HISTORICAL AND CONTEMPORARY ENVIRONMENTAL CONTEXT FOR THE SALINE-FIFTEEN SITE (3BR119)

Don C. Bragg[1] and Hope A. Bragg[2]

[1]USDA Forest Service, Monticello, AR
[2]University of Arkansas Cooperative Extension, McGehee

This paper summarizes the historical environmental context of the Saline-Fifteen site (3BR119) in Bradley County, Arkansas, developed from the General Land Office (GLO) public land surveys, other old documents, and an examination of current forest inventories and modern research to approximate past environmental attributes for this locality. While an imperfect source of information, the 1827-1841 GLO surveys for the Saline-Fifteen locality recorded at least 3,808 witness trees from a minimum of 45 taxa (assuming no grievous taxonomic identification errors). Oaks, pines, gums, and hickories were the most common taxa; a range of different-sized witness trees were also used, with a few oaks and cypress exceeding 60 inches (152 cm) in diameter. In addition to the witness trees and improvements of early Euroamerican settlers, other identifiable environmental attributes of interest to archeologists in the GLO notes include a variety of wildlife; mineral, soil, and abundant water resources; natural mounds; prairies and other natural vegetative communities; and scores of understory plants. Comparison with contemporary forest inventory data show that significant changes to landscape vegetation patterns have occurred over the past 150+ years. For example, chinquapin was present during the GLO surveys and probably represented an important food source for prehistoric populations, but this species is now virtually absent from the Saline-Fifteen locality.

INTRODUCTION

Understanding the environmental context of archeological sites is critical to their interpretation (King and Graham 1981), but the information needed to reconstruct long-past conditions is rarely available. Uncovering reliable sources of these data has long been an objective of ecologists and archeologists alike, with considerable effort expended to find first-person documentation, direct physical evidence, and proxies of past environments. After decades of conceptual development and study, useful approximations of historical environmental conditions have been assembled from sources such as the General Land Office (GLO) public land survey notes; early explorer and settler reports; government geological, botanical, and cultural surveys; trade journal articles; old photographs; and even promotional materials. Old documentation is not the only option: research into current forest conditions, geomorphology, pollen (palynology), and other preserved deposits (including artifacts and ecofacts) can also contribute to these reconstructions.

Because it is relatively easy to reconstitute 19th Century environmental patterns from historical and modern records, it is common to see conditions from this period extrapolated to landscapes in the more distant past (e.g., King 1982, 1984; Jeter et al. 1990; Rolingson 1993; Williams 1993; Early 2000). However, extending historical and contemporary analyses to prehistoric environments must be cautiously done (Wood 1976; King 1978), as most landscapes are highly dynamic and sensitive to changes in climate, natural and anthropogenic disturbance regimes, and pedogenesis across a wide range of scales. A local environment at any given point in time is not necessarily consistent with those decades or centuries earlier—for instance, the cooler, wetter "Little Ice Age" (circa A.D. 1400 to 1700) had notably different weather patterns than the warmer, drier "Medieval Climate Anomaly" (circa A.D. 950 to 1250) across much of the Northern Hemisphere (Mann et al. 2009), which likely had dramatic consequences on the natural environment of affected areas. Indeed, dendrochronological, palynological, and geological studies of vegetation patterns in the Arkansas

region have clearly demonstrated both long- and short-term fluctuations in climate and species composition (e.g., Stahle et al. 1985; Delcourt et al. 1999; Kidder 2006), probably from changes in plant germination success and alterations to disturbance regimes as a function of local, regional, and even global weather patterns.

Humans also play a critical role in determining vegetation patterns and other environmental conditions, and these influences may vary as a function of cultural practices. Anthropogenic impacts can be the result of discrete environment-changing events (e.g., the clearing of a forest for agriculture), biased treatment of biotic resources (e.g., removal of unwanted species or the planting of desired ones), or other alterations to natural disturbance regimes. As an example of the latter, Guyette et al. (2006) studied fire scars recorded on trees in the Boston Mountains over the last three centuries as a proxy of the region's fire regime. Although large-scale drought and landforms helped determine those regimes, Guyette et al. (2006) attributed changes in the frequency of fire over time to differences in how the different cultures of the Boston Mountains (Osage versus Cherokee versus Euroamerican) used fire to manipulate the vegetation, thereby having a large-scale influence on vegetation patterns. Because settlement, culture, and environment are inherently synergistic and transformative (e.g., natural resources attract people, who then modify these resources to support their communities), even early human influences have the ability to persist and shape modern-day communities and their supporting natural environments.

Hence, the development of a better understanding of historical environmental conditions can help with the interpretation of archeological sites, including the possibility of using this information to uncover new (unidentified) historic and prehistoric sites. With this in mind, the objectives of this paper are three-fold. First, we summarize the best available historical information on environmental conditions for the locality surrounding 3BR119 (hereafter, the Saline-Fifteen site) to support a broader ongoing analysis of the artifacts, ecofacts, and archeological interpretations of this prehistoric site by Dr. Marvin Jeter and colleagues. Second, and concurrent with the first objective, we provide a critical review of the primary information source (public land survey notes) using examples gleaned from the general locality. Finally, we present an analysis of historical and contemporary environmental conditions as a means to demonstrate how these sources of information can suggest possible relationships between past human occupations and their associated contexts.

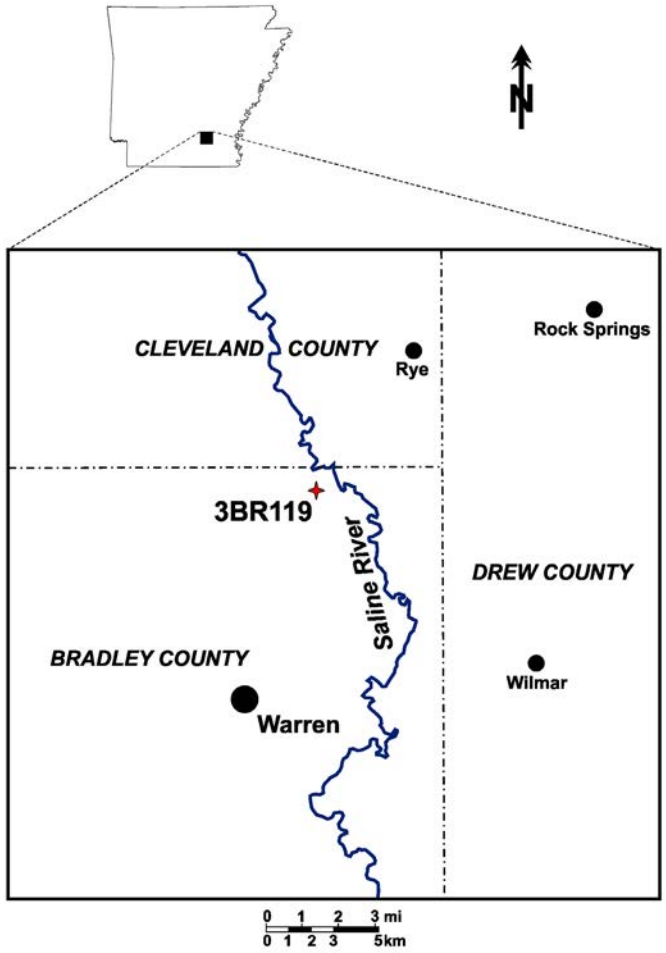

Figure 1. Location of the Saline-Fifteen site (3BR119) relative to modern-day political boundaries and municipalities. A geomorphological map (Saucier and Smith 1986: Warren NE quadrangle) places the Saline-Fifteen site just south of the northern edge of the Deweyville terrace (level 2); it is about 20 ft (6 m) higher than the bottomlands immediately to the north.

METHODS

Study location and archeological context

Uncovered in 1990 during the removal of road fill, the Saline-Fifteen site is named for the Saline River and then-Highway 15 intersection located just downstream (Figure 1). Originating in the Ouachita Mountains of central Arkansas, the Saline River passes through a poorly documented archeological region as it flows south through the Upper West Gulf Coastal Plain (UWGCP)[1] to its confluence with the Ouachita River near Crossett (Jeter and Early 1999, Jeter 2007). The UWGCP is an extensive area of low, gently undulating marine sediments and alluvium deposited during the Tertiary and Quaternary Periods (Saucier 1974; McFarland 1998). More recent upland erosion and accumulation along stream channels, loess deposition, and even seismic events have further

shaped the geology of these landscapes (Saucier 1974; Saucier and Smith 1986; Washington 2002; Cox et al. 2013). Humans arrived in the UWGCP over 10,000 years ago, but little physical evidence of these first settlers is present in the Saline River drainage (Jeter and Early 1999). Considerably more evidence of prehistoric occupation from the Archaic onward can be found across the region (Jeter and Early 1999).

Schambach (1998) placed the Saline River on the eastern frontier of his Trans-Mississippi South; undoubtedly, the broader Saline-Fifteen locality was influenced by a number of different cultures over the millennia. Saline-Fifteen is a multicomponent site that dates back to at least the Archaic, with a late Plaquemine occupation and a prominent Mississippian presence as suggested by an abundance of shell-tempered pottery and a "nearly ubiquitous" occurrence of maize (*Zea mays*) in associated midden and pit features (Jeter 2006; Lopinot 2007, cited in Jeter 2007). Radiocarbon dating of maize collected from the lowest portion of one of these pit features produced a 1-sigma range of A.D. 1280-1300, making the Saline-Fifteen site one of the earliest known occurrences of this crop in the Felsenthal region (Jeter 2006, 2007). Other artifacts suggest that this site was occupied until perhaps A.D. 1600; a minor historic component has also been recorded at the Saline-Fifteen site (Jeter 2006).

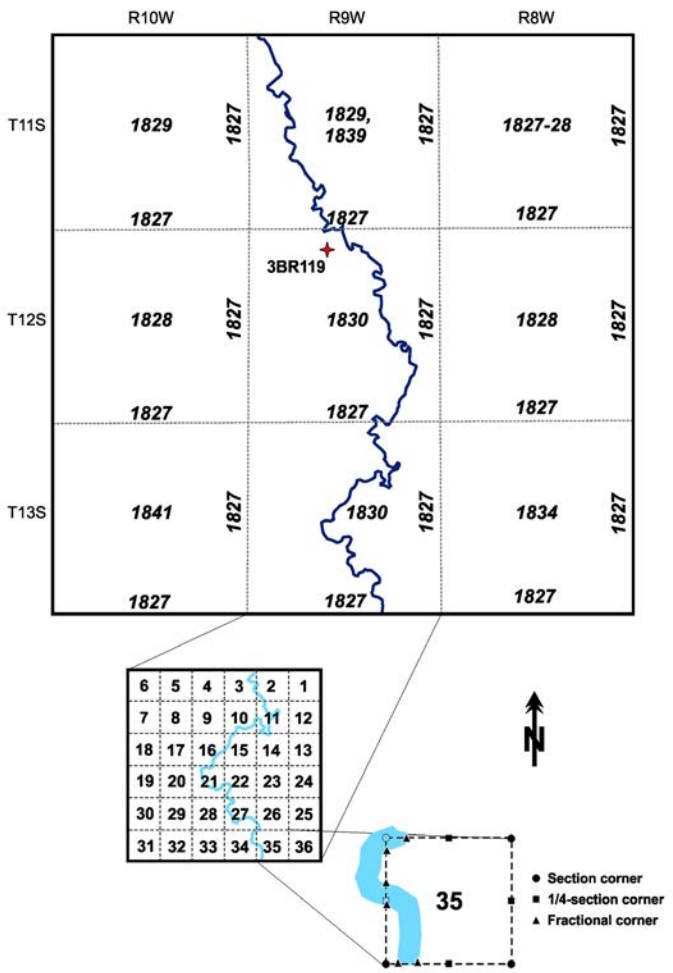

Figure 2. Top: periods when the General Land Office surveyors were traversing a given township or range line, or the interior of any given survey township, with the Saline-Fifteen locality. Bottom: examples how sections were laid out within a survey township, and where the corners were located.

Documenting the environment of the Saline-Fifteen locality

To assist in understanding how local and regional environments may have affected the occupation of the locality, we conducted a review of available literature and other contemporary data sources to approximate the past environmental conditions of the landscapes surrounding this site. Most of the information we developed on past environmental conditions for this locality comes from the GLO land survey notes from parts of Bradley, Cleveland, and Drew counties (Figure 2). To support the GLO data and its interpretation, we also incorporated other forms of information to increase the reliability and utility of the imperfect GLO notes (Bragg 2002b, 2003, 2008; Surrette et al. 2008).

The GLO public land surveys.—Although early Euroamerican explorers, missionaries, hunters, and eventually settlers traveled along the Saline River and overland past the site, virtually no written records of this region predate the GLO public land surveys. In Arkansas, the GLO operated from 1815 to 1855, and these records are part of a statewide collection available to the public (Daniels 2000; USDI BLM 2015; COSL 2015). The GLO surveys were a systematic, rectangular division of the public domain that followed a standardized if periodically altered set of practices.[2] Ideally, each GLO township was 6 miles by 6 miles (9.7 x 9.7 km) square (or 36 square miles (92.32 km^2) or 23,040 acres (9,332 ha)).[3] The starting point for all township and range lines in Arkansas is in a water tupelo (*Nyssa aquatica*) and baldcypress (*Taxodium distichum*) swamp at the intersection of Lee, Monroe, and Phillips counties near the present-day village of Blackton (Warwick 2003; Gill 2004). Since the Saline-Fifteen site is southwest of this initial point, all townships surrounding this locality are considered "South" townships, and all ranges are called "West." After their exterior boundaries were delineated, GLO townships were divided into 36 sections, nominally 1 mile (1.61 km) on a side and numbered consecutively in a serpentine pattern, starting in the northeastern corner, and ending in the southeast

(Figure 2). The Saline-Fifteen site is located in the SW1/4 of the NW1/4 of the SE1/4 of Section 4, Township 12 South, Range 9 West (hereafter abbreviated as T12S R9W). Nine townships surveyed between 1827 and 1841 and covering the approximately 207,000 ac (nearly 84,000 ha) that encompass 3BR119 (hereafter, the "Saline-Fifteen locality") were examined for this report (Figure 2).

We focused on two components of the GLO survey notes: witness trees and other environmental conditions. We evaluated the entire locality (rather than just the portion of T12S R9W including the Saline-Fifteen site; Figure 3) to ensure both a sufficient number of witness trees and a better sense of the larger context of the site. GLO surveyors recorded witness tree common species names (some more colloquial or "folk-taxonomic" than others), estimated stem diameters, and distance and bearing to the corner; we tallied every tree that had at least this information available. Taxonomic identifications were made to the degree they could be reliably assigned—for those with multiple possibilities, a range of options has been provided (Table 1).

