The History of Fire in the Southern United States

Cynthia Fowler
Wofford College
Spartanburg, SC[1]

Evelyn Konopik
USDA Forest Service
Asheville, NC[2]

Abstract

Anthropogenic fires have been a key form of disturbance in southern ecosystems for more than 10,000 years. Archaeological and ethnohistorical information reveal general patterns in fire use during the five major cultural periods in the South; these are Native American prehistory, early European settlement, industrialization, fire suppression, and fire management. Major shifts in cultural traditions are linked to significant transitions in fire regimes. A holistic approach to fire ecology is necessary for illuminating the multiple, complex links between the cultural history of the South and the evolution of southern ecosystems. The web of connections between history, society, politics, economy, and ecology are inherent to the phenomena of fire.

Keywords: *fire, culture, Native Americans, US South*

A Holistic View of People and Fire

Written documents that address fire ecology in the South include more than 380 years of publications, ranging from Smith's 1625 monograph to Kennard's 2005 essay. This body of literature includes the travelogues of European explorers, research reports on fossil pollen and charcoal records, as well as critical analyses of fire management policies. The wide variety of perspectives that is represented in this literature reflects the web of connections between history, society, politics, economy, and ecology that are inherent to the phenomena of fire.

A multidisciplinary synthesis of the literature in light of the complexity of fire ecology will lead us to a better understanding of long term interactions between people and fire in specific ecological communities. In this article, we approach the fire ecology literature from two points of view, looking at "fire through people's eyes" and "people through fire's eyes" (Vayda 2005). We describe general patterns in fire use during five major cultural periods (Table 1) in four of the South's physiographic regions: the Coastal Plains, Piedmont, Southern Appalachians, and Ozark-Ouachita Highlands. Using this holistic framework, we consider "both ends of the fire stick" (Vayda 2005) examining elements of fire use by each cultural group that has inhabited the South and its effects on southern ecosystems.

Table 1. Major Periods of Human-Caused Fire Regimes in the South

FIRE REGIME	Native American Prehistory	Early European Settlers	Industrial-ization	Fire Suppression	Fire Management
DATES	12,500 BP to 1500s AD	1500s AD to1700s AD	1800s to 1900s	1920s to 1940s/1980s	1940s/80s to Present
TYPICAL BURNS	Low intensity brush fires	Low intensity brush fires mainly for agricultural purposes	Stand replacing fires set by loggers and farmers	Federal lands protected from fire	Prescribed fires of mixed intensity and frequency

The Native American Contribution to Prehistoric Fire Regimes (12,500 BP to 1540s)

Archaeological, palynological, and charcoal data combined with ethnohistorical information provide some insights into the purposes and effects of Native American fires. Anthropogenic fires were sources of ecosystem disturbance in many places across the South during the prehistoric era. Table 2 lists the predominant reason why each of the five prehistoric Native American cultural groups used fire. The following section describes patterns in Native American fire use from a selection of sites that were occupied during the Clovis and Paleo-Indian era, the Archaic Period, the Woodland Period, and the Mississippian Period.

Southern Fire Regimes and the South's First Inhabitants

Frequencies and intensities of anthropogenic and lightning-ignited fires varied across the region during the Clovis (12,500-10,500 BP) and Paleo-Indian (10,500-9500 BP) cul-

Table 2. Characteristic Use of Fire by Native Americans in the South

CULTURAL PERIOD	CHARACTERISTIC USE OF FIRE
Clovis (12,500-10,500 BP)	Hunting megafauna
Paleo-Indian (10,500-9,500 BP)	Hunting
Archaic (8,000-2,800 BP)	Hunting, clearing fields, and maintaining ecotones
Woodland (2,800-1,300 BP)	Preparing seed beds, encouraging pioneer species
Mississippian (1,300-400 BP)	Clearing maize fields

tural periods (Christensen 1981; Delcourt 1978). Major transitions in southern environments due to climate change occurred during this period and they complicate our ability to discern human- from lightning-ignited fires. However, analyses of charcoal content in soils indicate an increase in the frequency of fires coinciding with the migration of Clovis Indians and Paleo-Indians into the South, but anthropogenic fires at that time had minor impacts on habitat composition.

Clovis Indians and Paleo-Indians used fire for hunting animals, collecting nuts, and encouraging pioneer plant species. They burned the landscape during the fall and winter when smaller mobile bands congregated for communal hunts of mastodon, bison, and caribou. Clovis and Paleo-Indian hunter-gatherers used ring fires to trap game within a circle where they could be more easily hunted and point fires to drive game towards a natural barrier such as a river where they could be captured more easily (Hammett 1992). The use of fire for hunting megafauna ceased after the Ice Age ended around 12,500-10,000 BP with the gradual warming and drying of the climate and the disappearance of megafauna (Fagan 1991).

Long-Term Records of Anthropogenic Disturbance at Cliff Palace Pond and Horse Cove Bog

In order to find out whether or not fire influenced the establishment and regeneration of Southern forests, pollen data can be combined with charcoal records. The fossil pollen records of Cliff Palace Pond in the Appalachian Mountains of Kentucky show that oaks (*Quercus*) and other fire-tolerant species have increased in abundance since 9500 BP (Delcourt et al. 1998). Although this process was interrupted by a cedar-dominated period between 4800 and 3000 BP, oak percentages rose from 10% to 55%. In the interval between 3000 and 200 BP, oak (55%) dominated along with chestnut (19%) and pine (17%). Total values of fire-tolerant species had increased from values of 7- 20% to 82% in the period between 9500 to 7300 BP. Records of Horse Cove Bog in western North Carolina indicate that oak and chestnut (*Castanea*) have been dominant for the past 4000 years (Delcourt and Delcourt 1997). Lynch and Clark's study (2002) shows dominance of oak, pine, (*Pinus*) and chestnut, with some local variability, throughout the Southern Appalachians for the past 1000 years.

Frequent local fires at Cliff Palace Pond were already part of the disturbance regime in the early Holocene. Periods of reduced local fire in the middle Holocene can be explained by the warm-temperate and humid climate with possibly increased precipitation. After about 3000 BP—consistent with the shift toward an oak-chestnut forest—charcoal evidence indicates frequent, local ground fires around the pond (Delcourt et al. 1998).

The increase in charcoal particles at Horse Cove Bog also corresponds with increasing levels of oak and chestnut (Delcourt et al. 1998). Native Americans in Horse Cove Bog used fire to select for particular ecological conditions. In the Late Archaic, Indians probably set fire to upper slopes and ridges for hunting. The ridge fires had the effect of maintaining stands of Table Mountain Pine (*P. pungens*) and Pitch Pine (*P. rigida*). During the Late Archaic, Woodland, and Mississippian Periods, Indians burned riverine areas around their settlements for a variety of subsistence purposes (Delcourt and Delcourt 1997). At various sites throughout the Appalachians, charcoal accumulation increased after 1400 BP indicating a shift towards a different sort of fire regime in which anthropogenic fires were increasingly influential on forests. Another charcoal increase occurred after 1400 AD in the Southern Appalachians coinciding with a significant increase in the size of Native American populations and another shift in human demography (Lynch and Clark 2002).

