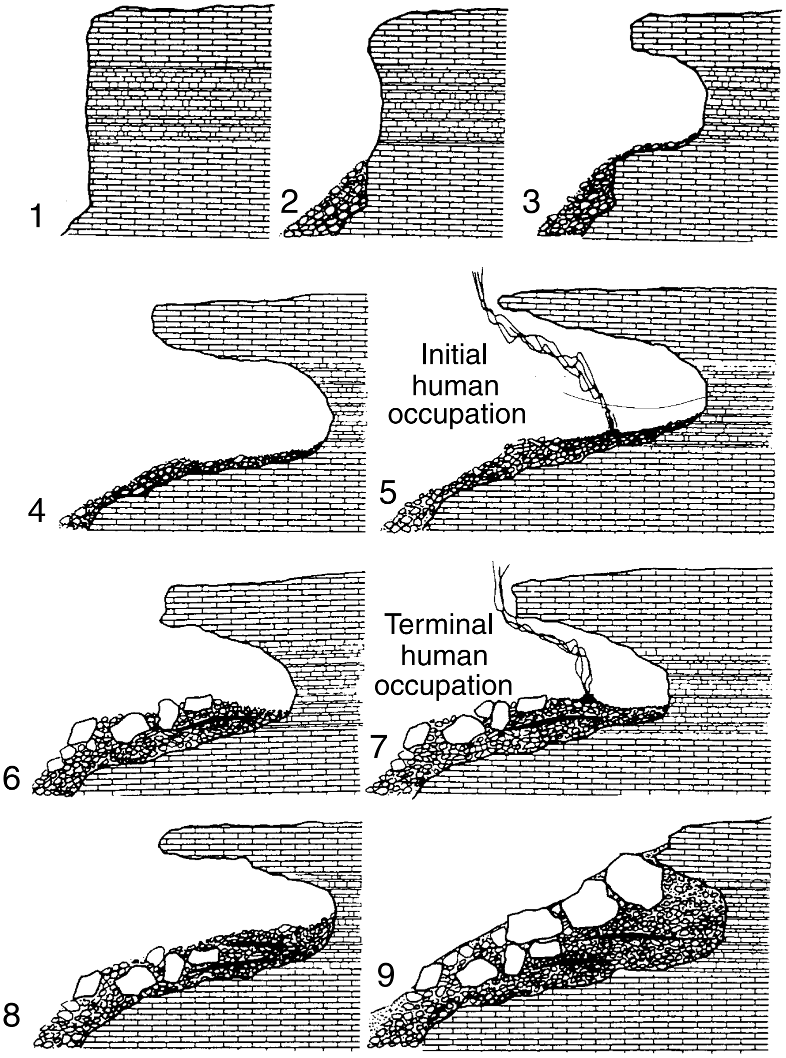

Figure 2—Schematic of Ozark bluff shelter formation processes (Cande 1997, Laville and others 1980).

Table 3—Listing of red oak and white oak acorns from Ozark archaeological sites in Arkansas

Site	Red oak	Red oak	White oak	White oak	Total
	no.	*percent*	*no.*	*percent*	*no.*
3BE1	749	65.1	402	34.9	1,151
3WA4	173	39	266	61	439
3BE10	211	85.5	36	14.5	247
3CR8	35	21	131	79	166
3BE6	41	63	24	37	65
3BE11	22	60	15	40	37
3MA5	13	54.2	11	45.8	24
3NW624	51	66	26	34	77
3NW625	5	31	11	69	16
Total	1,300		922		2,222

BE = Benton; WA = Washington; CR = Carroll; MA = Madison; NW = Newton.
Analyzed by Hilliard (1986) and Cande (1997).

In some of these sites, large conical pits were excavated and filled with over a gallon of acorns, in order to parch the contents. Parched acorns have also been found across the Ozarks in woven bags that served to reduce insect infestation, preserve the nut meat, and make the shells more removable (Fritz 1985, 1990, 1997). Red oaks may have been considered a more dependable food source since they do not germinate until spring and are less susceptible to insects, and the acorns have a slightly higher caloric value than white oaks (Hilliard 1986).