Most GLO surveyors also documented general vegetation types (e.g., open pine woods), landforms, unique features, and the disturbance events that affected the timber (e.g., wind damage, fires, land clearing). Arkansas Surveyor General William Pelham's 1843 instructions (quoted from Stewart 1935:166) specified:

> ….the distance to and where you leave all lakes, streams, swamps, fields, prairies, traveled roads and tracks (denoting the places to which, and from they lead), creek and river bottoms, mountains, hills, bluffs, and other natural objects, with their courses as well as you can conjecture; the distance to all mines, salt and other mineral springs, salt licks, forges, factories, cotton gins and other houses…

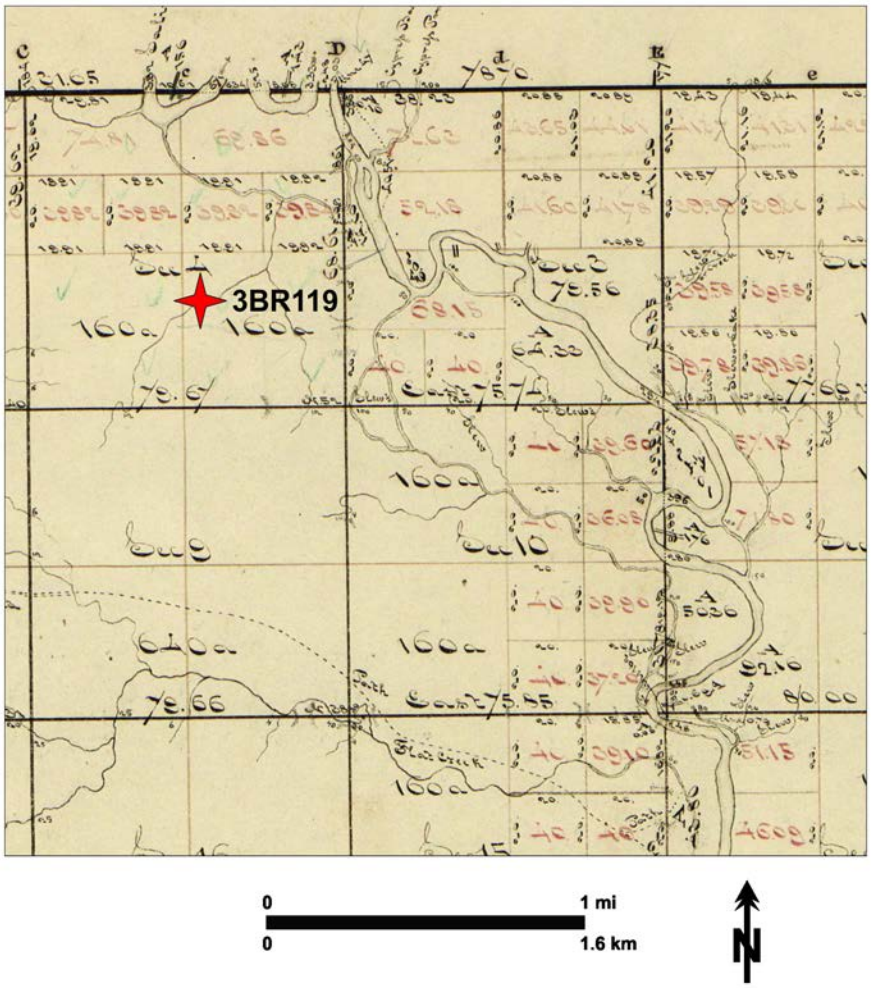

Figure 3. The portion of the original GLO plat map for T12S R9W (from USDI BLM 2015), drafted in 1839 from field survey work done between 1827 and 1830, with the approximate Saline-Fifteen site location (star) added.

Table 1. General Land Office surveyor plant identifications for the Saline-Fifteen locality. Misidentifications and taxonomic vagueness limit the species identifications in many cases to one of several possibilities, with the most likely candidate(s) identified with bold type.

Surveyor identifications [a]	Strata [b]	Probable species [c]
Ash	B	*Fraxinus* spp.
Beech	O	*Fagus grandifolia*
Birch (water birch, river birch)	O	*Betula nigra*
Black cherry	O	*Prunus serotina*
Black gum	B	*Nyssa sylvatica*
Black hickory	O	*Carya texana*
Black oak (b. oak)	B	***Quercus pagoda, Quercus falcata,*** *Quercus velutina, Quercus shumardii, Quercus rubra*
Black walnut (walnut)	B	*Juglans nigra*
Blackberry	U	*Rubus* spp.
Blackjack oak (blackjack)	O	*Quercus marilandica*
Cane	U	*Arundinaria gigantea*
Chinquipin (chinkapin, chinquepin)	B	*Castanea pumila* var. *pumila*
Cypress	O	*Taxodium distichum*
Dogwood	B	***Cornus florida***, *Cornus foemina*
Elm	B	*Ulmus* spp.
Grape	U	***Vitis rotundifolia, Vitis vulpina, Vitis aestivalis***, *Vitis cinerea, Vitis palmata*
Greenbriers	U	*Smilax* spp.
Gum	B	*Nyssa sylvatica, Liquidambar styraciflua, Nyssa aquatica*
Hackberry	O	***Celtis laevigata***, *Celtis occidentalis*
Hazel	U	*Corylus americana, Hamamelis virginiana*
Hickory	B	*Carya* spp.
Holly	B	*Ilex opaca*
Honey locust	O	***Gleditsia triacanthos***, *Gleditsia aquatica*
Hornbeam (horn beme)	B	***Carpinus caroliniana***, *Ostrya virginiana*
Huckleberry	U	***Vaccinium arboreum, Vaccinium elliottii, Vaccinium stamineum,*** *Vaccinium fuscatum, Vaccinium virgatum*
Ironwood	B	***Ostrya virginiana***, *Carpinus caroliniana*
Laurel	B	*Symplocos tinctoria, Magnolia virginiana, Lindera benzoin*
Locust	O	*Gleditsia triacanthos, Gleditsia aquatica, Robinia pseudoacacia*
Lynn (lin)	O	*Tilia americana*
Maple	B	*Acer rubrum, Acer saccharinum, Acer saccharum* var. *floridanum*
Mulberry	B	*Morus rubra*
Myrtle	U	*Myrica cerifera, Myrica heterophylla*
Oak (scrub oak)	B	*Quercus* spp.
Overcup oak	O	*Quercus lyrata*
Palmeto	U	*Sabal minor*
Pawpaw	B	*Asimina triloba*
Peach tree (wild peach)	B	***Magnolia virginiana***, ***Symplocos tinctoria***, *Prunus persica*
Pecan	O	*Carya illinoensis*
Persimmon	O	*Diospyros virginiana*
Pine	B	*Pinus echinata, Pinus taeda*
Pin oak	B	***Quercus phellos, Quercus nigra***, *Quercus laurifolia*
Post oak	B	*Quercus stellata*

Continued on next page…

Table 1 (cont.). General Land Office surveyor plant identifications for the Saline-Fifteen locality. Misidentifications and taxonomic vagueness limit the species identifications in many cases to one of several possibilities, with the most likely candidate(s) identified with bold type.

Surveyor identifications [a]	Strata [b]	Probable species [c]
Prickly sumac (prickle shoemake)	U	*Aralia spinosa, Zanthoxylum clava-herculis*
Privy (privey)	B	*Forestiera acuminata*
Red oak	O	***Quercus falcata, Quercus pagoda****, Quercus shumardii, Quercus texana, Quercus velutina, Quercus rubra*
Sassafras	B	*Sassafras albidum*
Shellbark hickory	O	*Carya ovata*
Smooth sumac	U	*Rhus glabra*
Spanish oak	O	*Quercus falcata, Quercus pagoda, Quercus rubra*
Sumac (shoomack, shoemake)	U	*Rhus glabra, Rhus copallina*
Summer grape	U	*Vitis aestivalis*
Swamp dogwood	U	***Cornus foemina****, Cornus florida*
Swamp elm	O	***Planera aquatica****, Ulmus rubra*
Swamp white oak	O	***Quercus michauxii****, Quercus lyrata*
Sweet bay (bay, green bay)	B	*Magnolia virginiana, Symplocos tinctoria*
Sweet gum	B	*Liquidambar styraciflua*
Sycamore (cycamore)	O	*Platanus occidentalis*
Water beech	O	*Carpinus caroliniana*
Water elm	O	*Planera aquatica*
White gum (tupelo gum, toopler)	O	*Nyssa aquatica*
White hickory	O	*Carya tomentosa*
White oak (w. oak)	O	***Quercus alba****, Quercus michauxii*
Whortleberry	U	***Vaccinium arboreum, Vaccinium elliottii, Vaccinium stamineum,*** *Vaccinium fuscatum, Vaccinium virgatum*
Willow	O	*Salix nigra*
Willow oak	O	***Quercus phellos****, Quercus nigra, Quercus laurifolia*
Winter whortleberry	U	*Vaccinium arboreum*
Witch hazel	U	*Hamamelis virginiana*

[a] Sometimes the surveyors used multiple spellings for the same species– these names (including those in parentheses) are the most typical common names

[b] Strata: O = reported in the overstory only; U = reported only in the understory; B = reported in both.

[c] Species nomenclature and interpretations from Arkansas Vascular Flora Committee (2006), Delcourt (1976), Moore (1999), Putnam and Bull (1932), Smith (1988), Bragg (2002a, 2003), Gentry et al. (2013), and Dr. Eric Sundell (pers. comm.)

We recorded other discernable environmental features in the GLO notes and plat maps as encountered, including any notable mentions of Euroamerican settlement and development. Unfortunately, the GLO surveyors inconsistently reported these attributes in southern Arkansas, with some describing them at some length and others hardly at all. We were also able to develop a historical forest distribution map for the Saline-Fifteen locality by combining information from the GLO notes, surveyor plat maps, and inferences from modern-day topographic maps.

Modern vegetation analysis.—To further refine our GLO data, USDA Forest Service Forest Inventory and Analysis (FIA) sample plots measured between 2000 and 2005 from Bradley, Cleveland, and Drew counties were used to develop a species list, relative abundance information, and data on contemporary tree size class structure (USDA Forest Service 2007). The FIA sample plots are part of a statistically representative forest inventory established across the United States to express large-scale forest patterns and dynamics (see Miles et al. (2001) for details). A FIA sample plot consists of four circular subplots each 0.04 ac (0.017 ha) in size (0.16 ac (0.067 ha) for the plot). In each subplot, all live trees at least 5 in (12.7 cm) in diameter at breast height (DBH) had their species, DBH, and vigor recorded by trained observers.

RESULTS AND DISCUSSION

The promise and perils of the Saline-Fifteen GLO data

The large number of surveyor-identified trees (with their corresponding diameters and physical locations) has long appealed to ecologists and archeologists. However, this information must be interpreted cautiously, for several reasons. First, the GLO was never intended as an unbiased vegetative inventory; rather, it was designed to expediently subdivide and help settle the public domain (e.g., Bragg and Webb 2014). Sometimes this expedience led to instances of fraud by the surveyors—none was apparent in the records from the Saline-Fifteen locality, but other parts of Arkansas have major issues (Bragg and Webb 2014). Not all land surveyors were equally skilled or diligent at their job, and hence their species assignments are often only approximate—some witness tree information may be imprecise, incorrect, or even fabricated (Bragg 2002a; Bragg and Webb 2014). GLO surveyors were not trained botanists, and much of their field surveying was done during the dormant season (November to April) when most leaves, flowers, and other useful taxonomic characteristics are lacking. It was of little concern to most surveyors if witness trees were proportionally selected or properly identified in the Saline-Fifteen locality, so long as settlers could find their corners.

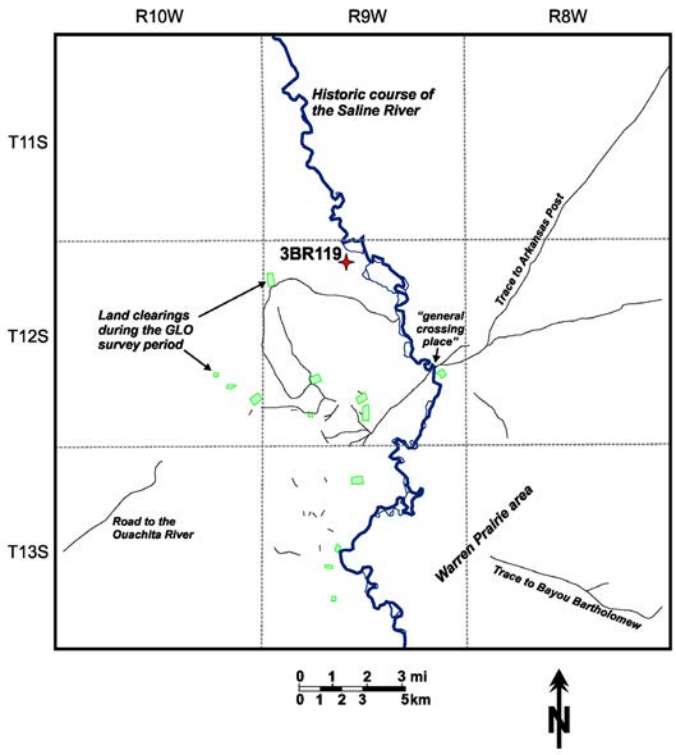

Figure 4. Key historical features derived from the GLO plat maps, including roads/traces/trails, settler cleared lands, and the historic course of the Saline River. Note that because of this map's scale, it does not show smaller improvements, such as homes, mills, and the stone coal quarry noted in the GLO notes. The dispersed settlement area that would eventually become the city of Warren is south and west of 3BR119.

Second, it is important to note that GLO witness tree data are sparsely distributed—usually only 2 to 4 per corner, and roughly the same number of line trees per mile of surveyed line. This sparsity means that witness and line trees rarely express the true arboreal richness of any given location: recent studies of mature forests in Arkansas have found even small parcels can have dozens of tree species (e.g., Board et al. 1993; Bragg 2004a; Fountain 1980; Heitzman et al. 2004; Shelton and Cain 1999). Surveyors also probably had species or size classes they preferred (or avoided) for witness trees. For instance, large, old trees tend to have very thick bark, and this would slow the inscribing of the witness trees with the required information (Bragg 2003). Since GLO surveyors were paid by the number of miles of completed line, if they had to choose between two trees of the same species, one being of modest size, the other very big, he probably would have picked the smaller of the two, thereby biasing the witness tree "sample" against larger trees. Hence, the scope of GLO-based analysis needed to include the entire Saline-Fifteen locality to produce meaningful reconstructions of vegetation patterns.

Third, the GLO notes represent a very specific snapshot in time, and the climatic conditions or disturbance regimes of the early- to mid-19th century that shaped local expressions of vegetation likely differed from those experienced decades or centuries earlier. We also do not know how events (such as high water) that occurred during the GLO surveys may have affected the surveyor's observations. As an example, Figures 3 and 4 include a side channel of the Saline River near the Saline-Fifteen site that is obvious on modern topographic maps but not apparent on the GLO plat maps. There is a good chance that this channel's absence in the historical plat maps arose from being obscured by flooding, thereby compromising the reliability of these surveys at that location.

These concerns (and others) have been known for decades, and some researchers have sought to correct bias or taxonomic imprecision (e.g., Bourdo 1956; Hutchison 1988; Manies et al. 2001; Mladenoff et al. 2002; Schulte and Mladenoff 2001; Surrette et al. 2008); however, these corrections are fraught with their own problems.[4] Even with these caveats (e.g., Bragg 2003; Chaney 1990; King 1978; Mladenoff et al. 2002; Schulte and Mladenoff 2001; Surrette et al. 2008), useful information on historical

environmental conditions can be gathered from the GLO notes for the Saline-Fifteen locality.