Anthropogenic Fires and Transforming Subsistence Strategies

Native Americans began to diversify their subsistence strategies, incorporating nuts, seed-bearing grasses, gray squirrels and white-tailed deer into their diets (Fagan 1991) during the Archaic cultural period (8000-2800 BP). Archaic Indians in the Little Tennessee River Valley used fire to create and maintain the ecotones where deer prefer to browse (Chapman et al. 1982). Low-intensity fires were often effective for hunting and had the added benefit of preventing damage to the skins of game animals (Hammett 1992). Archaic Indians burned patches of the landscape during the seasons of the year when smaller family groups gathered together in larger congregations to socialize, trade, hunt, and forage.

A cultural transition took place in the Woodland period (2800-1300 BP) from mobile, hunting-gathering groups to settled communities living in river valleys and alluvial plains.

The fertile soils in these areas supported plant cultivation. Woodland Indians used fire to maintain the disturbed habitats in which valuable plants thrive and to prepare seed beds for newly domesticated species (Fagan 1991).

An increase in maize cultivation together with an increase in prescribed burning took place at Fort Center, Florida during the time period between 3000 and 1550 BP. Native Americans at Fort Center cleared garden land with fire. They also used fire to manage grasslands and to maintain open, longleaf pine (*P. palustris*) communities. When disease, slavery, and conflict forced Native Americans to abandon the Fort Center area in the 1600s AD, fire regimes changed and broad-leaved forests emerged in the places where homesites, gardens, and grasslands had been (Myers and Peroni 1983). The old-growth longleaf pine stands that can be found nowadays in south-central Florida date back to the 1700s AD which was shortly after Indians stopped using fire to clear fields and homesites in the area (Myers and Peroni 1983).

Archaeological evidence in Florida's Ocala National Forest indicates that Indian burning practices had the effect of creating longleaf communities (Kalisz et al. 1986; Myers and Peroni 1983). Ninety-three percent of archaeological sites from the Late Archaic Period (6000-3000 BP) and the Transition Period (3000-2500 BP) are in longleaf pine stands. Sixty-four percent of archaeological sites from St. Johns Period I (2500-1200 BP) and St. Johns Period II (1200 BP-Contact) are located in longleaf pine stands (Kalisz et al. 1986).

During the Mississippian Period (1300-400 BP) Indians used fire for a variety of reasons, many of which have been described by early European explorers and settlers. Mississippian Indians used fire to modify more extensive tracts of land, to build political centers and villages and to grow maize. Fire was prominent in the myths and rituals of Mississippian Indians. They believed, for instance, that ceremonial fires were sacred because they represented the Sun and the Upper World (Carroll et al. 2002).

People have been modifying fire regimes in the prairies, pine forests, and oak forests of the Ozark-Ouachita Highlands for at least 10,000 years (Foti et al. 1999). During the Mississippian phase (800-1350 AD) approximately 6000 Quapaw hunted game, gathered wild products, and grew crops near the confluence of the White, Arkansas, and Mississippi Rivers in Arkansas. They burned during the winter and late summer or early fall, while the majority of lightning-ignited fires occur from March to April and from July through September (Foti et al. 1999). Fire regimes in the Ozark-Ouachita Highlands changed significantly when Quapaw populations declined to about 700 people by 1763 AD due to the introduction of European diseases (Guyette and Dey 2000).

Early Settlement and Ethnohistorical Descriptions (1540s to early 1800s)

Much of our understanding of post-contact Native American burning is based on ethnohistorical documents. The information that is contained in ethnohistories from the early historic period suggests that the burning practices of Native Americans had a significant influence on southern ecosystems. Table 3 lists the most notable European explorers and settlers whose journals contain information about early historic-era environments and Native American practices. The writings of these explorers and colonists either mention fire directly or indirectly in descriptions of ecological features that are typical to landscapes subjected to repeated burning. Fire is mentioned often in connection with hunting practices such as aforementioned ring fires (Beverly 1947 and Smith 1625, both cited in Maxwell 1910; Strachey 1998, cited in Brown 2000), and point fires (Lawson 1984; Smith 1624, cited in Brown 2000). General remarks about the use of fire for hunting purposes can also be found in Burnaby (1798), DeVries (1912), Benson (1937), Van der Donck (1656), and Wood (1634) (all sources cited in Day 1953).

Table 3. Authors and Dates of Notable Ethnohistorical Documents

ETHNOHISTORICAL AUTHORS	DATE WRITTEN
Hernando DeSoto's conquistadors	1540s
Cabeza de Vaca	1542
George Percy	1607
Francois Coreal	1666
Lederer	1670s
Gabriel Diaz Vara Calderon	1675
John Lawson	1700s
Mark Catesby	1720s
William Byrd	1720s
William Bartram	1775

Ethnohistorical documents reveal that the effects of Native American burning practices were to open woods for better visibility and to attract game to forage sites where they could be more efficiently hunted (Salomon 1984). Several ethnohistorical documents show that Native Americans used fire to clear areas of thick woods for better traveling (Williams 1643 and Wood 1634, both cited in Day 1953) and tree felling or clearing the land for agriculture (Hurd 1886, cited in Day 1953; Maxwell 1910). It might have been used for warfare or in conflict (Day 1953; Russell 1983). Martin Pring and his men harvested sassafras (*Sassafras albidum*) in the Massachusetts Bay area around 1625, when a group of Indians appeared unexpectedly. Pring's party forced the Indi-

ans to flee; the response of the Indians was to set fire to the sassafras patch (Anonymous 1906). Other reasons that Native Americans used fire in the early historic period, were to promote the growth of edible plants and increase field crop production; fireproof areas around their villages; and to send 'smoke signals' (DeVivo 1991; Salomon 1984; Williams 2002).

Some historical texts mention fire without commenting on the purpose or whether it was intentionally set or not. White (1600, cited in Russell 1983), for example, saw from his ship rising smoke, when he was searching for the colony on Roanoke. Others describe habitats that may have been fire-maintained including large treeless zones, canebrakes, park-like forests, and pastures occupied by grazing bison. The fact that fallow fields grew into forests within decades after Indians abandoned an area (Day 1953; Maxwell 1910) and Indians' lack of metal tools to clear forests (Bass 2002) support the proposition that Native Americans used fire to clear forests. Vast open areas or grasslands in western Virginia and along the Virginia-North Carolina line were described by Beverly (1947) and Lederer (1891, cited in Maxwell 1910), who traveled through different parts of Virginia in 1669 and 1670. In 1705, Beverly (1947) described the hundreds of acres of grasslands on the Virginia Piedmont. In the 1720s Mark Catesby noted that in the Carolinas there were large meadows with overgrown grass (Barden 1997). In Ashley County, Arkansas survey records from the General Land Office note the presence of grasslands (Bragg 2003). Several sources, including George Washington's writings from 1752 (Brown 2000), mention large grassy areas in the Shenandoah Valley and conclude that Indians used fire (Fallam 1998; Fontaine 1998; Maxwell 1910). The presence of the bison in the Southeast provides indirect evidence of widespread grassland resulting from Indian burning practices. The bison migrated into the region sometime after 1500 AD. Their eastward movement was probably a combination of the open areas created by anthropogenic burning and the lack of predation after the decrease of the Indian population through European diseases (DeVivo 1991; Bass 2002).