HISTORIC ARCHEOLOGY

Archeological surveys (Jurney 2001) of approximately 25 percent of the Ozark-St. Francis National Forest have recorded 2,535 historic sites (table 4). The largest single category is developed settlement-rural agriculture (73.9 percent), followed by pioneer settlement-agriculture (9.1 percent), developed settlement (7.6 percent), developed settlement-rural nonagriculture (3.5 percent), Anglo-American (1.8 per-

Table 4—Listing of historic sites on the Ozark-St. Francis National Forest compiled from the Automated Management of Archeological Site Data in Arkansas (AMASDA) database kept by the Arkansas Archeological Survey

Years ago	Site category	Count	Percent
450	Late Holocene semi-sedentary	24	0.9
150	Pioneer settlement	20	0.8
	Pioneer settlement-agriculture	231	9.1
110	Developed settlement	193	7.6
	Developed settlement-rural agriculture	1,877	74.0
	Developed settlement-rural-nonagriculture	90	3.6
	Developed settlement rural plantation	7	0.3
	Developed settlement-city/town	44	1.7
	Developed settlement-rural forager	1	0.1
	Anglo-American	45	1.8
	Developed settlement-African American	3	0.1
Total		2,535	100.0

cent), and developed settlement-city/town (1.7 percent). All other categories are represented by only a few sites (table 4).

The significance of these data is that the majority (89.2 percent) of the identified cultural components date to the developed settlement era of the late 19th and 20th centuries (ca. 1890 to 1940). This indicates a tremendous increase in human impacts to the landscape that tied to population growth and improved transportation (see Guyette and others, in press).

The historic archeological data (Jurney 2001) provide a minimum estimate of 9,452 farmsteads on the Ozark-St. Francis National Forests (total area 1,158,289 acres) that were occupied between 1890 and 1940. Using 110 acres as a mean farm size with 43 acres under cultivation (Schalm 1973), 1,039,720 acres (89.7 percent) of the forest could have been occupied between the late 19th and early 20th centuries, 406,436 acres were cleared and cultivated, and the remaining 633,284 acres were used as wooded pasture. Based on these interpolations, the unoccupied portion of the Ozark-St. Francis National Forests (188,569 acres) may have been used by free-range herders.

One historic site (3BE705) investigated as part of the present study consists of a 20-acre cleared field on the top of Wedington Mountain. The access road to the field passes through the rock escarpment in a narrow cleft. Rock fences had been constructed in all low areas along the escarpment to prevent free-ranging livestock from entering the field on the top, the fence and escarpment providing an approximate 4,592-foot perimeter. The rock wall, which comprises about 15 percent of the total perimeter, is 4 feet tall and measures 3 feet thick in places. It is estimated that 8,265.6 cubic feet of stone (approximately 1,836.8 tons) were removed from the field and rock outcrop to build this rock fence, a significant investment in labor to achieve a protected cultivated area. If the escarpment wall were not in place, the investment would have been much greater to protect the field crops from free-ranging livestock.

Old-growth trees were removed from the cultivated field but were left in place along the bench below the escarpment wall, where livestock were allowed to free-range. Since it was abandoned, the old field has been reclaimed by red cedars, pines, and mixed hardwoods. We cored these trees using a Swedish increment corer. The red cedars are at least 68 years old, indicating that the field was abandoned or converted to fallow ground around 1933. The bench and side slopes of this area retain old-growth characteristics. Tree-ring collections on the south end of the mountain by Wedington Gap have yielded one of the best records of frost rings (false spring events) in all of Arkansas and Oklahoma (Stahle 1990).

Based on our examination of the Benton County Deed Records in the Bentonville Courthouse and the Forest Service tract acquisition files, the land containing the field and old-growth wooded pasture on Wedington Mountain is part of a homestead land grant to Harry and Lizzie Beck dated November 3, 1899. The land falls on the dividing line between Washington and Benton Counties. The 80-acre parcel in Benton County was sold to Thomas Dunn in October 1905. The land was acquired by S.C. Peacock in a tax sale and was resold to Clarence S. and Cora Rankin July 12, 1913. They sold the land, including the portion in Washington County, to A.L. and Doris McCulley (134 acres total) on October 14, 1922. Doris and her son J.H. (wife Carrie E.) and daughter May sold the land to the U.S. Resettlement Administration on November 13, 1938. At that time, two dwellings, a poultry house, a barn, a well, and a spring were located at the core of the farm. The upland pasture was cultivated on the south end and wooded on the north end. Based on our courthouse and tract acquisition file research for this paper, little improvement and expansion was done to the farm from 1899 to 1907. During the Peacock ownership in 1908, a central barn was built. The McCulley ownership in 1922 marked the expansion of the farm with the construction of two houses, followed by a poultry house in 1933. The upland pasture was most likely cleared and cultivated around 1922. At least five serial occupations worked the land in this area. The McCulley occupation from 1922 to 1933 was the most intense.

DENDROCHRONOLOGY

Since the late 1950s, tree-ring samples have been collected from stands of living trees across Arkansas and adjacent States. A series of chronologies has been developed for the region from these collections (Stahle 1990; Stahle and Hehr 1984; Stahle and others 1984, 1985b). The five longest Arkansas chronologies established are for baldcypress (*Taxodium distictum*) and span the period 1322 to 1990.