Euroamerican settlement and surveying conditions

The first permanent Euroamerican settlers in the Saline-Fifteen locality arrived in the 1820s (Anonymous 1890), and their numbers increased steadily over the next few decades (Figure 4). These settlers (technically squatters since this portion of the public domain had not yet been formally offered for sale by the federal government) were firmly established when the first GLO surveyors traversed the countryside. For example, in 1827 Deputy Surveyor Nicholas Rightor noted a cotton gin and large plantation near the south boundary of T12S R9W owned by "Old Mr Pennington"—presumably, Isaac Pennington, one of Bradley County's first settlers. Nearby were other homes, a store house, fences, clearings ("improvements"), a cornfield, paths, traces, wagon roads, and a blacksmith shop. The blacksmith shop was probably supplied with fuel by a nearby "stone coal" quarry, also mentioned in the GLO notes. This development appears to be "Pennington's Settlement," the precursor of the present-day city of Warren. In his boundary notes for T12S R9W, Rightor described some of the settlement process:

> [This township] contains a large portion of good and Saleable land and in which several families have settled and from what I learn several Families [illegible word] are expected on soon from Big Red River to settle in this township and in the one that joins it on the West and have driven on [illegible word] stocks of Cattle which are now rangeing [sic] in the creek and River bottom The Township immediately west of it viz T 12 S.R. 10 W has likewise a fine proportion of good and saleable land and some families living in it.

Later, after a trip to acquire food, Rightor wrote:

> January 8th 1827 about 12 oclock [sic] I returned from the Settlement which is about 6 miles N E wardly [sic] where live within the compass of 6 or 8 miles about 20 families and these I seen were apparently good livers and some welthy [sic] people having a number of Slaves and very considerable improvements From what I learned the Settlement is fast increasing migrating from the Post of Washitaw [sic] and Big Red River. The land on which they have settled is really of excelant [sic] quality. I got one bushel of corn meal and 85 lb Pork and after my starved hands are sattisfied [sic] we will go ahead.

When Deputy Surveyor Laurentian Eiler arrived to complete the interior survey of T12S R9W in the fall of 1830, this township was even more settled. Along the southern portion of this township, Eiler noted the fields, fences, and home of Captain Bradley[5], and just to the south, near a road juncture, the T12S R9W plat map showed a structure labeled as a mill (Figure 5). Curiously, though mapped, this mill is not described in the survey notes, highlighting the need to examine both the notes and plat maps when using the GLO surveys. An abundance of wooded rangelands, a river for the transport of bulk goods, many water-powered mill locations, and existing "traces" (primitive, poorly developed roads) helped to draw Euroamerican settlers such as Pennington and Bradley.

Even with these advantages, life on this frontier was difficult, and particularly hard on the surveying crews. This growing settlement often lacked the supplies needed by the GLO crews—sometimes Rightor had to send his men as far away as Arkansas Post (over 50 miles (80 km) to the northeast) to purchase food. Poor health also affected the crews. In 1828 Deputy Surveyor Daniel Miller had to survey the interior lines of T12S R10E without his hand Antwine Duchapin who was sick at his home with "pleurisy" (an inflammation of the linings of the lung). A couple of days later, he was again shorthanded because a different man was suffering from an unspecified illness. Not surprisingly, survey crew turnover was high; in addition to hunger and illness, the $15 to $20 per month wage of a typical hand was scarce reward for the long hours, hard work, and otherwise dangerous working conditions in all kinds of weather, with prolonged separations from friends and family. Deputy Surveyor Eiler commented on this at the beginning of his survey of the interior of T13S R9W: "April 26, 1830 Paul Bono and Peter Trudo left me, giving as cause for lack conduct that they could not stand the hardships of the wood and a surveying life." Eschewing one of the few cash-paying jobs on the frontier, especially one that paid appreciably more than most other employment options (Lebergott 1960), is quite telling![6]

Historical forest community types

Prior to the early 20th Century, only a handful of

Figure 5. Close-up of plat map for T12S R9W showing the fields, roads, and structures on and around Captain Bradley's farm in the 1830s. The mill (inset) was not described in the notes, but appears in the plat map.

trained botanists explored the forests of Arkansas, so there are few reliable accounts of historical forest composition prior to the lumbering of the virgin forests. According to nearby GLO corner and line descriptions, the land surrounding the Saline-Fifteen site consisted of varying mixtures of hardwood and pine. With few exceptions, historical forests in this region were rarely pure[7] in their composition (Bragg 2008). Forty-five taxa (either genera or species) were mentioned by the surveyors in the Saline-Fifteen locality (Table 2). Some of these taxonomic groups represent two or more species, so the actual number of species encountered was probably even higher. Just over 20% of all witness trees were "black oak" (Table 2), followed by pine (17.86%), white oak (primarily *Quercus alba*) (13.42%), post oak (*Quercus stellata*) (12.92%), hickory (*Carya* spp.) (7.93%), and sweetgum (*Liquidambar styraciflua*) (7.51%). No other individual species exceeded 5% of the witness tree total.

Other historical sources also noted the diversity of forests in this locality. For example, Owen et al. (1860:139-141) described many forests of this region as "hickory, pine, and oak," "post-oak, black oak, and pine," and "elm, mulberry, prickly ash, red-oak, and a few white oaks and hickory." Likewise, Bradley County resident Abraham M. Lansdale (1858:1) wrote in a letter of forests of "…white oak, red oak, poast [sic] oak, hickory, pine, ash, beech, maple, elm, black and sweet gum…" with an understory of "…dogwood, ironwood, laurel, chinkpin [sic], holly, hackberry, [F]rench mulberry, grape and muskadine [sic] vines in profussion [sic], besides mirrads [sic] of weeds and vines of annual growth."[8] A later article in the trade journal *American Lumberman* (Anonymous 1906, p. 63) claimed that the lands of the Arkansas Lumber Company south of Warren, Arkansas, held

> …150,000,000 [board] feet of the finest sort of hardwood timber…[and] the yellow pine timberland holdings of the Arkansas Lumber Company contain these relative percents: Oak, 35 percent; hickory, 30 percent; gum, 25 percent;

Table 2. Historical (1827-1841) witness tree species abundances from the Saline-Fifteen locality, taken from the Arkansas General Land Office survey notes (Daniels 2000).

Surveyor tree name [a]	Number	Percent	Diameter [b] Minimum		Average		Standard deviation		Maximum	
			-in.-	-cm-	-in.-	-cm-	-in.-	-cm-	-in.-	-cm-
Black oak	775	20.35	3	7.6	20	50.8	7.6	19.3	60	152.4
Pine	680	17.86	3	7.6	18	45.7	8.8	22.4	50	127.0
White oak	511	13.42	4	10.2	20	50.8	8.0	20.3	60	152.4
Post oak	492	12.92	3	7.6	15	38.1	4.8	12.2	32	81.3
Hickory	302	7.93	3	7.6	12	30.5	4.6	11.7	36	91.4
Sweet gum	286	7.51	4	10.2	16	40.6	7.4	18.8	50	127.0
Black gum	190	4.99	4	10.2	13	33.0	4.2	10.7	36	91.4
Red oak	74	1.94	4	10.2	22	55.9	8.9	22.6	48	121.9
Maple	61	1.60	5	12.7	12	30.5	4.2	10.7	30	76.2
Pin oak	60	1.58	6	15.2	16	40.6	7.3	18.5	40	101.6
Elm	41	1.08	5	12.7	11	27.9	3.9	9.9	22	55.9
Hornbeme (hornbeam)	36	0.95	4	10.2	9	22.9	2.7	6.9	17	43.2
Holly	35	0.92	4	10.2	9	22.9	2.3	5.8	14	35.6
Cypress	33	0.87	8	20.3	27	68.6	15.2	38.6	60	152.4
Chinquipin	31	0.81	4	10.2	12	30.5	4.1	10.4	24	61.0
Ash	29	0.76	4	10.2	11	27.9	4.6	11.7	28	71.1
Dogwood	27	0.71	2	5.1	6	15.2	2.0	5.1	10	25.4
Black hickory	23	0.60	4	10.2	10	25.4	3.6	9.1	16	40.6
Birch	22	0.58	6	15.2	16	40.6	6.3	16.0	24	61.0
Ironwood	18	0.47	5	12.7	7	17.8	1.7	4.3	10	25.4
Willow oak	13	0.34	5	12.7	13	33.0	7.1	18.0	30	76.2
Beech	7	0.18	6	15.2	14	35.6	5.5	14.0	24	61.0
Overcup oak	7	0.18	8	20.3	17	43.2	6.1	15.5	28	71.1
Sassafras	7	0.18	3	7.6	14	35.6	8.8	22.4	30	76.2
Hackberry	6	0.16	5	12.7	12	30.5	5.1	13.0	20	50.8
Laurel	6	0.16	3	7.6	7	17.8	2.4	6.1	10	25.4
Lynn	5	0.13	12	30.5	18	45.7	4.8	12.2	24	61.0
Gum	4	0.11	10	25.4	14	35.6	6.6	16.8	24	61.0
Sycamore	4	0.11	12	30.5	16	40.6	5.7	14.5	24	61.0
Willow	4	0.11	10	25.4	12	30.5	2.8	7.1	16	40.6
Water elm	3	0.08	8	20.3	9	22.9	1.2	3.0	10	25.4
Mulberry	2	0.05	6	15.2	7	17.8	1.4	3.6	8	20.3
Persimmon	2	0.05	5	12.7	7	17.8	2.8	7.1	9	22.9
Oak	1	0.03	20	50.8	20	50.8	--	--	20	50.8
Pecan	1	0.03	18	45.7	18	45.7	--	--	18	45.7
Privy	1	0.03	7	17.8	7	17.8	--	--	7	17.8
Black walnut	1	0.03	36	91.4	36	91.4	--	--	36	91.4
Locust	1	0.03	12	30.5	12	30.5	--	--	12	30.5
Shellbark hickory	1	0.03	18	45.7	18	45.7	--	--	18	45.7
Spanish oak	1	0.03	12	30.5	12	30.5	--	--	12	30.5
Swamp white oak	1	0.03	40	101.6	40	101.6	--	--	40	101.6
Swamp elm	1	0.03	10	25.4	10	25.4	--	--	10	25.4
Sweet bay	1	0.03	4	10.2	4	10.2	--	--	4	10.2
White hickory	1	0.03	16	40.6	16	40.6	--	--	16	40.6
Wild peach	1	0.03	7	17.8	7	17.8	--	--	7	17.8
Totals:	3808	100.00								

[a] GLO surveyor tree names are provided as encountered in the notes. See Table 1 for likely scientific names.

[b] We do not know exactly where or how diameter was estimated by the GLO surveyors, but it did not likely follow the standards used by modern-day foresters.

> cypress, 10 percent. The varieties of oak are divided as follows: White oak, 35 percent; black oak, 30 percent; pin oak, 25 percent; Spanish oak, 5 percent; overcup oak 2½ percent, and post oak, 2½ percent.

These rather precise percentages could be somewhat misleading; by the time of this article (1906), many of the Arkansas Lumber Company lands had been partially or completely cut, removing the commercially preferred yellow pines, oaks, etc.[9] Also note that the oak fractions cited at the end of this quotation are a percentage of a percentage, so white oak actually made up only about 12% of all the upland trees (35% of 35%).

Historical vegetation patterns of the Saline-Fifteen locality

Because the Saline-Fifteen site did not fall along township, range, or section lines, or immediately adjacent to a surveyor corner, there is no specific forest description of the site in the GLO notes. The combination of old and modern geographic information displayed in Figure 6, though a coarser expression of large-scale vegetation

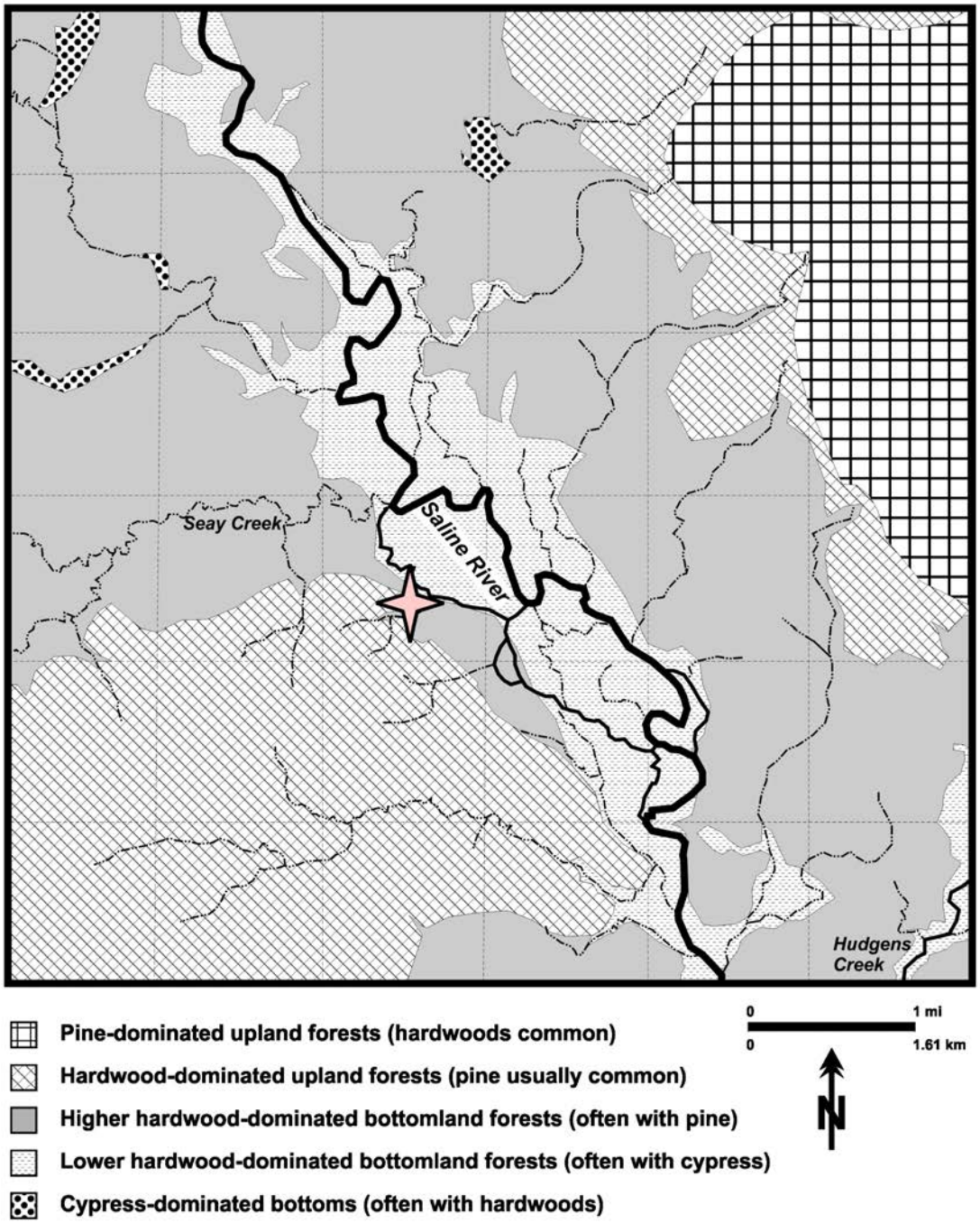

Figure 6. Map of the broad-scale historical vegetation patterns derived from the GLO notes, plat maps, and modern topography for the 36 square miles (93.3 km^2) surrounding the Saline-Fifteen site (3BR119) in Bradley and Cleveland counties, Arkansas.

patterns, helped minimize the ambiguity of surveyor tree identifications and better reflected large-scale plant communities. For example, Deputy Surveyor Eiler traversed the line between sections 4 and 9 in T12S R9W (just south of the Saline-Fifteen site) in October of 1830 and noted gently rolling hills with "second rate" soils dominated by oak (*Quercus* spp.), gum (*Liquidambar styraciflua* and/or *Nyssa* spp.), elm (*Ulmus* spp.), maple (*Acer* spp.), hickory, chinquapin (*Castanea pumila* var. *pumila*), and a significant amount of pine, with an undergrowth of cane (*Arundinaria gigantea*), vines, briars, dogwood (*Cornus florida*), and sumac (*Rhus* spp.).[10] Deputy Surveyor H.B. Allie described the line between sections 32 and 33 in T11S R9W (approximately 1 mi (1.61 km) to the northwest of the Saline-Fifteen site) as reasonable for agriculture, with the timber of this low terrace dominated by pine and oak

and an undergrowth of cane, briars, and vines. Across the Saline River to the northeast, pine tended to be somewhat more abundant, although these forests had an appreciable hardwood component (Figure 6).