Information about Indian burning practices at the time of contact in the mountains of western North Carolina and Tennessee mainly comes from the chronicles of early explorers like Hernando de Soto, who led expeditions through the Southeast and Midwest between 1539 and 1543 (Sheppard 2004). The detailed descriptions of William Bartram (1980), who traveled through Cherokee country in 1776, are also helpful. De Soto's chronicles describe the land between today's Columbia, South Carolina and Tryon, North Carolina as relatively flat with much grass and easy to travel through (Sheppard 2001). On their way from Tryon to Asheville, North Carolina they noticed oak forests and "plenty of pasturage for cattle . . . and very green and delightful valleys" (Sheppard 2001, 48). The expedition party replenished their maize supplies in an Indian town along the Little Tennessee River just below today's Fontana Dam indicating the existence of agricultural areas (Sheppard 2001).

In the early 1600s, American Indian groups were still actively burning the areas that they claimed ownership of, but did not burn outside of their territory (Hammett 1992). By the time Bartram traveled through Cherokee country, almost 300 years had passed since the first contact between Indians and Europeans who introduced diseases that killed as much as 90% of the Indian population in the Southeast (Bass 2002). This demographic collapse resulted in Indian fields lying fallow and the encroachment of early- to mid-successional vegetation on the abandoned land (Brantley and Platt 2001). On his way along an Indian trading path in 1776, which led him through the Cherokee and Nantahala Mountains, Bartram (1980) saw several abandoned Cherokee towns and "old plantations, now under grass" (Bartram 1980, 350). Some of the meadows and grassy fields he described might have been canebrakes, which were a dominant feature in the Southeast at the time of the European settlement (Brantley and Platt 2001). Cane was used by the Indians not only for food but also for the construction of dwellings, weapons, and for personal items. In order to maintain these canebrakes, the Indians would have burned them in a 7-10 year interval, since more frequent burning favors the growth of fire resistant woody vegetation. Both annual burning and the total lack of fire will eliminate cane (Brantley and Platt 1997, 2001). Because of the evidence of the presence of canebrakes, DeVivo (1991) concludes that the Cherokee burned regularly in the Asheville Basin in the early historic period.

The park-like forests described in several historical accounts (Budd 1685; Denton 1670; Lindeström 1925, all cited in Day 1953) were ascribed to the widespread use of fire to eliminate the understory and encourage mature overstory trees. Although these descriptions refer to northeastern forests, the same features undoubtedly also existed in parts of the South. Bartram (1980), for example, as he descended the west side of the Nantahala Mountains and before he reached the Nantahala River, traveled "through spacious high forests and flowery lawns" (Bartram 1980, 362; Sanders et al. 1999).

American Indian Methods for Burning the Landscape

According to an early settler, Coastal Plains Indians prepared a swidden field by burning trees at their roots, waiting for the trees to die, and then planting maize in and around the hollowed trunks (Hammett 1992). On April 28, 1607 George Percy reported seeing smoke and burnt grasslands near Jamestown, Virginia. Percy thought that the Indians burned the grasslands either to prepare them for planting or to send a

message to their allies that they were going to attack Percy and his men (Hammett 1992; Brown 2000). According to William Byrd (1737) Virginia's Coastal Plains Indians used similar techniques to prepare their fields for planting (Hammett 1992). They girdled trees to cause them to die and dry out. Later, they created a buffer zone around the dead trees by cutting down smaller live trees and then they set fire to the desiccated vegetation within the buffer zone. In 1709 John Lawson reported that Indians on the Coastal Plains used tree moss for torches and Indians in the mountains used pounded cypress bark to carry fire (Hammett 1992).

Seasons of Indian Fires

Ethnohistorical evidence suggests that Indians burned during the autumn and late winter or early spring. Mark Catesby, who traveled through the Carolinas in the 1720s, and John Lawson, who was in the Carolinas in 1701 and 1709, both mentioned that Indians burned many miles of wood during hunting season in February and March (Barden 1997). In the 1720s, Le Page du Pratz reported that Indians in the southern Ozark Highlands set dry grasslands on fire in September, or early autumn (Foti et al. 1999).

Anthropogenic Fires During the Early Settlement Period

The burning practices of European settlers in many parts of the South were a combination of European traditions adapted to the New World by colonial settlers, practices learned from Native Americans, and experimentation with fire in new environments. Like Native American fires, European settlers' fires and their effects on southern landscapes varied from place to place. Early European burning practices were similar to Native American fire regimes in the early historic period. In the early settlement period, Europeans used fire for many of the same reasons as Indians: to collect wild foods, to hunt, to produce forage for wild game and grazing animals, to clear farming land, to support their aesthetic preferences, and for entertainment. One major difference between European farmers and Indians in the Southern Appalachians, however, was that Europeans mostly practiced permanent-field agriculture while Indians were mainly swidden farmers.

The Europeans who began settling the Southern Appalachians in the late 1700s often took over old Indian fields for farming and grazing where they replicated the fire practices of local Indians. Using mostly low intensity fires, early settlers burned the landscape to clear space for their houses and other buildings (Williams 1998). They burned bottomlands, woodlands, and hilltops—annually in some cases—to prepare them for growing corn and other row crops. Settlers burned grasslands in valleys, floodplains and pastureland to improve the forage for their cows and other grazing animals nearly every year (Van Lear and Waldrop 1989). They also used fire to encourage the growth of early succession plants such as blueberries and to control woody undergrowth. Many settlers believed that prescribed fire would reduce insect damage to their crops. Some cotton farmers, for example, attempted to control boll weevils with an annual burning regime.

One of the reasons Cherokee Indians in the Southern Appalachians burned the woods in the autumn was to clear the litter on the forest floor so that it would be easier to collect chestnuts. The Cherokee believed that if the old witch who lives in the woods saw the smoke rising from their fires she could sneak up on them and do harm (Mooney 1995). Euro-American settlers in southern Allegheny Mountains learned how to use fire to collect chestnuts from the Cherokee and continued their tradition of burning the mountainsides in the autumn when the chestnuts were ripe (Mooney 1995).

Demographic Changes and Transitions in Fire Use

During the historic era, the decline of Native American populations and the decrease in Indian fires had significant effects on vegetation. European exploration and settlement in the South caused a decline of 90-95% in Indian populations between the mid-1500s and the 1800s (Carroll et al. 2002) due to diseases introduced by Europeans, conflict, migration, change in land ownership, and forced removal. In the absence of Native American land managers, many of the places where they had previously used fire to clear vegetation became densely overgrown (Williams 2002).