The mean germination date is 1498, and the stands range in age from 214 to 668 years. The nine second-longest chronologies are for white oak. White oak spans the period 1598 to 1993, with a mean germination date of 1697 and an age range of 89 to 395 years. Thirty-four post oak chronologies span the period 1626 to 1993, with a mean germination date of 1671 and an age range of 257 to 372 years. Five shortleaf pine (*Pinus echinata*) chronologies span the period 1649 to 1982, with a mean germination date of 1760 and an age range of 71 to 333 years. Two black oak chronologies span the period 1870 to 1959 and are similar to red oak in growth patterns and ages (< 100 years longevity).

The significance of these data revolves around the maximum ages of various species. Baldcypress, the longest lived at 650 years, is restricted to aquatic habitats of large rivers and swamps. Several stands are present on the St. Francis Division of the Ozark-St. Francis National Forests. Post oak and white oak have approximately the same life spans (350 years), while the life span of shortleaf pine is slightly less. These three species generally reach old age between 300 and 350 years. Black oak and red oak have much shorter life spans, rarely reaching 100 years. Because of this range in life spans, it is to be expected that species dominance should vary across the landscape. It is our opinion that the apparent decline of red oak in the area may be a result of an overly mature species dying out, while longer-lived species such as shortleaf pine, white oak, and post oak remain viable.

We have collected fire-scarred trees and stumps in the southern Ozarks as part of ongoing fire and ecosystem studies conducted by the USDA Forest Service. In the southern Ozarks, continuous fire scar records have been compiled on the Bayou and Pleasant Hill Ranger Districts for three time periods: 1747 to 1764, 1804 to 1906, and 1916 to 1954. From 1747 to 1764, the fire return interval ranged from 1 to 3 years with a mean return interval of 2.43 years. From 1804 to 1906, the fire return interval ranged from 1 to 9 years with a mean return interval of 4.4 years. From 1916 to 1954, the fire return interval ranged from 1 to 12 years with a mean return interval of 5.3 years (D.H. Jurney. 2002. Historic fire regime. 19 p. On file with: Ozark-St. Francis National Forests, 605 W. Main, Russellville, AR 72801). This suggests a general trend toward decreasing fire returns with increasing historical settlement and fragmentation of the landscape (R. Guyette. 2000. Notes on fire history at three sites in the Lower Atoka Hills adjacent to the Arkansas River. On file with: School of Natural Resources, I-30 Agriculture Building, University of Missouri, Columbia, MO 65211).

CONCLUSIONS

Natural pollen traps—sediment deposits containing fossilized pollen—have not been found in the Wedington study area, or, more generally, in the Ozark-St. Francis National Forests. This discussion presents a broad-brush comparison using data from adjacent regions. Pollen and geological studies suggest that over the last 40,000 years, climate has been the major driving force behind changes in plant communities across the landscape (Bousman 1991). Around 16,000 years ago, dominant tree species included pine (29.3 percent), oak (16.9 percent), willow (16.5 percent), and hickory (10.1 percent), with about 50 percent canopy cover. Current landforms developed around 7,500 years ago; since then, there have been at least five periods alternating between aggradation and erosion (Jacobson and Primm 1997). Around 9,000 years ago, vegetation was dominated by oak (63.8 percent) and pine (9 percent), with 40 percent canopy cover. Early Indians were highly mobile and apparently followed large herds of now-extinct animals. They may have used large fires to drive animals into traps or to attract grazing herds to certain locations. Human population was low, and the extent of human-caused and natural disturbances remains unknown.

Around 5,000 to 6,000 years ago, the current climate and suite of natural ecosystems developed and included the most extensive grasslands and lowest percentage of canopy cover (10 percent, minimum). Oaks continued to grow in dominance (72 percent) and remain at this level today (Bousman 1991). Pines decreased to 5 percent; hickories comprise 6 percent. Indian populations increased during the same period; they appear to have settled into specific ecological niches where their activities were concentrated. The Ozark bluff shelters received extensive settlement at this time and appear to have been bases for seasonal rounds of plant and animal exploitation. Human-caused environmental disturbances increased around base camps and gardens and led to the domestication of wild plants in the Ozarks (Fritz 1985, 1990, 1997). Around 1,500 years ago, tropical cultigens imported from Mexico provided the basis for the development of sedentary life ways. Indians developed large population centers with settlement concentrated in the flood plains. Bluff shelters appear to have been used for mortuary practices and food storage. Fire scar records from trees indicate a mean fire return interval of 2.43 years during the late 1700s (R. Guyette. 2000. Notes on fire history at three sites in the Lower Atoka Hills adjacent to the Arkansas River. On file with: School of Natural Resources, I-30 Agriculture Building, University of Missouri, Columbia, MO 65211) (D.H. Jurney. 2002. Historic fire regime. 19 p. On file with: Ozark-St. Francis National Forests, 605 W. Main, Russellville, AR 72801). Based on Texas pollen studies (Bousman 1991), around 1,000 years ago the canopy cover was 20 percent. Today, the percentage of canopy cover has returned to the level of 8,000 years ago (40 percent).