Upland pine and pine-hardwood forests.—At the Saline-Fifteen locality, loblolly and shortleaf pines were usually found in mixtures with numerous hardwood species, particularly oaks and hickories. Historically, loblolly pine was most abundant on moister locations in southern Arkansas, such as along the Saline River bottoms or on minor stream bottoms or flats, while the more fire-adapted shortleaf would have been more common in higher, drier uplands (Sargent 1884; Mattoon 1915; Bragg 2002b, 2008; Surrette et al. 2008). GLO surveyors rarely mentioned pine-only stands in the Saline-Fifteen locality, although relatively pure pine forests were sometimes found in southern Arkansas (e.g., Mattoon 1915; Mohr 1897). For example, Ashley County (southeast of the Saline-Fifteen locality) had extensive tracts of pure pine (Bragg 2003). Williams (1993:27, his Figure 6) also identified a large patch of woods east of the Hardman Site (3CL418) overlooking the Ouachita Valley near present-day Arkadelphia with a prominent pine component—so much so that he speculated that activities related to Caddoan salt extraction (especially fire) had promoted pine abundance. Extensive pine dominance is consistent with other historical reports of upland forests in southern Arkansas (e.g., Anonymous 1906; Chapman 1913; Lansdale 1858; Morbeck 1915; Olmsted 1902; Owen et al. 1860; Sargent 1884), and helped fuel the regional timber industry.

Mixed hardwood stands with a minor and varying pine component dominated the region. The most commonly used witness tree species in the Saline-Fifteen locality was "black oak" (Table 2). While a few of these surveyor-designated black oaks were probably *Quercus velutina*, black oak in this region likely represents a complex of related species (see later discussion). Other upland hardwoods with appreciable counts (at least 5%; Table 2) included white oak, hickory, sweetgum, and blackgum (*Nyssa sylvatica*). Red or "Spanish" oak was also relatively common (1.94%), and also likely represents a species complex including what we now distinguish as southern red oak (*Quercus falcata*), cherrybark oak (*Quercus pagoda*), northern red oak (*Quercus rubra*), and perhaps even a few *Quercus velutina*. Maples, elms, ash (*Fraxinus* spp.), hornbeam (*Carpinus caroliniana*), holly (*Ilex opaca*) and ironwood (*Ostrya virginiana*) were infrequently reported across the locality (Table 2).

Woodland and prairie.—There were few tell-tale signs of oak-pine woodlands in the immediate proximity of the Saline-Fifteen site—no corners or lines were described as "open" or "grassy woods" or "prairie woods" as they are elsewhere. Across the UWGCP, open woodlands were dominated by oak (usually post oak) and shortleaf pine, taxa well adapted to survive frequent low-intensity burns. Post oak was frequently mentioned not far to the south of the site and along the eastern portion of the Saline-Fifteen locality (Figure 6). Such woodlands are often associated with relatively small diameter witness trees that had been stunted by repeated surface fires and/or poor growing conditions. These open woodlands are largely absent from modern landscapes in southern Arkansas, as fire suppression contributed to noticeable increases in tree density and species richness and many of these woodlands were converted to pasture.

Unlike the UWGCP in Ashley County, only limited portions of the Saline-Fifteen locality were described by the GLO surveyors as prairie. However, a grassland (now known as Warren Prairie) in T13S R8W and T13S R9W was described (see Figure 4). One deputy surveyor's comments on the Warren Prairie are particularly telling:

> [at the quarter-section post on the east side of section 24, T13S R9W] Land level and very wet poor prairie interspersed with Island of pine and post oak timber which are upon apperant [sic] monds [sic] not fit for cultivation

The "monds" are "pimple" or "prairie" mounds of natural origin (Larance et al. 1976; Bragg 2003) (see later section). Today, some of the post oaks that grow on these mounds approach 200 years old, and thus would have been present when the prairie was surveyed. Severe growing season dryness due to drainage conditions and high levels of sodium and magnesium in the Warren Prairie soils have kept much of this grassland permanently free of woody vegetation—in some locations, bare soil is exposed because of the phytotoxic nature of these soils (Larance 1961; Larance et al. 1976). Many of the lands near the Warren Prairie are only marginal for tree growth, producing stunted or dwarfed oak and pine, often called "scrub" by the surveyors.

The open, grassy woodlands and small pockets of prairie helped foster the Euroamerican settlement of the locality. Early settlers in southern Arkansas were primarily subsistence farmers and pastoralists, grazing their hogs and cattle in the unfenced woods and prairies (Anonymous 1890) and manipulating the vegetation to

support their efforts. Across the southern United States, settlers deliberately fired the prairies, woodlands, and forests to increase livestock forage, improve hunting and traveling conditions, kill ticks and snakes, contain disease, and to encourage useful plants (Shea 1940; Hammet 1992). The practice of "woods-burning" persisted across most of the region well into the 20th Century when fire control programs by state and federal agencies finally proved successful (Shea 1940).

Bottomland hardwoods.—Outside of the higher hills and terraces, much of the Saline-Fifteen locality is dominated by bottomland hardwoods (Figure 6). The complex hydrology and landform structure of bottomlands produced some of the highest species richness in the historical forests surrounding the Saline-Fifteen site. There are also meaningful vegetative differences between major and minor stream systems, depending on soil parent materials, flood regimes, topographic features such as bars, sloughs, flats, ridges, swamps, and terraces, and depth to the water table. For instance, Grell et al. (2005) found slight elevation differences, coupled with soil and moisture effects, produced distinct vegetation assemblages in a Calhoun County tract of old-growth bottomland hardwoods and loblolly pine. This is important when trying to differentiate between species and discrete plant communities, for the GLO notes are rarely specific enough to identify the significant but small-scale features found in many of the bottomlands. With few exceptions, flood-tolerant tree species would have occupied the frequently inundated lower terraces, flats, sloughs, and other riparian features (Hodges 1997). The wettest bottoms with long-standing water would have been occupied by baldcypress and/or water tupelo (*Nyssa aquatica*) gum-dominated forests (only the major concentrations of cypress-gum swamps are shown on Figure 6—many smaller pockets were also present). There are also a few locations labeled "pine swamps" by the GLO surveyors, especially northwest of the site. These were probably loblolly pine-dominated stands subject to periodic flooding.

Besides the more ubiquitous species found across a range of site conditions (e.g., sweetgum, blackgum, sycamore (*Platanus occidentalis*)) and generically defined taxa (e.g., "gum," "oak," "elm," "ash"), the most prominent bottomland hardwoods included "pin oak" (1.58% of witness trees), river birch (*Betula nigra*) (0.58%), willow oak (*Quercus phellos*) (0.34%), and overcup oak (*Quercus lyrata*) (0.18%). In addition to challenging surveying conditions, taxonomic uncertainties probably made the bottomland hardwood forests of the Saline-Fifteen locality the most poorly described in the GLO notes. Many of the most common hardwoods today are not mentioned at all in the GLO notes for the Saline-Fifteen locality, including water tupelo (sometimes called "tupelo gum," "toopler," or "white gum" by the surveyors (Bragg 2002a)), honeylocust (*Gleditsia triacanthos*), water hickory (also called bitter pecan; *Carya aquatica*), mockernut hickory (*Carya tomentosa*), red maple (*Acer rubrum*), winged elm (*Ulmus alata*), American elm (*Ulmus americana*), and green ash (*Fraxinus americana*). However, it is likely some or all of these missing taxa were subsumed under the generic witness tree labels of "gum," "hickory," "maple," "elm," "ash", etc. Others were poorly identified—for example, in southern Arkansas the "pin oak" of the GLO surveyors is not what some (e.g., King 1984) have interpreted as *Quercus palustris* (southern pin oak, which is not native to this part of the state). Rather, the "pin" label instead refers to the long, narrow, often unlobed leaves of willow oak, water oak (*Quercus nigra*), and perhaps laurel oak (*Quercus laurifolia*). Similarly, some of the "white oaks" identified by the surveyors may have been either overcup oak (King 1984) or swamp chestnut oak (*Quercus michauxii*, identified by Harvey (1881) as the "principal" species of white oak in southeastern Arkansas).

Vague or inaccurate species identifications are not the only reason why some species may have been underreported in the GLO. As noted earlier, surveyors often preferred medium-sized trees and avoided either very small- or very large-diameter individuals, thus biasing their observations (Bragg 2003). A number of hardwood species (e.g., pawpaw (*Asimina triloba*), water-elm (*Planera aquatica*)) common today but rare or absent in the GLO notes (Table 2) were probably shunned due to their characteristically small stature.[11] Baldcypress also represents a bit of an enigma. GLO surveyors usually paid close attention to cypress, as it was one of the first species commercially exploited for lumber across the southeastern United States, including Arkansas (Bragg 2011). However, the rarity of cypress in the Saline-Fifteen GLO notes (less than 1% of all witness trees) suggests surveyors may have eschewed this common and often very large conifer growing in the wettest of locations.

Plant records of special interest across the Saline-Fifteen locality

Chinquapin.— Chinquapin (*Castanea pumila*) is a large shrub or small tree closely related to the American chestnut (*Castanea dentata*). Historically, chinquapin was locally common in some parts of the UWGCP of Arkansas (e.g., Harvey 1880; Warder 1881). In southeastern Arkansas, it occasionally appeared in the GLO notes

as a witness tree—Bragg (2003) reported that 0.26% of the 12,963 witness trees he surveyed in the Ashley County were chinquapin. Chinquapin was somewhat more common in the Saline-Fifteen locality (31 of 3,808 witness trees, or 0.81%). Because of its sweet, edible nut, it is possible that chinquapin may have been favored by prehistoric populations in the Saline-Fifteen locality: Native Americans at least encouraged, if not deliberately cultivated, many edible seed producing trees and shrubs, including chinquapin (e.g., Fritz 1995; Hall 2000; Hammett 1992; Davies 1994; Abrams and Nowacki 2008).

Peach tree.—One deputy surveyor (probably Nicholas Rightor) identified a "peach tree" along the south boundary of T13S R10W near Beech Creek southwest of modern-day Warren. Apparently, this surveyor was told by local settlers that they called this tree, an evergreen shrub, "sweet laurel" or "sweet bay," (probably *Magnolia virginiana*) but he insisted that this "…was what the Spaniards call the glory of the world or the peach tree…". Native to Asia, peach (*Prunus persica*) could be found across Arkansas by 1819 (Nuttall 1980, p. 112) as it was widely planted by many settlers desiring its sweet fruits (Early 2000). Other mentions of peach can be found in the Arkansas GLO notes. For example, a surveyor (also probably Rightor) had identified a "wild peach" in the lower portions of the Saline River drainage in late 1826, and peach and apple (*Malus pumila*) trees were associated with former Native American settlements near Crowley's Ridge in east-central Arkansas circa 1817 (Bragg 2003).

But are the peach along the Saline River *Prunus persica* or some other visually similar species? After all, there are other native members of the *Prunus* family (namely, the plums) common to southern Arkansas that can appear similar to peach. Key to this taxonomic quandary is that the surveyor described this shrub as having green foliage when this survey was being done (January of 1827). Since both peaches and plums are deciduous, it is likely that the surveyor had seen either sweetbay (as suggested by the locals) or horse-sugar (*Symplocos tinctoria*), also known as common sweetleaf. Sweetbay and the more abundant horse-sugar are found across parts of southern and central Arkansas (Smith 1988; Gentry et al. 2013), and both are evergreen (or semi-evergreen, in the case of horse-sugar), with large, oval to elliptical-shaped leaves reminiscent of peach foliage.

Dwarf palmetto.—The GLO surveyors only rarely reported dwarf palmetto (*Sabal minor*) in their notes for the Saline-Fifteen locality (Table 3). This contrasts sharply with the present-day distribution of this species, which often forms the dominant understory cover in the low ground in and around the Warren Prairie. Dwarf palmetto may have expanded its range in this part of the state during recent decades—its abundance was limited enough as late as 1974 for the state of Arkansas to propose a natural area in Bradley County to protect a water oak/willow oak stand with a fairly continuous palmetto understory (Arkansas Department of Planning 1974). Dwarf palmetto, however, was noted to be "abundant" in the lowest bottomlands of Colonel J.R. Hampton's plantation in another part of Bradley County (Owen et al. 1860:139).

Cane.—Giant or "switch" cane was frequently mentioned (over 200 times) in the understory descriptions of the Saline-Fifteen locality (Table 3), and appears to have been considerably more common historically than it is today. As an important economic resource to both Native Americans and early settlers, cane did not decline until later settlement and agricultural practices marginalized this species across the South (Stewart 2007). The cane thickets or "brakes" were at times dense enough in the Saline-Fifteen locality to hinder the work of the surveyors. For example, Deputy Surveyor H.B. Allie blamed dense cane brakes for some of the departure (error) in the lines he surveyed along the Saline River bottoms in T11S R9W.

Historical forest structure inferred from the GLO notes

Most of the witness trees used by the GLO surveyors were of moderate dimensions. On average, witness trees ranged from 8 to 24 inches (20 to 60 cm) in diameter, and only rarely exceeded 40 inches (100 cm) in diameter (Table 4, Figure 7). As previously mentioned, witness trees less than 6 inches (15 cm) in diameter were uncommon in the Saline-Fifteen locality. The six most abundant taxa (black oaks, pines, white oaks, post oak, hickories, and gums) dominated the moderate to large size classes. With the exception of baldcypress, which had a disproportionately higher number of very large stems, all of the remaining species were primarily found in the two smallest size classes (Figure 7). This result is not surprising, given that the most common "other" hardwoods—including flowering dogwood, American holly, American hornbeam, and ironwood—are usually of small stature and likely underrepresented in the GLO.

Very large witness trees were also uncommon—only a few exceeded 50 inches (125 cm) in diameter (Table 4, Figure 7). Cypress and black oak were the most frequently used very large witness trees, and a few of the pines in

Table 3. Understory and overstory plants mentioned in the line descriptions of the GLO surveyors for the Saline-Fifteen locality. See Table 1 for likely scientific names of species.