Over time, the ways European settlers used fire for land management became very different from those of Native Americans. In the early historic period, Native Americans and early European settlers typically lit low-intensity brush fires. Frequent low-intensity burns helped to create and maintain the longleaf pine and wiregrass (*Aristida stricta*) communities that were typical to the Florida sandhills in the early historic era (Myers and White 1987). Spanish settlers introduced cattle grazing to the St. Johns River basin in the 16th and 17th centuries. In the 1700s, Spanish and Seminole cattle farmers burned the sandhills at least annually to kill old wiregrass and to encourage more desirable forage. In the 18th century, Seminole Indians and, later, English settlers used fire to maintain grazing lands for cattle and for hunting (Myers and White 1987).

The fire history of the Ozark-Ouachita highlands demonstrates that migration affects fire regimes. Native American migration into the region during the 1700s and European migration in the 1800s caused initial increases and subsequent decreases in fire frequencies. During the late 1700s, Cherokee Indians migrated into the Ozarks after European settlers displaced them from their homelands in the

Southern Appalachians. Between 1760 and 1820, the number of sites that were burned in the Current River watershed in Missouri increased by 21% (Guyette and Dey 2000). The number of annually-burned sites in the Current River watershed almost doubled as population density increased between 1810 and 1850. By 1803 there were about 6,000 Cherokee living in southeast Missouri and northeast Arkansas. In 1838 more Cherokee settled in the Ozark region when the United States government forced them to leave the Southern Appalachians and march westward on the Trail of Tears. This migration process likely altered vegetative communities in their old and new homelands. Conflict and war between Indian groups and between Indians and Euro-Americans may also have caused changes in fire regimes.

In the late 1800s and early 1900s, the logging and railroad industries caused drastic changes in fire regimes. Euro-Americans cleared major portions of the region by harvesting timber and establishing cotton farms. In the decades following the timber and cotton booms and busts, secondary growth appeared and forests re-emerged on some of the damaged, abandoned land (Foti et al. 1999). Nowadays on some of these sites in western Arkansas, pure 150-250 year old shortleaf pine stands occur that began growing when the land was abandoned and anthropogenic fires disappeared (Foti et al. 1999).

Industrial Fires (late 1800s to 1900s)

Fire regimes began to change dramatically across the South in the 1880s as settler populations expanded and the Industrial Revolution began. Ashe (1895), an early forester in the mountains, denounced farmers for not understanding that by slashing and burning the woods for farming and grazing, they robbed themselves of future timber resources. Yet, shifting cultivation may not have been a major cause of deforestation since three-fourths of Southern Appalachia was still forested in 1911 even though farmers had been using slash-and-burn methods in the Southern Appalachians for up to 200 years (Otto 1983).

In the late 1800s and early 1900s, settlers expanded their burning practices into more remote areas as they began harvesting timber for the commercial trade, establishing settlements, building agricultural operations, and developing road and railroad systems (Van Lear and Waldrop 1989). Whereas the typical fires during pre-European times and in the early settlement period were low intensity brush fires, the logging-era fire regime was characterized by high intensity, stand replacing fires (Brose et al. 2001a). Intense, widespread fires occurred in the Southern Appalachians as a consequence of the timber boom that lasted from the 1890s through the 1920s. Steam power and the development of locomotives that were able to perform on steep terrain made timber harvesting economically feasible even in the mountains, so that timber companies started to buy large tracts of land in remote areas (Brose et al. 2001a).

During the 1880s timber and coal mining companies gained control of large parts of the region and relentlessly exploited the newly acquired properties. Between 1880 and 1895 the lumber output in North Carolina alone had more than tripled (Ashe 1895). Commercial logging consisted of the systematic cutting of saw timber and smaller timber that could be used for fence posts, railroad ties, and other products (Bass 2002). After cutting the wood, the slash was often burned and the land used for grazing livestock, which inhibited the re-establishment of woody vegetation (Van Lear and Waldrop 1989). If the slash was not burned intentionally, it dried on site and was easily ignited by sparks from passing locomotives. This resulted in intense burns that could be detrimental for soils or adjacent uncut forests, especially during dry periods (Brose et al. 2001a). In 1894, for example, the combination of drought, intentional burning, and accidental ignitions provoked by logging practices resulted in extensive and destructive forest fires. At least seven counties in western North Carolina suffered severe or numerous fires. Another five reported medium fire damage or large areas that had been burned for pasturage (Ashe 1895). Soon the effects of fire, lumbering, and agriculture on mountain slopes became obvious:

> *When first cleared most of this mountain land is covered with a layer of humus several inches thick...but on cultivation and exposure to the sun and washing rains this organic matter rapidly disappears...over the more elevated portion of the Appalachian Mountain region erosion is so rapid that the slow-growing hard-wood forests do not readily regain their footing* (Ayers and Ashe 1905, 20).

The land management practices of European colonists on the Piedmont also caused major changes in vegetation. Before European settlement, some forests on the Piedmont had many fire tolerant pine species, suggesting that fires were frequent in the prehistoric period. After several centuries of European occupation, those same forests had more fire intolerant species, suggesting that fires were not as frequent as previously. In the early historic period, European settlers cleared forests for agriculture. After growing row crops on the land for several centuries, the settlers' descendants abandoned the land and let it revert back to secondary forests that resembled the pre-settlement landscape, with many fast growing pioneer species and pine species that benefit from disturbance (Cowell 1998). During the 1880s and early 1900s, logging encouraged the spread of pine forests because

it created open canopy areas that pines prefer and changed the character of forest fuels.

On the Coastal Plain, turpentine collectors burned pine forests annually during the 1800s and 1900s. Also in the late 1800s and early 1900s, the logging industry cleared 80-100% (Stanturf et al. 2002) of the Coastal Plain region, substantially reducing longleaf pine populations in Florida.

Fire Suppression and Landowners' Fires (1890s to 1980s)

The fire suppression movement began in the late 1890s on the platform that fire destroyed forests and that excluding fire would help to conserve forest values. It was led by Gifford Pinchot, the founder of the Forest Service, and supported by many foresters as well as timber, pulp, and paper companies. The concept of 'fire control' was developed partly in reaction to the environmental damages caused by industrial logging and destructive wildfires. The United States Forest Service, under the command of Chief Forester Henry Graves, adopted fire control as a principle duty of the agency (Williams 2002). Fire suppression became the doctrine and leading policy of federal agencies. For instance, when the Great Smoky Mountains National Park was established in 1931, fire suppression was a central objective of forest managers (Harmon 1982). Government officials who wanted to restore southern forests encouraged the prevention and suppression of all forest fires and the restoration of desirable plant and animal species (Williams 1998).

The Forest Service experimented with "light burning" in the 1910s and concluded that prescribed fires were destructive (Williams 2002). In the 1924 Clark-McNary Act, the federal government allocated funding for states to develop their capacity to fight forest fires (Stanturf et al. 2002). In 1926 the U.S. Forest Service developed a policy of controlling wildfires before they reached the size of 10 acres. Nine years later this was complemented by the "10:00 a.m. policy" which stated that when forest fires exceeded 10 acres, they should be controlled before the next high danger period began at 10:00 a.m. (Gorte 2000).