With the advent of European settlement in the 19th century, the trend toward nucleated settlement in the flood plains increased. The rectangular land survey system forced land grants into shapes oriented north-south, and the average grant ranged from 40 to 160 acres, arbitrarily chosen from the available public domain. This pattern of public land distribution forced dispersed settlement into 40- to 160-acre parcels. Land was first chosen along larger streams where cultivation was possible, then less suitable land was chosen by later settlers. By the late 1800s, most of the Ozarks had been claimed by settlers, and farmsteads dotted the landscape (1 per 110 acres). During this period, a mean fire return interval of 4.4 years was recorded in fire-scarred trees (R. Guyette. 2000. Notes on fire history at three sites in the Lower Atoka Hills adjacent to the Arkansas River. On file with: School of Natural Resources, I-30 Agriculture Building, University of Missouri, Columbia, MO 65211) (D.H. Jurney. 2002. Historic fire regime. 19 p. On file with: Ozark-St. Francis National Forests, 605 W. Main, Russellville, AR 72801). The increased population density contributed to a reduction in forest fire spread but increased the impacts to specific land parcels through logging, plowing, construction of rock fences, and soil depletion from increased erosion. Certain trees such as red cedar, bois d'arc (*Maclura pomifera*), and walnut were transplanted for food and economic purposes to locations where they had formerly been rare (Jurney 1994).

Acquisition of worn-out farmlands by the USDA Forest Service in the early 20th century led to the rehabilitation of many eroded fields and the planting of trees that could provide a sustained yield of wood products. Fire suppression became a primary concern, and fire was taken out of the ecosystem. Fire-scarred trees indicate mean return intervals ranging from 5.3 to 22 years during this period (R. Guyette. 2000. Notes on fire history at three sites in the Lower Atoka Hills adjacent to the Arkansas River. On file with: School of Natural Resources, I-30 Agriculture Building, University of Missouri, Columbia, MO 65211) (D.H. Jurney. 2002. Historic fire regime. 19 p. On file with: Ozark-St. Francis National Forests, 605 W. Main, Russellville, AR 72801). The fire atlases for the Bayou and Piney Ranger Districts from 1935 to 1972 yield data on fire occurrence at the time. Because fires were immediately suppressed, the atlases cannot provide extent information, only the area of the District and number of fires for each period of record. Dividing the District area by the number of fires and the number of years in the record, lightning fires ranged from zero on the St. Francis in the Mississippi Delta, 150 miles from Wedington, to 111 on the Bayou at the eastern edge of the Ozark Dome, 50 to 80 miles southeast of the Wedington study area. This yields a minimum estimate of 6 to 18 lightning fires per million acres per year. Human-caused fires ranged from 91 on the St. Francis to 672 on the White Rock (50 miles southeast of Wedington) (D.H. Jurney. 2002. Historic fire regime. 19 p. On file with: Ozark-St. Francis National Forests, 605 W. Main, Russellville, AR 72801). This yields a minimum estimate of 87 to 114 human-caused fires per million acres per year.

Today, forests resembling presettlement conditions are rare. The wooded pastures of Wedington Mountain are examples of old-growth post oak forests, barrens, and savannahs that have received fewer disturbances by historic settlement than adjacent areas. It is important that such areas are managed for their old-growth characteristics to retain the diverse ecosystems in which they are located. In our opinion, old-growth wooded pastures exhibit long-term resiliency, and perhaps maintenance of this ecosystem will reduce forest susceptibility to infestations such as the red oak borer and oak decline.

Specific recommendations to preserve and maintain diverse old-growth ecosystems are presented here for consideration by forest managers. First, we recommend using the GLO records to develop a GIS layer showing potential historic vegetation prior to extensive European disturbances. The correlation of GLO vegetation types to soils, slope/aspect, and land type associations will enhance the silvicultural prescriptions that are used to plan future forests. Dendrochronological analysis is recommended to develop spatial models of natural old-growth distributions of multiple tree species. Point-specific fire scars should also be collected from old trees and snags to improve our understanding of the frequency, intensity, and extent of wildfires in the presettlement ecosystem. Finally, there is a need to correlate lightning strikes and lightning-caused wildfires with weather parameters to improve modeling of fire spread across the Ozark landscape.

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