Surveyor name	Number of times mentioned in the understory	Number of times mentioned in the overstory
Vines	547	0
Briers	389	0
Oak (scrub oak)	281	488
Pine	236	578
Cane	213	0
Dogwood	209	14
Hickory	180	487
Grass (high prairie grass)	78	0
Gum	64	312
Sumac (shoomack, shoemake, smooth sumac)	52	0
Huckleberry	46	0
Laurel	44	0
White oak	39	204
Maple	39	28
Black oak	38	246
Sassafras	37	14
Brush/bushes/shrubs	33	0
Whortleberry	33	0
Sweetbay (bay, sweet laurel, green bay)	29	1
Paw paw	26	0
Post oak	22	98
Hazel	20	0
Grape	19	0
Witch hazel	19	0
Chinquipin (chincapin, chinkapin, chinkpin, chiquepin)	18	60
Ash	14	27
Greenbriers	12	0
Spicewood	12	0
Prickly sumac (prickle shoemake)	11	0
Holly	9	36
Sweetgum	5	30
Pin oak	5	12
Elm	4	34
Peach tree	4	0
Summer grape	4	0
Blackberry	3	0
Black gum	1	16
Black walnut	1	5
Hornbeam	1	2
Mulberry	1	2
Ironwood	1	0
Moss	1	0
Myrtle	1	0
Palmeto	1	0
Privy	1	0
Sedge	1	0
Swamp dogwood	1	0
Winter whortleberry	1	0
Cypress	0	17
Red oak	0	7
Beech	0	4
Shellbark hickory	0	4
Hackberry	0	3
Birch	0	2
Water beech	0	2
White gum	0	2
Willow	0	2
Black hickory	0	1
Lynn	0	1
Swamp white oak	0	1
Sycamore	0	1
Water elm	0	1

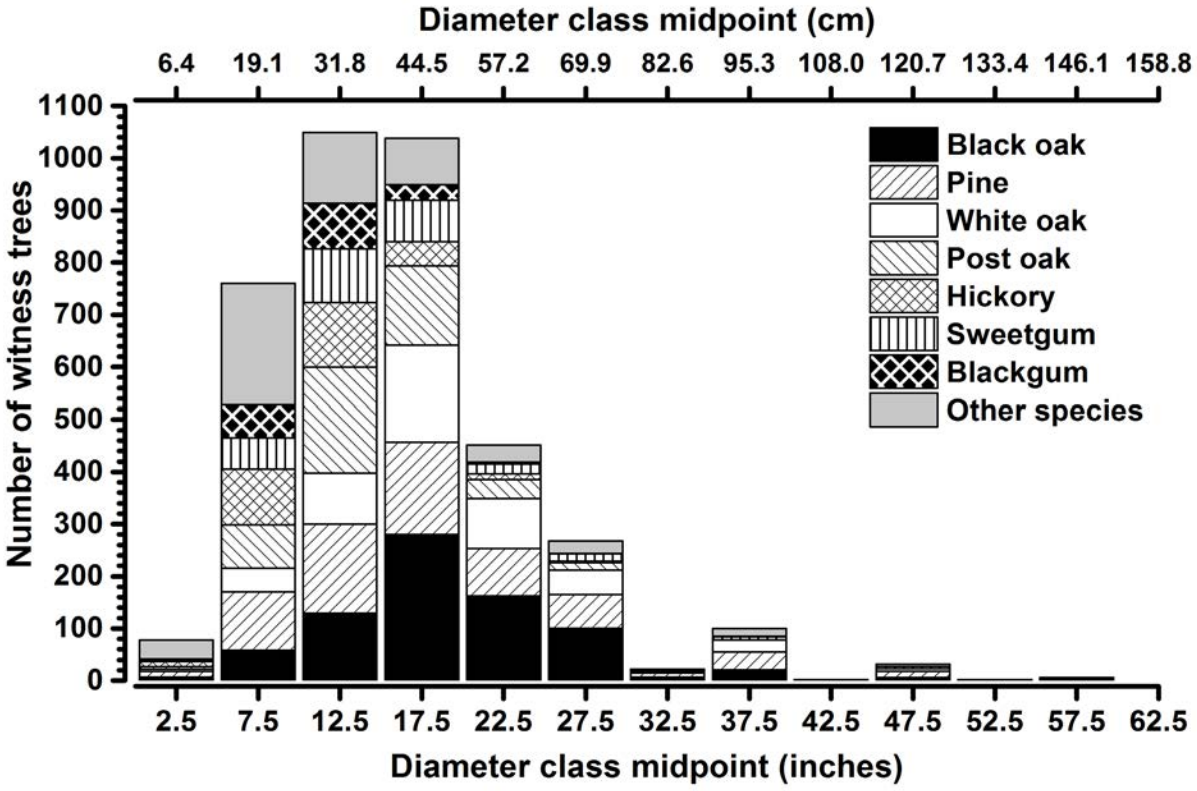

Figure 7. Diameter class distribution of all witness trees combined.

the immediate vicinity of the Saline-Fifteen site were also substantial—Deputy Surveyor Eiler used a 50 in (127 cm) diameter pine as a witness tree. No witness trees surpassed 60 inches (153 cm) in diameter—still substantial trees, for sure, but noticeably smaller than the potential of many species from this region. For instance, Bragg (2003) noted numerous witness trees greater than 65 inches (165 cm) in the GLO notes from Ashley County (albeit from a larger sample), including a few cypress greater than 118 inches (300 cm) in diameter; other cypress, white oak, and black oak greater than 78 inches (200 cm) in diameter; and pin oak, tupelo gum, pine, and sweetgum greater than 66 inches (170 cm) in diameter. Additionally, very large trees were commonly mentioned in other historical sources from this portion of Arkansas (e.g., Anonymous 1909; Bragg 2002b, 2004b; Morbeck 1915). While the soils of the Saline-Fifteen locality are somewhat less favorable for tree growth than other parts of southern Arkansas, most of the discrepancy in the abundance of very large witness trees is probably due to surveyor bias.

Other noteworthy surveyor observations

Wildlife.—The GLO notes for the Saline-Fifteen locality provide only few mentions of wildlife—unlike the witness tree data, inclusion of animal observations were solely at the discretion of the surveyor. One GLO deputy surveyor described a series of unusual wildlife encounters while surveying the east boundary of T12S R8W. As he was traversing the east side of Section 36, he had difficulty finding unbroken timber for witness trees, a scarcity he attributed to windthrow. This canopy disturbance triggered a proliferation of blackberry (*Rubus* spp.) in the understory, sometimes forming "desperate" thickets. In addition to slowing the surveyor's progress, this briar patch attracted black bears (*Ursus americanus*), as his crew found a bear "nest" with two "beautiful" cubs. Soon thereafter, the surveyor changed his mind about what felled the timber and called the disturbed area a "pidgeon rust" (pigeon roost). Passenger pigeons (*Ectopistes migratorius*) were still exceedingly abundant when this surveyor was working (circa 1827), and Arkansas was one of the main wintering areas (Schorger 1973). Flocks of passenger pigeons sometimes roosted in such numbers so as to break branches and even whole trees under their accumulated weight (Schorger 1973; Ellsworth and McComb 2003). In addition to damaging trees, huge flocks of passenger pigeons could have even affected forest regeneration dynamics, given the quantity of mast (e.g., acorns, nuts, berries) consumed and then dispersed by this species (Ellsworth and McComb 2003).

Table 4. Large diameter (at least 50 inches (127 cm)) individuals used as witness trees in the Saline-Fifteen locality.

Surveyor name	----- Diameter ----- (inches)	(cm)	Township	Range	Year recorded
Black oak	60	152	11S	8W	1828
Black oak	60	152	12S	9W	1830
Cypress	60	152	12S	9W	1830
Cypress	60	152	13S	9W	1830
White oak	60	152	11S	8W	1828
Black oak	56	142	13S	8W	1834
White oak	54	137	13S	8W	1834
Black oak	52	132	11S	10W	1829
Pine	50	127	12S	9W	1830
Pine	50	127	12S	9W	1830
Black oak	50	127	12S	9W	1830
Cypress	50	127	11S	10W	1827
Cypress	50	127	12S	9W	1830
Cypress	50	127	13S	9W	1830
Sweet gum	50	127	12S	9W	1830

Minerals and water.—With the considerable depth to bedrock in this portion of the UWGCP (Fisk 1944), there is little in the way of exposed stone resources in the Saline-Fifteen locality. Alluvial gravels are an exception to this—several described areas of gravelly soils, such as Deputy Surveyor Jonas Smith's description of the north half of the line between sections 13 and 14 in T12S R8W having multi-colored "pebbles". Another surveyor described parts of the line between sections 23 and 24 in T11S R9W as "mostly stony." A settler's letter (Lansdale 1858, p. 1) stated that the soil was "…in places very full of little round clear flint." Many of these stony soils were Saffell gravelly fine sandy loams, one of the soil series present in the vicinity of the Saline-Fifteen site. The stone content of Saffell soils is remarkably high for this region, with 35 to 75% of its volume comprised of gravels of chert, novaculite, and quartz up to 2 inches (5 cm) in diameter (Jones and Klinger 1979; Larance 1961; Larance et al. 1976). The GLO surveyors may have thought these gravels to have been of economic importance, especially in the virtually stone-free UWGCP, or they may have been mentioned because of anticipated problems for agriculture (rocky soils are often less fertile and harder to plow).

On July 25, 1830, Deputy Surveyor Eiler, while traversing the Saline River in section 21 of T13S R9W, mentioned a "stone coal quarry." Although there is currently no commercial coal production in southern Arkansas, the Eocene sedimentary deposits of the Jackson Group contains thin beds of lignite interspersed in the Redfield Formation of this group (McFarland 1998). A series of archeological surveys (e.g., Jones and Klinger 1979; Lafferty and House 1986a) were conducted not far from the Saline-Fifteen locality in the 1970s and 1980s when a strip mining company explored the possibility of large-scale coal extraction in Calhoun County. Similar stone coal deposits have been noted in the GLO notes in nearby Ashley County (Bragg 2004c) and confirmed by early geological expeditions through the region (e.g., Owen et al. 1860; Harris 1894). Owen et al. (1860, p. 139) one such outcrop as:

> …there is an exposure of lignite in the bed of Saline River at Goulett Island, belonging to Governor E. N. Conway. It extends entirely across the stream, forming a partial dam, over which the water falls with considerable noise. At the time of my visit this bed was under water, and I learned from Antoine Foyle it was six or seven feet thick, compact, and of a black color; and that it is mined in large blocks, which burn well in a fireplace and make a hot fire.

Such deposits would be appealing to Euroamerican settlers, who utilized coal for metalworking and other purposes. Owen et al. (1860, p. 140) also mentioned the potential to extract crude oil from the lignite found in Bradley County.

A couple GLO surveyors noted some problems with their compasses while traversing portions of T11S R8W and T11S R9W. They reported their compass needles

being affected by "attraction" that influenced the accuracy of their lines. This is either an excuse for sloppy surveying or possibly an abundance of ferrous metals. Owens et al. (1860, p. 141) reported a "large quantity of tertiary iron ore, containing casts of fossil shells" in the northwestern part of Bradley County. Harris (1894) also reported a number of different outcrops of "ferrunginous sandstone" or "ironstone" in the general vicinity. A short distance further up the Saline River, near the modern-day village of Rison (in Cleveland County), underground deposits of magnetite are found (Arkansas Geological Commission 2007) that apparently have affected the compasses of pilots flying overhead (Anonymous 2003).

Another possible mineral resource of the Saline-Fifteen locality may be found in the alkaline Lafe soils of Warren Prairie. Lafe soils are defined by their high sodium and magnesium content—in some locations, they have so much salt as to develop white crusts on the surface during dry periods (Larance et al. 1976). While there is no specific evidence suggesting these soils were exploited for salt in the past, it seems possible.

Mounds.—As noted earlier, a deputy surveyor reported mounds in the vicinity of what is now known as Warren Prairie, upon which thin, stunted oak and pine timber grew. Deputy Surveyor Jonas Smith set the corner for sections 27, 28, 33, and 34 in T11S R8W on a 30-foot (9-m) wide mound. While there are some Indian mounds in the Saline-Fifteen locality, the ones noted by the deputy surveyors are almost certainly "prairie" or "pimple" mound formed by natural processes. These low, circular mounds are common across southeastern Arkansas, and have been reported by other GLO surveyors (Bragg 2003). While not constructed by them, prairie mounds were certainly used by Native Americans and early Euroamerican settlers. For example, in Bradley County, Owen et al. (1860, p. 139) reported:

> On what is called the "second bottom" or "hummock land" there are many ancient mounds, with local beds of fresh-water shells, mostly Unionidae, collected together no doubt by the Indians who formerly inhabited this region, to whom these animals served as food.

It is not unusual for other types of artifacts, including stone tools and potsherds, to be found in some of these mounds (e.g., Lafferty and House 1986b), suggesting at least temporary utilization (Jeter and Early 1999).

INFERENCES FROM MODERN-DAY VEGETATION PATTERNS

Settlement and natural resource exploitation in the Saline-Fifteen locality since the 1820s have dramatically affected vegetation patterns. Southern Arkansas was largely cleared of its virgin forests by the early 20th Century. Much of the landscape was farmed after the timber was removed, but few of the uplands proved suitable for row crops and were eventually converted to pasture or reverted to natural stands of pine and hardwood. In addition to these impacts, residential, commercial, and industrial development; the introduction of exotic species; and changes to natural disturbance regimes have also shaped today's forests. Currently, most of the landscape in the Saline-Fifteen locality is either commercial forest or pasture; many of the natural-origin upland forests have been converted to loblolly pine plantations in recent decades. While most of the same species encountered by the GLO surveyors are still present, comparisons with contemporary forest conditions clearly show their size distributions and relative abundances have changed considerably.

Modern forest surveys

According to the most recent large-scale FIA data for Bradley, Cleveland, and Drew counties (USDA Forest Service 2007), loblolly pine is the most dominant overstory tree species, comprising 47.5% of the 3,025 sampled trees (Table 5). Pine, especially loblolly, is the preferred timber species across the uplands of southern Arkansas. In the latter half of the 20th Century, genetically improved loblolly pine plantations have replaced many second-growth pine, pine-hardwood, and hardwood forests of natural (seed or sprout) origin across the UWGCP (Klepzig et al. 2014). Sweetgum (13.9%) and water oak (3.3%) are a distant second and third, respectively, and no other tree species exceeded 100 trees (roughly 3%) from this FIA dataset (Table 5). Unlike the GLO data, the FIA values are statistically reliable estimates of the population size of different tree species in the three counties. However, some species may still be underrepresented (or missed altogether) by the FIA program—the spatially extensive but sparse distribution of small (0.16 ac (0.067-ha)) FIA sample plots (approximately one every 6,000 ac (2,400 ha)) means that much of the landscape is not sampled, hence individuals or small clusters of rare species may not be tallied.