In order to effectively reduce the number of human-ignited fires, it was necessary, according to the Forest Service, to educate the public about fires and how to prevent them. The first campaign in 1937 featured Uncle Sam dressed as a forest ranger. During WW II Uncle Sam paraphernalia were replaced by posters with the slogan "Fires Aid the Enemy." Disney's "Bambi" which was produced in 1944, was so successful in teaching an anti-fire message that the Forest Service decided to continue using an animal mascot. Thus, Smokey Bear became the mascot of the anti-fire campaign (USDA 2004). Smokey Bear has been a highly effective symbol, teaching two or three generations of Americans that careless fires are harmful to forests.

Throughout the fire suppression period, there was opposition to policies within federal and state agencies from advocates of "light burning" or "Indian fires" (Pyne 2000a, b). On private lands—despite federal fire prevention policies—prescribed burning continued to be used by the farming, grazing, and logging industries and maintained its role in the southern economy. On many public lands in the South, however, prescribed burning was banned for more than 50 years. Accidental and arson fires and lightning-ignited fires still occurred, but were controlled and extinguished as soon as possible. Between 1930 and 1960 the area consumed by fire nationwide had been reduced from over 50 million acres to about 2-5 million acres (MacCleery 1992).

The era of fire prohibition that began in the early 1900s caused a shift in fire regimes marked by longer fire return intervals. In the Great Smoky Mountains National Park, for example, fire return intervals increased from 10-40 years with a mean of 12.7 years during the Euro-American settlement period (1856-1940) to a 2000 year fire return interval in the fire suppression era (1940-1979) (Harmon 1982). In the Ozark-Ouachita Highlands, the fire suppression era began in the 1930s. Subsequently, fire regimes changed drastically. In Hot Springs National Park the fire return interval in 1700 was 41.4 years and by 1980 it had increased to 1200 years (Foti et al. 1999). In McCurtain County Wilderness Area the fire return interval in 1700 was 29.9 years and in 1980 it was 547 years (Foti et al. 1999).

The exclusion of fires from southern landscapes caused changes in vegetation. When fires became less common, forests began to regenerate or the composition of existing forests began to change. The Appalachian hardwood forests recovered in the almost complete absence of fire, which had detrimental effects on fire-tolerant oak and fire-dependent pine stands (Brose et al. 2001a). The establishment of oaks (*Q. rubra, Q. alba*) had formerly been facilitated by Native American fire—possibly over thousands of years—and by logging, burning and the chestnut blight from the time of European settlement until the beginning of the 20th century. However, during the time of fire suppression these sites have been invaded by late-succession species. Abrams et al. (1995) studied an old growth white pine (*P. strobus*) and mixed oak community in southern West Virginia and came to the conclusion that fire and other fairly frequent disturbances maintained this forest over the past 300 years. After the exclusion of fire, oak recruitment ceased in favor of maple (mainly *Acer rubrum*), beech (*Fagus grandifolia*) and hemlock (*Tsuga canadensis*). Today, sites that have been cut over since 1930 are often dominated by maples (*Acer rubrum, A. saccharum*), yellow poplar (*Liriodendron tulipifera*) and hickories (*Carya*

spp.). Only on drier or nutrient-poor sites do oaks still regenerate successfully (Lorimer 1993).

The same seems to be true for Pitch and Table Mountain Pine communities. Pitch pine stands on the southwest shoulder of Looking Glass Rock in Pisgah National Forest have regenerated continuously since at least 1889 (Barden 1977), but generally pine stands are declining in the Southern Appalachians and are being replaced by hardwoods, especially chestnut oak (*Q. montana*) and hickories (Waldrop and Brose 1999). Ninety-eight percent of the pine/hardwood stands at the Coweeta Hydrologic Laboratory in western North Carolina, for example, have little or no live pine any more (Vose et al. 1997). The cones of Table Mountain Pine are serotinous (they require heat from a fire to open and release seeds). Both Table Mountain and Pitch Pine are extremely shade-intolerant and need an exposed seedbed in order to germinate. In the absence of fire the cones either do not release seeds or the pine seedlings cannot compete under the shade of invading hardwoods (Brose et al. 2001b). In addition to the effects of fires suppression, pines have been suffering from widespread pine beetle infestations since the mid-1980s after a drought weakened the trees and made them more susceptible to damage (Vose et al. 1997).

In the Missouri Ozarks, late-succession trees such as black oak (*Q. velutina*) and scarlet oak (*Q. coccinea)* began replacing shortleaf pines (*P. echinata*), white oaks, and post oaks (*Q. stellata*) because fire was excluded (Foti et al. 1999). In other parts of the Ozarks, oaks are becoming less dominant as maples, blackgums (*Nyssa sylvatica*), and yellow poplars replace them. On the prairies of the Ozark-Ouachita Highlands, prairie legumes and tall grasses are being replaced by eastern red cedar (*Juniperus virginiana*).

Fire regimes on the Coastal Plain of Florida have been mixed in past decades. This is evident on the Welaka Reserve in northeastern Florida and the Archbold Research Station in south-central Florida (Myers and White 1987) where the types of plants that are growing have different relationships to fire. Sand pine scrub, which favors infrequent, high-intensity fires, is a prominent vegetation type in both the Welaka and Archbold sites. Other elements, which favor more frequent, lower-intensity fires, are scrubby flatwoods, longleaf pine, and slash pine (*P. elliottii*). This is true even though prescribed fires were discontinued in the Welaka Reserve in 1935 and in Archbold Research Station in 1927 (Myers and White 1987). The relationships between the age and abundance of longleaf pines (older and less abundant) and slash pines (younger and more abundant) suggest that fires became less frequent at these sites about 150-200 years ago (Myers and White 1987).

The decrease in Florida's longleaf pine communities during the 20th century was partly caused by the government's ban on prescribed fire. The health of longleaf pine communities depends on frequent, low-intensity fires. Other causes for the decrease in longleaf pine densities are the logging and turpentine collecting that took place in the late 1800s and early 1900s. For these same reasons, several species of deciduous oak (*Q. laevis, Q. incana, Q. stellata, Q. falcata*) have become more abundant in the former longleaf pine communities (Myers and White 1987). In the drier parts of the Coastal Plains of Louisiana and Florida, the ban on prescribed fires caused a decrease in pines and an increase in hardwoods. Fires were more frequent in the late 1800s on the Coastal Plains of Louisiana and Florida than they were in the 1980s. In wetter parts of the Coastal Plains, fire exclusion caused a decrease in beech trees and an increase in mixed hardwoods (Christensen 1981).

In some parts of the Piedmont, where fires have been absent because of fire exclusion policies or land use patterns, the early- and mid-succession forests of pine and pine/hardwood mixtures convert to late-succession forests of mixed hardwoods such as maples (*Acer*) and gum (*Liquidambar*) (Buckner 2000).