Modern-day forest patterns can help archeologists

understand historical forest conditions. Gentry et al.'s (2013) atlas of vascular plants in Arkansas indicates that the current forests of the Saline-Fifteen locality have at least 17 species of oak and 8 species of hickory, numbers comparable to those from the 2000-2005 FIA data for this area (Table 5). Our own experiences in this locality suggest that the relative oak and hickory abundances reported in the GLO notes (at least those accurately reported to species) are also consistent with the FIA data. Presumably, the same species/site relationships that occurred during historical conditions produce similar arboreal assemblages today in naturally regenerated forests. For instance, the forests along major riparian systems generally follow predictable developmental pathways and structural outcomes. On the most recently formed land surfaces, willow (*Salix* spp.), cottonwood (*Populus* spp.), and/or river birch dominate, to be replaced over time by a more diverse mixture of oaks, gums, hickories, elms, and ashes, amongst other species (Hodges 1997). The wettest of the forests outside of the main stream channels, including along the smaller tributaries, are occupied by baldcypress and, to a lesser extent, water tupelo, water-elm, and water hickory. Some of the higher bottomland forests, especially along the terraces of smaller streams, can have a prominent loblolly pine component (Bragg 2004d; Heitzman et al. 2004).

Taxonomic uncertainties, then and now

As in most other historical vegetation descriptions, only common species names were used for GLO witness trees, so how modern researchers interpret these identifications can affect the analysis (Mead 1970). Fortunately, because FIA data are robust estimates of modern-day forests, they can be used to evaluate certain aspects of the GLO data. For instance, the most common tree used by the GLO surveyors in the nine township locality surrounding the Saline-Fifteen site was identified as "black oak," which comprised 20.35% of the 3,808 identifiable witness trees (Table 2). However, it is highly unlikely that most of the black oaks in the Saline-Fifteen locality were what we now know as black oak (*Quercus velutina*), especially when reported in the bottomlands. Today, *Quercus velutina* is relatively abundant in drier uplands of northern Arkansas but noticeably less common in the southern part of the state (Moore 1999, Rosson and Rose 2010). Sargent (1947:138) reported that *Quercus velutina*, though found across Arkansas, was "…not common and never gregarious, it is generally scattered on dry ridges through the maritime Pine belt." Consistent with Sargent's observation, only 5 of 3,025 trees (0.17%) in the three-county FIA data from 2007 were *Quercus velutina* (Table 5).

The black oak discrepancy between the FIA data and the information in the GLO notes from the Saline-Fifteen locality almost certainly arises from misidentification of superficially similar oaks—a problem even for those formally trained in botany (Palmer 1942). If lacking their obvious leaves, the dark bark of willow, cherrybark, northern red, Shumard (*Quercus shumardii*), southern red, and a number of other oak species may have led surveyors to call them black oak (Bragg 2003). Others have also questioned the surveyors' identification of black oak in this region. For example, King (1984) believed the GLO-designated black oaks near the Cedar Grove Site (3LA97) along the Red River in southwestern Arkansas were willow oak. Foti (2001) thought GLO-labeled black oaks in the wetter parts of east-central Arkansas were probably cherrybark, Nuttall (*Quercus texana*), water, or southern red oaks. Surrette et al. (2008) used Hilgard's (1860) interpretation of common names to suggest surveyor-identified black oaks may have also included northern red oak.

Not every glaring discrepancy between modern-day population estimates and those from the GLO are the fault of the surveyors, though. Some of these discrepancies are technical: Nuttall oak was not formally designated a unique species by botanists until the late 1920s (Palmer 1927), decades after the completion of the GLO surveys. Forest health problems and changes to large-scale environmental conditions, especially natural disturbance regimes and climate, across much of eastern North America have altered tree establishment and success (Wood 1976; King 1978; Delcourt et al. 1999). As an example, chinquapin periodically appeared as an understory species and occasional witness tree (Tables 1 and 3) and was included in Lansdale's list of abundant understory species. However, it is completely lacking (Table 5) from the FIA overstory data collected during the last decade. This "absence" is not likely due to misidentification by the GLO surveyors or being missed by the FIA—chinquapin is readily distinguishable from other species and should have been inventoried if present. Rather, chinquapin's absence in the FIA records is probably of pathological origin, as chinquapins were devastated statewide by a disease called chestnut blight caused by a fungus (*Cryphonectria parasitica*) introduced from Asia early in the 20th Century (Paillet and Cerny 2012; see also Chapman et al. 2006:91). Similarly, the abundance of elms, especially American elm, in the Saline-Fifteen locality has been severely impacted by Dutch elm disease (caused by a different introduced fungus, *Ophiostoma ulmi*).

Table 5. Modern-day (2000-2005) overstory (diameter at breast height (DBH) > 2 in. (5 cm)) ranked tree abundance and size data for Bradley, Cleveland, and Drew counties, taken from the USDA Forest Service's Forest Inventory and Analysis Arkansas database (USDA Forest Service 2007).

Common name[a]	Scientific name[a]	Number	%	DBH[b] Minimum		Average		Std. dev.		Maximum	
				-in.-	-cm-	-in.-	-cm-	-in.-	-cm-	-in.-	-cm-
Loblolly pine	*Pinus taeda*	1,437	47.5	2.0	5.1	10	25.4	5.1	13.0	30	76.2
Sweetgum	*Liquidambar styraciflua*	419	13.85	2.0	5.1	8	20.3	4.3	10.9	27	68.6
Water oak	*Quercus nigra*	101	3.34	2.0	5.1	10	25.4	7.0	17.8	38	96.5
American hornbeam	*Carpinus caroliniana*	82	2.71	2.0	5.1	5	12.7	2.1	5.3	10	25.4
Cherrybark oak	*Quercus pagoda*	81	2.68	2.0	5.1	14	35.6	8.2	20.8	40	101.6
Blackgum	*Nyssa sylvatica*	79	2.61	2.0	5.1	7	17.8	3.8	9.7	20	50.8
White oak	*Quercus alba*	74	2.45	2.0	5.1	13	33.0	7.0	17.8	30	76.2
Red maple	*Acer rubrum*	70	2.31	2.0	5.1	5	12.7	2.5	6.4	14	35.6
Winged elm	*Ulmus alata*	62	2.05	2.0	5.1	7	17.8	3.5	8.9	20	50.8
American holly	*Ilex opaca*	61	2.02	2.0	5.1	6	15.2	2.9	7.4	19	48.3
Southern red oak	*Quercus falcata*	60	1.98	2.0	5.1	10	25.4	5.4	13.7	23	58.4
Baldcypress	*Taxodium distichum*	53	1.75	4.0	10.2	11	27.9	5.4	13.7	32	81.3
Post oak	*Quercus stellata*	52	1.72	2.0	5.1	10	25.4	7.1	18.0	34	86.4
Shortleaf pine	*Pinus echinata*	39	1.29	6.0	15.2	14	35.6	4.4	11.2	24	61.0
Willow oak	*Quercus phellos*	39	1.29	2.0	5.1	11	27.9	6.9	17.5	31	78.7
Eastern hophornbeam	*Ostrya virginiana*	38	1.26	2.0	5.1	5	12.7	2.0	5.1	11	27.9
Green ash	*Fraxinus pennsylvanica*	25	0.83	2.0	5.1	7	17.8	4.3	10.9	19	48.3
Black cherry	*Prunus serotina*	22	0.73	2.0	5.1	7	17.8	5.9	15.0	24	61.0
Black hickory	*Carya texana*	18	0.6	3.0	7.6	9	22.9	4.8	12.2	19	48.3
Overcup oak	*Quercus lyrata*	18	0.6	6.0	15.2	16	40.6	5.7	14.5	28	71.1
Mockernut hickory	*Carya tomentosa*	14	0.46	2.0	5.1	10	25.4	8.9	22.6	30	76.2
Pignut hickory	*Carya glabra*	14	0.46	6.0	15.2	12	30.5	5.3	13.5	23	58.4
American elm	*Ulmus americana*	13	0.43	4.0	10.2	8	20.3	3.5	8.9	15	38.1
Flowering dogwood	*Cornus florida*	12	0.4	2.0	5.1	4	10.2	1.6	4.1	7	17.8
Water hickory	*Carya aquatica*	12	0.4	6.0	15.2	10	25.4	3.6	9.1	16	40.6
White ash	*Fraxinus americana*	12	0.4	3.0	7.6	6	15.2	2.3	5.8	11	27.9
Nuttall oak	*Quercus texana*	11	0.36	2.0	5.1	15	38.1	9.3	23.6	29	73.7
Sugarberry	*Celtis laevigata*	11	0.36	2.0	5.1	11	27.9	8.7	22.1	33	83.8
Sassafras	*Sassafras albidum*	10	0.33	3.0	7.6	6	15.2	2.8	7.1	12	30.5
Swamp chestnut oak	*Quercus michauxii*	10	0.33	4.0	10.2	16	40.6	5.9	15.0	22	55.9
Water tupelo	*Nyssa aquatica*	10	0.33	6.0	15.2	12	30.5	4.4	11.2	18	45.7
Shagbark hickory	*Carya ovata*	8	0.26	5.0	12.7	14	35.6	8.1	20.6	30	76.2
Common persimmon	*Diospyros virginiana*	6	0.2	4.0	10.2	5	12.7	1.8	4.6	7	17.8
American beech	*Fagus grandifolia*	5	0.17	11.0	27.9	22	55.9	11.1	28.2	35	88.9
Black oak	*Quercus velutina*	5	0.17	6.0	15.2	9	22.9	3.9	9.9	16	40.6
Sweetbay	*Magnolia virginiana*	5	0.17	10.0	25.4	16	40.6	6.7	17.0	26	66.0
Water-elm	*Planera aquatica*	5	0.17	4.0	10.2	6	15.2	1.9	4.8	9	22.9
Blackjack oak	*Quercus marilandica*	4	0.13	2.0	5.1	7	17.8	3.9	9.9	11	27.9
Delta post oak	*Quercus similis*	4	0.13	2.0	5.1	15	38.1	11.0	27.9	28	71.1
Eastern cottonwood	*Populus deltoides*	3	0.1	5.0	12.7	9	22.9	3.3	8.4	11	27.9
Black willow	*Salix nigra*	2	0.07	3.0	7.6	3	7.6	0.3	0.8	3	7.6
Hawthorn	*Crataegus* spp.	2	0.07	6.0	15.2	7	17.8	0.4	1.0	7	17.8
Honeylocust	*Gleditsia triacanthos*	2	0.07	8.0	20.3	11	27.9	4.5	11.4	15	38.1
Northern red oak	*Quercus rubra*	2	0.07	6.0	15.2	7	17.8	1.8	4.6	8	20.3
Sycamore	*Platanus occidentalis*	2	0.07	4.0	10.2	6	15.2	2.8	7.1	8	20.3

Continued on next page…

Table 5 (cont.). Modern-day (2000-2005) overstory (diameter at breast height (DBH) > 2 in. (5 cm)) ranked tree abundance and size data for Bradley, Cleveland, and Drew counties, taken from the USDA Forest Service's Forest Inventory and Analysis Arkansas database (USDA Forest Service 2007).

Common name [a]	Scientific name [a]	Number	%	DBH [b] Minimum		Average		Std. dev.		Maximum	
				-in.-	-cm-	-in.-	-cm-	-in.-	-cm-	-in.-	-cm-
American basswood	*Tilia americana*	1	0.03	27.0	68.6	27.0	68.6	--	--	27.0	68.6
Boxelder	*Acer negundo*	1	0.03	7.0	17.8	7.0	17.8	--	--	7.0	17.8
Eastern redbud	*Cercis canadensis*	1	0.03	20.0	50.8	20.0	50.8	--	--	20.0	50.8
Eastern redcedar	*Juniperus virginiana*	1	0.03	5.0	12.7	5.0	12.7	--	--	5.0	12.7
Nutmeg hickory	*Carya myristiciformis*	1	0.03	9.0	22.9	9.0	22.9	--	--	9.0	22.9
Red mulberry	*Morus rubra*	1	0.03	8.0	20.3	8.0	20.3	--	--	8.0	20.3
River birch	*Betula nigra*	1	0.03	16.0	40.6	16.0	40.6	--	--	16.0	40.6
Shumard oak	*Quercus shumardii*	1	0.03	28.0	71.1	28.0	71.1	--	--	28.0	71.1
Silver maple	*Acer saccharinum*	1	0.03	18.0	45.7	18.0	45.7	--	--	18.0	45.7
Slippery elm	*Ulmus rubra*	1	0.03	4.0	10.2	4.0	10.2	--	--	4.0	10.2
Willow	*Salix* sp.	1	0.03	18.0	45.7	18.0	45.7	--	--	18.0	45.7

[a] Scientific species names taken from Moore (1999) and Gentry et al. (2013); common names from Miles et al. (2001).
[b] Tree trunk diameter at 4.5 ft (1.37 m) above the ground surface.

Mast and other ethnobotanical resources

Tree- and shrub-borne fruits were critical resources for past inhabitants of the Saline-Fifteen locality, either through their direct consumption or because they attracted white-tailed deer (*Odocoileus virginianus*), black bear, wild turkeys (*Meleagris gallopavo*), passenger pigeons, squirrels (*Sciurus* spp.), and other wild game (e.g., Byrd and Neuman 1978; Fritz 1995; Hilliard 1980; Davies 1994; Abrams and Nowacki 2008). Evidence suggests that Native Americans used fire to encourage the establishment and growth of fire-tolerant mast producing genera, including oaks, chestnuts, and blackberries (*Rubus* spp.) (e.g., Davies 1994; Delcourt et al. 1998). Oak and hickory mast was of particular importance because of its abundance, nutritional value, and relative ease of collection (Hilliard 1980). Historical settlers also relied on mast resources to help fatten their cattle and hogs and hunted mast-consuming game for both subsistence and commercial purposes. In addition to sustenance and wood, many of the plants noted in the GLO surveys would have provided tools, fibers, medicines, dyes, livestock forage, and other products.

While the examination of archeobotanical remains presents an opportunity to determine utilization (e.g., Early 2000; Williams 2000), the organic remains (besides maize) found to date at the Saline-Fifteen site are very limited. In addition to a possible piece of a black walnut (*Juglans nigra*), some persimmon (*Diospyros virginiana*) seeds, and sumac (*Rhus* spp.) remains, the limited sample of plant materials taken from the Saline-Fifteen site had undifferentiated hickory nut and oak acorn fragments in almost all levels of the excavation (Lopinot 2007, cited in Jeter 2007), suggesting these were important food items. Archeobotanical assessments of other prehistoric sites in Arkansas (e.g., Hilliard 1980; Fritz 1993; Williams 2000) contained large quantities of (typically) poorly differentiated acorn or hickory shells. Unfortunately, the GLO notes from the Saline-Fifteen locality provide little clarity on the hard mast[12] remains uncovered at the site itself. Oaks were very common in the Saline-Fifteen GLO data, with *Quercus* comprising slightly more than half of all witness trees and almost 62% of all hardwood taxa (Table 2) and hickory was another abundant hard mast genus. If the surveyors selected oak witness trees in proportion to their abundance, the red and white oak groups from the GLO notes are fairly equally represented. The GLO surveyors spent even less time differentiating hickory species, probably because most of the hickories are even less distinguishable than the oaks. Of the 328 *Carya* individuals used as witness trees, only 26 were labeled something other than just "hickory" (23 black hickories (*Carya texana*), 1 shellbark hickory (*Carya ovata*), 1 white hickory (probably *Carya tomentosa*), and 1 pecan (*Carya illinoensis*)) (Table 2).

However, we cannot assume that the proportions of

GLO witness trees reflect unbiased samples of historical forest composition, nor can we assume that surveyor species identifications are sufficiently reliable to speculate on the taxonomic identity of the mast species utilized at the Saline-Fifteen site. Suffice to say, acorns of both primary oak groups (red and white) and hickory nuts have long been abundant, and thus likely served as a major source of nutrition for the past inhabitants of the Saline-Fifteen site. Furthermore, the GLO records, when coupled with contemporary forest inventories and archeobotanical samples, can expand upon foodway possibilities. For instance, other notable species producing edible materials (as suggested by UMD 2007) documented for the Saline-Fifteen locality by this study include chinquapin, American beech (*Fagus grandifolia*), eastern redcedar (*Juniperus virginiana*), sugarberry (*Celtis laevigata*), red mulberry (*Morus rubra*), pawpaw, sassafras (*Sassafras albidum*), black cherry (*Prunus serotina*), and sweetgum.

CONCLUSIONS

Archeologists and ecologists are taking an increasingly nuanced look at historical documentation and artifacts to better understand past landscapes across North America. In particular, the long-term and widespread use of fire to improve food, fiber, fuel, and other resources in forested landscapes has received considerable attention (e.g., Delcourt et al. 1998; Gremillion 2015; Surrette et al. 2008), as have changes related to population change, agriculture, wood gathering, and other elements of subsistence living (e.g., Brender and Merrick 1950; Gremillion 2015; Guiterman et al. 2016; Liebmann et al. 2016). This developing view incorporates humans (in both prehistoric and historic times) as a major if somewhat inconsistent influence on the patterns and processes of a heretofore "pristine" natural environment. While people are now viewed as a highly influential factor in the development of many ecosystems, much still needs to be learned on the mechanisms of human influence, whether or not these actions were deliberately intended to cause specific changes, and how natural systems restructured themselves in both the presence and sudden absence of people.

While it should not be assumed that historically observed plant communities represent any other time period than the one from which they were documented, when combined with other sources of information they can suggest some possibilities. We believe that the preceding description of the 19th century environment of the Saline-Fifteen locality represents a good if incomplete approximation of the ecological landscape at that point in time, and provides a sense of the natural resources available to prehistoric and historic settlers. The GLO survey notes for the Saline-Fifteen locality reflect at least some of the environmental conditions of the site during the mid-19th century, and by extrapolation, the plant communities found during prehistoric occupations of this locality. All of the available evidence found in the excavations of the Saline-Fifteen site, coupled with this historical analysis and contemporary examinations, indicates that this landscape held an abundance of natural resources. Given some of the inherent weaknesses of the GLO data, further evaluation of historical records of the area, combined with modern information, is still needed to better represent the long-term human settlement dynamics as they responded to and influenced the plant communities of the Saline-Fifteen locality.

Although inherently localized by the intersecting geomorphological, meteorological, ecological, and cultural circumstances of this landscape over the millennia, commonalities exist both locally (for contemporary occupations at other sites) and regionally that can help archeologists understand the nature of the resources available. Hence, this analysis has utility beyond just the Saline-Fifteen site—it can contribute to the understanding of other contemporary archeological sites across this part of the Upper West Gulf Coastal Plain. When placed into proper context, description of historical environmental conditions can help archeologists learn about conditions centuries earlier, and what may be missing from today's landscapes (e.g., chinquapin). This is possible because the prehistoric people who occupied the Saline-Fifteen locality and similar landscapes both shaped their environment and modified their circumstances over the years, and their influence undoubtedly persisted well beyond their physical presence.

Acknowledgements

We would like to thank the following for their assistance in preparing this manuscript: Dr. Marvin Jeter (Arkansas Archeological Survey, retired), Dr. Michael Shelton (US Forest Service, Retired), and Dr. James Guldin (US Forest Service). Dr. Glen Akridge and an anonymous reviewer graciously provided many helpful review comments that improved this paper considerably. This article was written by a U.S. Government employee on official time and is therefore in the public domain.

Notes

[1]Bordered to the north by the Ouachita Mountains, the UWGCP is an ecoregion that stretches from the Mississippi River Alluvial Plain in the east to the Great Plains in the west and lies north of the longleaf pine (*Pinus palustris*)-dominated Gulf Coastal Plain in Louisiana and Texas (Bailey 1995).

[2]GLO records consist of boundary surveys (those done along the exteriors of survey townships, or the township and range lines), interior surveys (the subdivision of survey townships, usually into sections), private surveys (traverses of Spanish and French land grants recognized by the American government), meander surveys along large, navigable bodies of water (usually rivers), and plat maps of each township that integrate the features of the other surveys.

[3]We say "ideally" and "nominally", because errors by the surveyors, coupled with the roundness of the earth, often produced survey townships and sections of somewhat irregular shapes and sizes.

[4]This list of challenges to using the GLO notes does not include fraudulent work that was done by some surveyors, including a number who worked in Arkansas (e.g., Bragg and Webb 2014).

[5]This is Captain Hugh Bradley, a Tennessee native and War of 1812 veteran who settled here in the mid-1820s; Bradley County is named after him, and the city of Warren was named for his slave (Woodard 2015).

[6]Although little data on frontier salaries for Arkansas exist, Lebergott (1960:453) estimated average monthly farm wages for Louisiana, Mississippi, and Texas to be between $10 and $12 during the 1830-1850 period.

[7]"Pure" has a specific meaning in forestry—it is generally held to represent a stand or forest that is at least 80% of a given species (Helms 1998: 145).

[8]Landsdale (1858: 1) went on to say that, unlike other parts of the southeastern United States, Bradley County had "…no long leaf pine, no poplar, no chestnuts, no cuckleber [sic], and if there is any cedar I have seen none."

[9]The term "yellow pine" refers to both loblolly (*Pinus taeda*) and shortleaf (*Pinus echinata*), the only native pine species in Arkansas.

[10]Determining understory vegetation patterns from the GLO notes is difficult, especially since shrubs and small trees were rarely used to witness corners. Most understory plants are mentioned only in the brief descriptions of the undergrowth given at most quarter-section, section, and fractional corners. In many instances, the understory is ambiguously described with labels such as "bushes," "vines," or "grass."

[11]Some of these species are mentioned in the surveyors' "understory" comments (Table 3).

[12]We distinguish between "hard" and "soft" mast as follows: hard mast is a fruit with a hard exterior surface (typically higher in fats and proteins; e.g., acorns, hickory nuts, walnuts) while soft mast are usually perishable fleshy fruits (typically higher in sugars and vitamins, e.g., berries, persimmons, pawpaws) (Apsley and Gehrt n.d.).

REFERENCES

Abrams, Marc D. and Gregory Nowacki
2008 Native Americans as Active and Passive Promoters of Mast and Fruit Trees in the Eastern USA. *The Holocene* 18(7):1123-1137.

Anonymous
1890 *Biographical and Historical Memoirs of Southern Arkansas*. The Goodspeed Publishing Company: Chicago, IL.

1906 The Wonderful Resources of the Arkansas Lumber Company, of Warren, Ark. *American Lumberman* 24 November 1906:59-85.

1909 Rise, Progress and Resources of the Bluff City Lumber Company, Pine Bluff, Ark. and the Clio Lumber Company, Clio, Ark. *American Lumberman* 17 July 1909:67-114.

2003 Timber Industry Thrives in Cleveland County. *The Historical News* 23(8AR):5. (free promotional newspaper published by Southern Historical News, Inc. for Ashley, Chicot, Cleveland, Columbia, Drew, Grant, Ouachita, and Union counties in Arkansas).

Apsley, Dave and Stan Gehrt
n.d. Enhancing Food (Mast) Production for Woodland Wildlife in Ohio. Ohio State University Extension Fact Sheet F-60-06. Available online at: http://ohioline.osu.edu/for-fact/0060.html; last accessed September 22, 2015.

Arkansas Department of Planning
1974 *Arkansas Natural Area Plan*. Arkansas

Department of Planning, Little Rock, AR.

Arkansas Geological Commission
n.d. Iron. http://www.state.ar.us/agc/iron.htm. Online version accessed on 27 July 2007.

Arkansas Vascular Flora Committee
2006 *Checklist of the Vascular Plants of Arkansas.* University of Arkansas Herbarium, Fayetteville, AR.

Bailey, Robert G.
1995 *Description of the Ecoregions of the United States*, 2nd edition. Miscellaneous Publication 1391. USDA Forest Service, Washington, DC.

Board, Veryl V., Charlotte Allen, and Andrea Reeves
1993 Botanical Inventory of a Cypress-Tupelo Swamp. *Proceedings of the Arkansas Academy of Science* 47:20-22.

Bourdo, Eric A.
1956 A Review of the General Land Office Surveys and its Use in Quantitative Studies of Former Forests. *Ecology* 37:754-768.

Bragg, Don C.
2002a Checklist of Major Plant Species in Ashley County, Arkansas Noted by General Land Office Surveyors. *Journal of the Arkansas Academy of Science* 56:32-41.

2002b Reference Conditions for Old-Growth Pine Forests in the Upper West Gulf Coastal Plain. *Journal of the Torrey Botanical Society* 129(4):261-288.

2003 Natural Presettlement Features of the Ashley County, Arkansas Area. *American Midland Naturalist* 149:1-20.

2004a Composition, Structure, and Dynamics of a Pine-Hardwood Old-Growth Remnant in Southern Arkansas. *Journal of the Torrey Botanical Society* 131(4):320-336.

2004b Dimensionality From Obscurity: Revisiting Historical Sources of Big Tree Size. In *Proceedings of the 14th Central Hardwood Forest Conference*, edited by D. Yaussy, D.M. Hix, P.C. Goebel, and R.P. Long, pp 440-447. General Technical Report NE-316, USDA Forest Service. Newtown Square, PA.

2004c General Land Office Surveys as a Source for Arkansas History: The Example of Ashley County. *Arkansas Historical Quarterly* 63:166-184.

2004d Composition and Structure of a 1930s-era Pine-Hardwood Stand in Arkansas. *Southeastern Naturalist* 3(2):327-344.

2008 The Prominence of Pine in the Upper West Gulf Coastal Plain During Historical Times. In *Proceedings of the Freeman and Custis Red River Expedition of 1806: Two Hundred Years Later*, edited by L. M. Hardy, pp 29-54. Bulletin of the Museum of Life Sciences 13. Louisiana State University-Shreveport, Shreveport, LA.

2011 Cypress Lumbering in Antebellum Arkansas. *Arkansas Review: A Journal of Delta Studies* 42(3):185-196.

Bragg, Don C. and T. Webb
2014 "As False as the Black Prince of Hades": Resurveying in Arkansas, 1849-1859. *Arkansas Historical Quarterly* 73(3):268-292.

Brender, Ernst V. and Elliott Merrick
1950 Early Settlement and Land Use in the Present Toccoa Experimental Forest. *The Scientific Monthly* 71(5):318-325.

Byrd, Kathleen M. and Robert W. Neuman
1978 Archaeological Data Relative to Prehistoric Subsistence in the Lower Mississippi River Alluvial Valley. *Geoscience and Man* 19:9-21.

Chapman, Herman H.
1913 Prolonging the Cut of Southern Pine. I. Possibilities of a Second Cut. Yale University *School of Forestry Bulletin* 2:1-22.

Chapman, Ruth A., Eric Heitzman, and Michael G. Shelton
2006 Long-term Changes in Forest Structure and Species Composition of an Upland Oak Forest in Arkansas. *Forest Ecology and Management* 236:85-92.

Chaney, Phillip L.
1990 Geographic Analysis of the Presettlement Vegetation of the Middle Fork of the White River, Arkansas: A GIS approach. M.A. thesis, University of Arkansas, Fayetteville, AR.

Commissioner of State Lands (COSL)
2015 Historical Documents, Maps, & More: Louisiana Purchase. Digital data available online, last accessed 28 August 2015, at: http://history.cosl.org/lp.htm.

Cox, Randel T., J. Luke Hall, and Chris S. Gardner
2013 Tectonic History and Setting of a Seismogenic Intraplate Fault System that Lack Microseismicity: The Saline River Fault System, Southern United States. *Tectonophysics* 608:252-266.

Daniels, Charlie [commissioner]
2000 Arkansas Original General Land Office Survey Notes and Plats. Arkansas State Land Office, Little Rock, AR. 16 compact disks.

Davies, Karl M., Jr.
1994 Some Ecological Aspects of Northeastern American Indian Agroforestry Practices. *Annual Report of the Northern Nut Growers Association* 85:25-37.

Delcourt, Hazel R.
1976 Presettlement Vegetation of the North of Red River Land District, Louisiana. *Castanea* 41:122-139.

Delcourt, Paul A., Hazel R. Delcourt, Cecil R. Ison, William E. Sharp, and Kristen J. Gremillion
1998 Prehistoric use of fire, the Eastern Agricultural Complex, and Appalachian Oak-Chestnut Forests: Paleoecology of Cliff Palace Pond, Kentucky. *American Antiquity* 63(2):263-278.

Delcourt, Paul A., Hazel R. Delcourt, and Roger T. Saucier
1999 Late Quaternary Vegetation Dynamics in the Central Mississippi Valley. In *Arkansas Archeology: Essays in honor of Dan and Phyllis Morse,* edited by Robert C. Mainfort, Jr. and Marvin D. Jeter, pp 15-30. University of Arkansas Press, Fayetteville.

Early, Ann M.
2000 The Caddo and the Forest. *Forest Farmsteads: A Millennium of Human Occupation at Winding Stair in the Ouachita Mountains,* edited by Ann M. Early, pp 93-110. Research Series 57, Arkansas Archeological Survey, Fayetteville.

Ellsworth, Joshua W. and Brenda C. McComb
2003 Potential Effects of Passenger Pigeon Flocks on the Structure and Composition of Presettlement Forests of Eastern North America. *Conservation Biology* 17(6):1548-1558.

Fisk, Harold N.
1944 *Geological Investigation of the Alluvial Valley of the Lower Mississippi River*. U.S. Army Corps of Engineers, Mississippi River Commission.

Foti, Thomas L.
2001 Presettlement Forests of the Black Swamp Area, Cache River, Woodruff County, Arkansas, From Notes of the First Land Survey. In *Bottomland hardwoods of the Mississippi Alluvial Valley: Characteristics and Management of Natural Function, Structure, and Composition*, edited by Paul B. Hamel and Thomas L. Foti, pp 7-15. General Technical Report SRS-42. USDA Forest Service, Ashville, NC.

Fountain, Michael S.
1980 Species Composition of Unmanaged Stands of Bottomland Hardwoods in South Arkansas. *Arkansas Farm Research* 29(2):9.

Fritz, Gayle J.
1993 Archeobotanical Analysis. In *Caddoan Saltmakers in the Ouachita Valley: The Hardman Site*, A.M. Early, ed., pp. 159-168. Research Series 43, Arkansas Archeological Survey, Fayetteville.

1995 New Dates and Data on Early Agriculture: The Legacy of Complex Hunter-Gatherers. *Annals of the Missouri Botanical Garden* 82:3-15.

Gentry, Johnnie L., George P. Johnson, Brent T. Baker, C. Theo Witsell, and Jennifer D. Ogle [editors]
2013 *Atlas of the Vascular plants of Arkansas*.

University of Arkansas Herbarium, Fayetteville.