Fire Management (1940s to Present)

The era of fire management in the South replaced the fire suppression era in the 1940s and continues through the present. "Fire management" refers to the current prevailing approach to land management in which prescribed fire is used to restore and maintain healthy ecosystems. Fire management policies have been created to respond to unhealthy environmental conditions resulting from historical fire practices and in response to contemporary social, economic, and political needs. Many organizations are conducting research to determine how to use fire to achieve their land management goals.

Prescribed fire was reintroduced to different parts of the South at different points in history. Thus, the revitalization of prescribed fire has occurred gradually across the South over the past 50 years. In the 1930s, Herbert Stoddard and other advocates of fire management encouraged the use of prescribed fire to create healthy, productive environments. After several decades of fire suppression, land managers, scientists, and policy makers began noticing the forests and fields changing in undesirable ways. Problematic levels of forest fuels were accumulating in some of the places where prescribed burning had been discontinued, ecosystem integrity was declining, and the threat of catastrophic wildfires was increasing.

Several scientific publications appeared in the 1930s supporting the reintroduction of prescribed burning, or the use of fire to manage the land. The benefits of "Indian fires" to longleaf pine forests were documented in Greene (1931)

and Chapman (1932). Herbert Stoddard published a number of important early articles about the role the of prescribed burning in southern landscapes including "The use and abuse of fire on southern quail preserves," published in 1931; "Use of controlled fire in southeastern upland game management," published in the *Journal of Forestry* in 1935; and "Relation of burning to timber and wildlife" in the *Proceedings of the North American Wildlife Conference* in 1936. Since the 1930s, the South has produced more fire research than any other region of the United States. The E.V. Komarek Fire Ecology Database at the Tall Timbers Research Station is an extensive bibliography of the southern fire science literature.

The first official prescribed fire on federal property since the fire suppression era was in 1943 in the Osceola National Forest on Florida's Coastal Plain (Stanturf et al. 2002). Prescribed fires became increasingly common after World War II, but remained a highly controversial subject and were discontinued in many parts of the South. In Georgia's Okefenokee Swamp, for example, prescribed burning was discontinued in the 1930s. Fire was excluded from many public lands on the Florida sandhills, such as the Welaka Reserve after 1935. Also in parts of the Piedmont, land managers stopped using fire in the 1940s.

In the Okefenokee Swamp as well as in parts of the Piedmont region fire was re-introduced in the 1970s. In the 1980s public land managers began setting prescribed fires during the dormant season (winter) in the Welaka Reserve (Myers and White 1987). Nowadays, land managers on the Piedmont are using periodic, low intensity fires to restore pine stands similar to the ones that existed when Native Americans managed the territory. In the Southern Appalachians, where land managers began reintroducing prescribed burning in the 1980s, low intensity surface fires are most appropriate for particular combinations of vegetation, topography, and aspect, while high intensity crown fires are appropriate for other combinations, such as Table Mountain Pine-Pitch Pine forests.

Today the prevention of serious fire hazards is still considered the primary management objective on state, private and federal lands. Using prescribed burns to re-establish or maintain threatened and endangered species has become the second most important objective on federal land. Slash reduction burning continues to decrease, indicating a shift from post-harvest slash management towards fire-dependent ecosystem management on public lands in the South (Haines et al. 2001). Other objectives are to improve habitat for certain wildlife and game species, reduce pest populations, optimize plant growth and facilitate stand regeneration (e.g., by controlling understory hardwoods), and minimize the risk of catastrophic wildfires.

Summary of Human Influences, Anthropogenic Fires, and Ecosystem Change

Through time, people have used fire for a variety of social, political, economic, and ecological purposes. The fire regimes that existed before Native Americans migrated to the South were defined by the frequency and intensity of lightning-caused fires. In general, Native Americans increased the fire frequency and expanded the seasonality of lightning-ignited fires in many of the ecosystems they inhabited. In the early historic period, fire regimes were more or less frequent, depending on whether the land was managed by American Indians who cultivated temporary slash-and-burn gardens or by European settlers who raised row crops in permanent fields and grazed livestock in pastures. Industrialization, involving commodities such as cotton, turpentine, and timber, in the 19th and 20th centuries generally caused increases in fire frequencies and intensities. The creation of the United States Forest Service and shifts in federal policy from fire suppression to fire management caused major transitions in fire regimes during the 20th century.

Transitions in southern U.S. ecosystems are linked to biological, social, political, and economic changes. The degree to which the burning practices of any particular group of 'Southerners' has altered the landscape varies and depends on several factors including human population densities, burning techniques, fire behavior, and the responses of biological components of the ecosystem. In general, temporal variability in Southern fire frequencies are due to the following cultural, economic, and political transitions:

- from unpopulated to intermittently and temporarily populated habitats
- from temporary to permanent settlements
- from hunting-gathering to farming
- from low to high population densities
- from Native American to European cultures
- from communal territorial organization to private and state property ownership
- from agricultural to industrial systems
- from suppressing to managing fires.

The extent to which human-ignited fires cause ecosystem changes depends in part on background lightning fire regimes which varies temporally and spatially (Frost 1996). Generally, lightning fires are more common in piney woods and grasslands of the Piedmont and Coastal Plains (Kennard 2005) than they are in the Southern Appalachian Mountains. Lightning-ignited fires currently occur in the longleaf pine stands in Florida's Ocala National Forest at a rate of 1.7 per year per 10,000 acres (Outcalt 1996). A Southern Appalachian study of lightning fires showed an average of six

lightning fires per year per one million acres (Barden and Woods 1973). In the southeast today, lightning typically ignites fires during the spring and summer; the highest frequency of lightning-ignited fires is in August and September.

A 'Natural' Connection between People and Fire

To return to the issue of a holistic approach to fire ecology: What do we see when we consider both ends of the firestick? At one end, we find a human hand, guided by subsistence needs, an intelligent brain, and a complex culture. On the other end, we find hot flames, sparked by friction, reacting to the oxygen/heat/fuel triangle, behaving predictably or unpredictably. How do the people, at one end, and the flames, at the other end, view one another? From the human point of view fire is a tool that is useful for achieving a multitude of economic, political, and cultural goals. The human at one end of the firestick sees fire as some combination of tame and wild. In certain situations, people control the ignition of the flame. Depending on the circumstances, fire can behave predictably or unpredictably; it is somewhat mysterious at the same time that it is a partially known element. From the fire's point of view, we can speculate that fire sees a creature whose behaviors—including previous burning, lack of burning, planting, harvesting, draining, flooding, introduction of new species, home building, road construction, and other practices—have shaped the fuels that it needs to burn. Fire looks towards a hand that will sometimes fan its flames and other times use extraordinary means to extinguish them. When fire looks over at people, it sees contempt as well as fear; it hears tales, myths, and debates about itself; it witnesses organizations built and tremendous funds expended for the purpose of managing it; and it observes deep ignorance as well as intensive examination of itself.