Gill, John P.
2004 *Journal of the Louisiana Purchase 2002 Base Line Expedition*. Louisiana-Purchase Bicentennial Committee of Arkansas, Little Rock, AR.

Grell, Adrian G., Michael G. Shelton, and Eric Heitzman.
2005 Changes in Plant Species Composition Along an Elevation Gradient in an Old-Growth Bottomland Hardwood-*Pinus taeda* Forest in Southern Arkansas. *Journal of the Torrey Botanical Society* 132(1):72-89.

Gremillion, Kristen J.
2015 Prehistoric Upland Farming, Fuelwood, and Forest Composition on the Cumberland Plateau, Kentucky, USA. *Journal of Ethnobiology* 35(1):60-84.

Guiterman, Christopher H., Thomas W. Swetnam, and Jeffrey S. Dean.
2016 Eleventh-Century Shift in Timber Procurement Areas for the Great Houses of Chaco Canyon. *Proceedings of the National Academy of Science* 113(5): 1186-1190.

Guyette, R.P., M.A. Spetich, and M.C. Stambaugh
2006 Historic Fire Regime Dynamics and Forcing Factors in the Boston Mountains, Arkansas, USA. *Forest Ecology and Management* 234:293-304.

Hall, Grant D.
2000. Pecan Food Potential in Prehistoric North America. *Economic Botany* 54(1):103-112.

Hammett, Julia E.
1992 The Shapes of Adaptation: Historical Ecology of Anthropogenic Landscapes in the Southeastern United States. *Landscape Ecology* 7(2):121-135.

Harris, Gilbert D.
1894 The Tertiary Geology of Southern Arkansas. *Volume II of the Annual Report of the Geological Survey of Arkansas for 1892*. Pilot Printing Company, Morrillton, AR.

Harvey, Francis L.
1880 Notes from Arkansas. *Botanical Gazette* 5(8/9):91-93.

1881 Forest Notes. *Botanical Gazette* 6(10):273.

Heitzman, Eric, Michael G. Shelton, and Adrian Grell
2004 Species Composition, Size Structure, and Disturbance History of an Old-Growth Bottomland Hardwood-Loblolly Pine (*Pinus taeda* L.) Forest in Arkansas, USA. *Natural Areas Journal* 24(3):177-187.

Helms, John A.
1998 The Dictionary of Forestry. *Society of American Foresters*, Bethesda, MD.

Hilgard, Eugene W.
1860 *Report on the Geology and Agriculture of the State of Mississippi.* E. Barksdale, State Printer, Jackson, MS.

Hilliard, Jerry E.
1980 Prehistoric Ozark Settlement-Subsistence and Nut Resource Utilization. M.A. thesis, University of Arkansas, Fayetteville.

Hodges, John D.
1997 Development and Ecology of Bottomland Hardwood Sites. *Forest Ecology and Management* 90:117-125.

Hutchison, Max
1988 A Guide to Understanding, Interpreting, and Using the Public Land Survey Field Notes in Illinois. *Natural Areas Journal* 8(4):245-255.

Jeter, Marvin D.
2006 Site survey form, 3 BR 119. Arkansas Archeological Survey.

2007 The Outer Limits of Plaquemine Culture: A View from the Northerly Borderlands. In *Plaquemine Archaeology*, edited by Mark A. Rees and Patrick C. Livingood, pp. 161-195. University of Alabama Press, Tuscaloosa.

Jeter, Marvin D., Kathleen H. Cande, and John J. Mintz
1990 Goldsmith Oliver 2 (3PU306): A Protohistoric

Archeological Site near Little Rock, Arkansas. Report submitted to the Federal Aviation Administration by the Arkansas Archeological Survey, Fayetteville.

Jeter, Marvin D. and Ann M. Early
1999 Prehistory of the Saline River Drainage Basin, Central to Southeast Arkansas. In *Arkansas Archeology: Essays in honor of Dan and Phyllis Morse*, edited by Robert C. Mainfort, Jr. and Marvin D. Jeter, pp 31-63. University of Arkansas Press, Fayetteville.

Jones, R.D. and Timothy C. Klinger
1979 Modern Environment and Archeological Survey Conditions. In *Hampton: An Archeological and Historical Overview of a Proposed Strip Mine Tract in South Central Arkansas*, assembled by Timothy C. Klinger, pp. 5-19. Research Report 19, Arkansas Archeological Survey, Fayetteville.

Kidder, Tristram R.
2006 Climate Change and the Archaic to Woodland Transition (3000-2500 cal. B.P.) in the Mississippi River Basin. *American Antiquity* 71(2):195-231.

King, Frances B.
1978 Additional Cautions on the Use of the GLO Survey Records in Vegetational Reconstructions in the Midwest. *American Antiquity* 43(1):99-103.

1982 Vegetation Reconstruction Around the Powell Canal Site. In *Powell Canal: Baytown period occupation on Bayou Macon in southeast Arkansas*, edited by John H. House, pp. 10-15, Research Series 19, Arkansas Archeological Survey, Fayetteville.

1984 Presettlement Vegetation of the Cedar Grove site. In *Cedar Grove: An Interdisciplinary Investigation of a Late Caddo Farmstead in the Red River Valley*, edited by Neal Trubowitz, pp. 26-29. Research Series 23, Arkansas Archeological Survey, Fayetteville.

King, Frances B. and Russell W. Graham
1981 Effects of Ecological and Paleoecological Patterns on Subsistence and Paleo-environmental Reconstructions. *American Antiquity* 46(1):128-142.

Klepzig, Kier, Richard Shelfer, and Zanethia Choice
2014 *Outlook for Coastal Plain Forests: A Subregional Report from the Southern Forest Futures Project.* General Technical Report SRS-196. USDA Forest Service, Southern Research Station, Asheville, NC.

Lafferty, Robert H. and John H. House.
1986a *Model Validation in Sparta*. Research Report 25, Arkansas Archeological Survey, Fayetteville.

1986b The Environment at Sparta. In *Model Validation in Sparta*, edited by Robert H. Lafferty, and John H. House, pp. 6-25. Research Report 25, Arkansas Archeological Survey, Fayetteville, AR.

Lansdale, Abraham M.
1858 Letter to Henry and Mary Bradley. Online version accessed February 13, 2007 at: http://www.rootsweb.com/~arbradle/letters/lansdale_letter1858.html

Larance, Fred C.
1961 *Soil Survey of Bradley County, Arkansas*. USDA Soil Conservation Service, Washington, DC.

Larance, Fred C., Hiram V. Gill, and Charles L. Fultz
1976 *Soil Survey of Drew County, Arkansas.* USDA Soil Conservation Service, Washington, DC.

Lebergott, Stanley
1960 Wage Trends, 1800-1900. In *Trends in the American Economy in the Nineteenth Century*, William N. Parker, ed., pp. 449-500. Princeton University Press, Princeton, NJ.

Liebmann, Matthew J., Joshua Farella, Christopher I. Roos, Adam Stack, Sarah Martini, and Thomas W. Swetnam
2016 Native American Depopulation, Reforestation, and Fire Regimes in the Southwest United States, 1492-1900 CE. *Proceedings of the National Academy of Sciences* 113(6) E696-E704.

Lopinot, Neal H.
2007 Archeobotany of the Saline-Fifteen Site.

Unpublished report submitted to Arkansas Archeological Survey, UAM Research Station, Monticello.

Manies, Kristen L., David J. Mladenoff, and Erik V. Nordheim
2001 Assessing Large-Scale Surveyor Variability in the Historic Forest Data of the Original U.S. Public Land Survey. *Canadian Journal of Forest Research* 31:1719-1730.

Mann, Michael E., Zhihua Zhang, Scott Rutherford, Raymond S. Bradley, Malcolm K. Hughes, Drew Shindell, Caspar Ammann, Greg Faluvegi, and Fenbiao Ni
2009 Global Signatures and Dynamical Origins of the Little Ice Age and Medieval Climate Anomaly. *Science* 326:1256-1260.

Mattoon, Wilbur R.
1915 *Life History of Shortleaf Pine*. USDA Bulletin 244. Goverment Printing Office, Washington, DC.

McFarland, John D.
1998 *Stratigraphic Summary of Arkansas*. Information Circular 36. Arkansas Geological Commission, Little Rock.

Mead, George R.
1970 On the Improper Usage of Common Names when Giving Botanical Data. *American Antiquity* 35(1):108-109.

Miles, Patrick D., Gary J. Brand, Carol L. Alerich, Larry F. Bednar, Sharon W. Woudenberg, Joseph F. Glover, and Edward N. Ezzell.
2001 *The Forest Inventory and Analysis Database: Database Description and Users Manual Version 1.0.* General Technical Report NC-218, USDA Forest Service, North Central Research Station, St. Paul, MN.

Mladenoff, David J., Sally E. Dahir, Erik V. Nordheim, Lisa A. Schulte, and Glenn G. Guntenspergen
2002 Probabilistic Classification of Ambiguously Identified Tree Species in Historical Survey Data. *Ecosystems* 5:539-553.

Mohr, Charles
1897 *The Timber Pines of the Southern United States*. USDA Division of Forestry Bulletin 13. Government Printing Office, Washington, DC.

Moore, Dwight M.
1999 *Trees of Arkansas, 5th ed*. Arkansas Forestry Commission, Little Rock, AR.

Morebeck, G. C.
1915 Logging Shortleaf Pine in Arkansas. *Ames Forester* 3:92-118.

Nuttall, Thomas
1980 *A Journal of Travels into the Arkansas Territory During the Year 1819*, S. Lottinville, ed. University of Oklahoma Press, Norman.

Olmsted, Frederick E.
1902 *A working plan for forest lands near Pine Bluff, Arkansas*. USDA Bureau of Forestry Bulletin 32, Goverment Printing Office, Washington, DC.

Owen, David Dale, Robert Peter, M. Leo Lesquereux, and Edward Cox
1860 Second Report of a Geological Reconnoissance of the Middle and Southern Counties of Arkansas Made During the Years 1859 and 1860. C. Sherman & Son, Philadelphia, PA.

Paillet, Frederick L. and K. Chris Cerny
2012 Reconstructing the Development of Two Ozark Chinquapin (*Castanea ozarkensis*) Stands in the Pre-Blight Forests of Northwest Arkansas. *Journal of the Torrey Botanical Society* 139(2):211-225.

Palmer, Ernest J.
1927 On Nuttall's Trail Through Arkansas. *Journal of the Arnold Arboretum* 8:24-55.

1942 The Red Oak Complex in the United States. *American Midland Naturalist* 7(3):732-740.

Putnam, J.A. and Henry Bull
1932 *The Trees of the Bottomlands of the Mississippi River Delta Region*. USDA Occasional Paper 27, USDA Forest Service Southern Forest Experiment Station, New Orleans.

Rolingson, Martha A.
1993 Archeology along Bayou Bartholomew, Southeast Arkansas. *The Arkansas Archeologist* 32:1-138.

Rosson, James F. and Anita K. Rose
2010 *Arkansas' forests, 2005.* Resource Bulletin SRS-166, USDA Forest Service, Ashville, NC.

Sargent, Charles S.
1884 *Report on the Forests of North America (Exclusive of Mexico)*. Government Printing Office, Washington, DC.

1947 *The Silva of North America*. Volume III, *Cupuliferae* (*Quercus*). Peter Smith, New York, NY.

Saucier, Roger T.
1974 *Quaternary Geology of the Lower Mississippi Valley*. Arkansas Archeological Survey Research Series 6.

Saucier, Roger T. and Lawson M. Smith
1986 *Geomorphic Mapping and Landscape Classification of the Ouachita and Saline River Valleys, Arkansas*. Assessments Report 51, Arkansas Archeological Survey, Fayetteville.

Schambach, Frank F.
1998 *Pre-Caddoan Cultures in the Trans-Mississippi South.* Research Series 53 Arkansas Archeological Survey, Fayetteville.

Schorger, Arlie W.
1973 *The Passenger Pigeon: Its Natural History and Extinction.* University of Oklahoma Press, Norman, OK.

Schulte, Lisa A. and David J. Mladenoff
2001 The Original US Public Land Survey Records: Their Use and Limitations in Reconstructing Presettlement Vegetation. *Journal of Forestry* 99(10):5-10.

Shea, John P.
1940 Our Pappies Burned the Woods. *American Forests* 46(4):159-162, 174.

Shelton, Michael G. and Michael D. Cain
1999 Structure and Short-Term Dynamics of the Tree Component of a Mature Pine-Oak Forest in Southeastern Arkansas. *Journal of the Torrey Botanical Society* 126(1):32-48.

Smith, Edwin B.
1988 *An Atlas and Annotated List of the Vascular Plants of Arkansas, 2nd ed.* Department of Botany and Microbiology, University of Arkansas, Fayetteville, AR. 489 p.

Stahle, David W., Malcom K. Cleaveland and J.G. Hehr
1985 A 450–year Drought Reconstruction for Arkansas, United States. *Nature* 316: 530–532.

Stewart, L.O.
1935 *Public Land Surveys: History, Instructions, Methods*. Collegiate Press, Ames, IA.

Stewart, Mart A.
2007 From King Cane to King Cotton: Razing Cane in the Old South. *Environmental History* 12:59-79.

Surrette, Sherry B., Steven M. Aquilani, and J. Stephen Brewer
2008 Current and Historical Composition and Size Structure of Upland Forests Across a Soil Gradient in North Mississippi. *Southeastern Naturalist* 7(1):27-48.

UMD (University of Michigan-Dearborn)
2007 Native American Ethnobotany Database. Digital data available online, accessed 6 December 2007, at: http://herb.umd.umich.edu/.

USDA (US Department of Agriculture) Forest Service
2007 Arkansas Forest Inventory and Analysis (FIA) data for Bradley, Cleveland, and Drew Counties. Digital data available online, accessed February 22, 2007 at: http://apps.fs.fed.us/fia/fido/index.html.

USDI (US Department of Interior) BLM (Bureau of Land Management)
2015 The Official Federal Land Records Site. Digital data available online, last accessed August 28, 2015, at: http://www.glorecords.blm.gov/default.aspx.

Warder, John A.
1881 Notes from Arkansas. *Botanical Gazette* 6(4):188.

Warwick, Mickie
2003 West of the Mississippi. *American Congress on Surveying and Mapping Bulletin* 205:28-30.

Washington, Paul A.
2002 Neotectonic Deformation of Alluvial Valleys in Southern Arkansas and Northern Louisiana. *Gulf Coast Association of Geological Societies Transactions* 52:991-1002.

Williams, G. Ishmael, Jr.
1993 Environmental Setting. *Caddoan Saltmakers in the Ouachita Valley: The Hardman Site*, edited by A.M. Early, pp. 15-28. Research Series 43, Arkansas Archeological Survey, Fayetteville, AR.

Williams, Michele L.
2000 Ethnobotanical Analysis. *Forest Farmsteads: a Millennium of Human Occupation at Winding Stair in the Ouachita Mountains*, edited by A. M. Early, pp. 111-122, Research Series 57, Arkansas Archeological Survey, Fayetteville.

Wood, W. Raymond.
1976 Vegetational Reconstruction and Climatic Episodes. *American Antiquity* 41(2):206-208.

Woodard, Jann.
2015 Warren (Bradley County). Information available online, last accessed 29 August 2015, at: http://www.encyclopediaofarkansas.net/encyclopedia/entry-detail.aspx?entryID=840.