Fire and people have frequent encounters. They have been rendezvousing for millennia. In the South's fire-adapted ecosystems, their relationship is extremely intimate to the degree that they are inseparable. Fire is inextricable from many southern ecosystems. People are inextricable from and increasingly abundant in many of those same ecosystems. Like fire-adapted ecosystems, people can live harmoniously with fire and they can die violently from fire, but people cannot live long or well without fire. Ecological communities can live productively with people or, at the other extreme, they can/have become wastelands because of people, but we cannot realistically consider ecosystems without also considering human ecology.

The evidence that we have reviewed in this article shows that not only has fire been important in human evolution, but it has also been important in the evolution of southern ecosystems both prior to and since the arrival of *Homo sapiens* at least 10-12 thousand years ago. In light of such a long history, anthropogenic fires—and the human influence on the environment more generally—are 'natural' phenomena. Throughout the course of five major cultural periods, human-ignited fires have been integral to the evolution of southern ecosystems. The South has been a cultural landscape and people have been a 'natural' part of fire regimes for a very long time.

Endnotes

1. Author to whom correspondence should be directed: E-mail: fowlerct@wofford.edu
2. E-mail: Ekonopik72@cs.com

References

Abrams, M.D., D.A. Orwig and T.E. DeMeo. 1995. Dendrochronology and successional dynamics of a presettlement-origin white pine-mixed oak forest in the southern Appalachians USA. *Journal of Ecology* 83,123-133.

Anonymous. 1906. The voyage of Martin Pring, 1603. *Original Narratives of Early American History* 3, 341-352.

Ashe, W.W. 1895. *Forest Fires: Their Destructive Work, Causes, and Prevention.* Bulletin No. 7. Raleigh, NC: North Carolina Geological Survey.

Ayers, H.B. and W.W. Ashe. 1905. *Southern Appalachian forests*. Professional Paper No 37 (Series H, Forestry, 12). Washington: U.S. Geological Survey, Government Printing Office.

Barden, L.S. 1997. Historic prairies in the Piedmont of North and South Carolina, USA. *Natural Areas Journal* 17, 2, 149-52.

Barden, L.S. 1977. Self-maintaining populations of Pinus pungens Lam. in the Southern Appalachian Mountains. *Castanea* 42, 316-323.

Barden, L.S. and F.W. Woods. 1973. Characteristics of lightning fires in Southern Appalachian Forests. In *Proceedings; 13th Tall Timbers Fire Ecology Conference*, 345-361. Tallahassee, FL: Tall Timbers Research Station.

Bartram, W. 1980. *Travels through North and South Carolina, Georgia, East and West Florida*. Charlottesville: University Press of Virginia.

Bass, Q. 2002. *The Forest Ecosystem and the Effects of Land Use in the Southern Appalachian Physiographic Province, inclusive of the Cherokee National Forest*. www.safc.org/resources/docs/QB_Full.pdf.

Benson, A.B. (trans. and ed.). 1937. *Peter Kalm's travels to North America.* New York: Wilson Erickson.

Beverly, R. 1947 (1705). *The History and Present State of Virginia*. Chapel Hill: University of North Carolina Press.

Bragg, D.C. 2003. Natural presettlement features of the Ashley County, Arkansas area. *The American Midland Naturalist* 149, 1, 1-20.

Brantley, C.G. and S.G. Platt. 2001. Canebrake conservation in the southeastern United States. *Wildlife Society Bulletin* 29, 4, 1175-1181.

Brantley, C.G. and S.G. Platt. 1997. Canebrakes: An ecological and historical perspective. *Castanea* 612, 1, 8-21.

Brose, P., T. Schuler, D. Van Lear and J. Berst. 2001a. Bringing fire back: The changing regimes of the Appalachian mixed-oak forests. *Journal of Forestry* 30-35.

Brose, P., F. Tainter, and T. Waldrop. 2001b. Regeneration history of three Table Mountain Pine/Pitch Pine stands in northern Georgia. In K.W. Outcalt (ed), *Proceedings of the Eleventh Biennial Southern Silvicultural Research Conference*, 290-295. General Technical Report SRS-48. Asheville, NC: USDA Forest Service, Southern Research Station.

Brown, H. 2000. Wildland burning by American Indians in Virginia. *Fire Management Today* 60, 3, 29-39.

Buckner, E. 2000. In summary: Fire in the evolution of the eastern landscape, a timeline. In D.A. Yaussy (comp), *Proceedings: Workshop on fire, people, and the central hardwoods landscape*, 120-129. General Technical Report NE-274. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station.

Budd, T. 1685. *Good order established in Pennsylvania & New Jersey in America*. New York: William.

Burnaby, A. 1798. *Travels through the Middle Settlements in North America in the Years 1759 and 1760*. London: A. Wassels.

Byrd, William. 1737. *Natural history of Virginia*. Richmond Croom Beatty and William J. Mulloy (trans.). Richmond, VA: The Deitz Press.

Carroll, W.D., P.R. Kapeluck, R.A. Harper and D.H. Van Lear. 2002. Background paper: Historical overview of the southern forest landscape and associated resources. In D.N. Wear and J.G. Greis (eds.), *Southern Forest Resource Assessment*, 583-605.Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station.

Chapman, H.H. 1932. Is the longleaf type a climax? *Ecology* 13, 4, 328-334.

Chapman, J., P.A. Delcourt, P.A. Cridlebaugh, A.B. Shea and H.R. Delcourt. 1982. Man-land interaction: 10,000 years of American Indian impact on native ecosystems in the lower Little Tennessee River Valley, eastern Tennessee. *Southeastern Archaeology* 1, 2, 115-21.

Christensen, N.L., Jr. 1981. Fire regimes in southeastern ecosystems. In H.A. Mooney, T.M. Bonnicksen, N.L. Christensen, Jr., J.E. Lotan and W.A. Reiners (eds.), *Proceedings of the Conference Fire Regimes and Ecosystem Properties*, 112-136. General Technical Report. Washington, DC: U.S. Department of Agriculture, Forest Service.

Cowell, C.M. 1998. Historical change in vegetation and disturbance on the Georgia Piedmont. *The American Midland Naturalist* 140, 1, 78-89.

Day, G.M. 1953. The Indian as an ecological factor in the northeastern forest. *Ecology* 34, 329-346.

Delcourt, P.A. 1978. Goshen Springs, Alabama: Late Quartenary plant-fossil record for the Gulf Coastal Plain. *Bulletin of the Ecological Society of America* 59, 97.

Delcourt, H.R. and P.A. Delcourt. 1997. Pre-Columbian Native American use of fire on Southern Appalachian landscapes. *Conservation Biology* 11, 4, 1010-1014.

Delcourt, P.A., H.R. Delcourt, C.R. Ison, W.E. Sharp and K.J. Gremillion. 1998. Prehistoric human use of fire, the eastern agricultural complex, and Appalachian oak-chestnut forests: Paleoecology of Cliff Palace Pond, Kentucky. *American Antiquity* 68, 2, 263.

Denton, D. 1670. *A Brief Description of New York*. New York: William Gowans.

DeVivo, M.S., 1991. Indian use of fire and land clearance in the southern Appalachians. In S.C. Nodvin and T.A. Waldrop (eds.), *Fire and the Environment: Ecological and Cultural Perspectives: Proceedings of an International Symposium*, 306-310. General Technical Report. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station.

DeVries, D.P. 1912. From the "korte hisotriael ende journaels aenteyckeninge," by David Pietersz. De Vries, 1633-1643 (1655). *Original Narratives of Early American History* 12, 181-234.

Fagan, B.M. 1991. *Ancient North America: The Archaeology of a Continent.* London: Thames and Hudson.

Fallam, R. 1998 (1671). A journal from Virginia. In Branch, M.P. and D.J. Philipoon (eds), *The height of our mountains*, 58-61. Baltimore: The Johns Hopkins University Press.

Fontaine, J. 1998 (1716). The journal of John Fontaine. In M.P. Branch and D.J. Philipoon (eds), *The height of Our Mountains*, 71-78. Baltimore: The Johns Hopkins University Press.

Foti, T., L.L. Richards, J. Andre and J.E. Veoller. 1999. Prehistoric and historic changes. In T. Foti, L.L. Richards, J. Andre and J.E. Veoller (eds.), *Ozark-Ouachita Highlands Assessment: Terrestrial Vegetation and Wildlife*, 7-20. General Technical Report SRS 31-35. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station.

Frost, C.C. 1996. Presettlement fire frequency regimes of the United States: A first approximation. In *Fire in Ecosystem Management: Shifting the Paradigm from Suppression to Prescription. Proceedings of the 20th Tall Timbers Fire Ecology Conference*, 70-81. Tallahassee, FL: Tall Timbers Research Station.

Gorte, R.W. 2000. *Forest Fire Protection*. http://www.cnie.org/nle/crsreports/forests/for-34.pdf.

Greene, S.W. 1931. The forest the fire made. *American Forests* 53-54.

Guyette, R.P. and D.C. Dey. 2000. Humans, topography, and wildland fire: The ingredients for long-term patterns in ecosystems. In D.A. Yaussy (ed.). *Proceedings: Workshop on Fire, People, and the Central Hardwoods Landscape*, 28-35. General Technical Report NE-274. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station.

Haines, T.K., R.L. Busby, and D.A. Cleaves. 2001. Prescribed burning in the South: Trends, purpose, and barriers. *Southern Journal of Applied Forestry* 25, 4, 149-153.

Hammett, J.E. 1992. The shapes of adaptation: Historic ecology of anthropogenic landscapes in the southeastern United States. *Landscape Ecology* 7, 2, 121-135.

Harmon, M. 1982. Fire history of the western-most portion of Great Smokey Mountains National Park. *Bulletin of the Torrey Botanical Society* 109, 1, 74-79.

Hurd, D.H. 1886. *History of Chesire and Sullivan Counties, New Hampshire*. Philadelphia: J.W. Lewis.

Kalisz, P.J., A.W. Dorian and E.L. Stone. 1986. Prehistoric land-use and the distribution of longleaf pine in the Ocala National Forest, Florida: An interdisciplinary synthesis. *The Florida Anthropologist* 39, 183-193.

Kennard, D. 2005. Frequency of lightning-caused fires. In *Encyclopedia of Southern Fire Science*, http://fire.forestencyclopedia.net/Appalachian/Ecology/disturbance%20and%20succession/fire/historical_and_present-day_fire_regimes/lightning-caused_fires.htm/view.

Lawson, J. 1984. *A New Voyage to Carolina*. Chapel Hill: University of North Carolina Press.

Lederer, J. 1891. *Discoveries of John Lederer.* Charleston, SC.

Lindestrom, P. 1925. *Geographia Americae with an Account of the Delaware Indians. Translated by A. Johnson. Written 1691 from notes made in 1654-56*. Pennsylvania: Swedish Colonial Society.

Lorimer, C.G. 1993. Causes of the oak regeneration problem. In D. Loftis and C.E. McGee (eds.), *Proceedings: Oak Regeneration: Serious Problems, Practical Recommendations*, 14-29. General Technical Report SE-84. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station.

Lynch, J.A. and J.S. Clark. 2002. *Fire and Vegetation Histories in the Southern Appalachian Mountains. The Historical Importance of Fire before and afterEuropean/American Settlement*. Durham, NC: Biology Department and Nicholas School of Environment, Duke University.

MacCleery, D. 1992. *American Forests: a History of Resiliency and Recovery*. General Technical Report FS-540. Durham, N.C.: U.S. Department of Agriculture, Forest Service in cooperation with Forest History Society.

Maxwell, H. 1910. The use and abuse of forests by the Virginia Indians. *William and Mary Quarterly Historical Magazine* 19, 2, 73-103.

Mooney, J. 1995. *Myths of the Cherokee.* New York: Dover Publications.

Myers, R. and P.A. Peroni. 1983. Commentary: Approaches to determining Aboriginal fire use and its impact on vegetation. *Bulletin of the Ecological Society of America* 64, 217-218.

Myers, R.L. and D.L. White. 1987. Landscape history and changes in sandhill vegetation in north-central and south-central Florida. *Bulletin of the Torrey Botanical Club* 114, 1, 21-32.

Otto, J.S. 1983. The decline of forest farming in Southern Appalachia. *Journal of Forest History* 27, 1, 18-27.

Outcalt, K.W. 1996. The impact of lightning on longleaf pine systems at Savannah River Site. *Bulletin Supplement 81st Annual Ecological Society America Meeting* 77, 3, 337. Abstract.

Pyne, S.J. 2000a. *The Mystery of the Missing Fires. Book Review: Indians, Fire and the Land in the Pacific Northwest*.

Pyne, S.J. 2000b. Where have all the fires gone? *Fire Management Today* 60, 3, 4-6.

Russell, E.W.B. 1983. Indian-set fires in the forests of the northeastern United States. *Ecology* 64, 1, 78-88.

Salomon, J.H. 1984. Indians that set the woods on fire. *The Conservationist* 38, 5, 34-39.

Sanders, B., M. Bellamy, and C. Spomick. 1999. *North Carolina. Exploration of Cherokee County, 1775-85*, http://www.bartramtrail.org/pages/Bartram_Trail/nc.html.

Sheppard, D.E. 2004. *Native American conquest.* Tampa, FL: The Native American Conquest Corp., http://www.floridahistory.com/inset44.html.

Sheppard, D.E. 2001. *Native American Conquest: The Southeast*. The Native American Conquest Corp. http://floridahistory.com/southeastern-conquest-trails.pdf.

Smith, J. 1625. The description of Virginia. 1691-1704. In S. Purchs, *Purchas and his Pilgrimes*. London: Wm. Strachey.

Smith, J. 1624. The general historie of Virginia, New England, and the Summer Isles. Book II, part I. In J. Lankford (ed.), *Captain John Smith's America*, 3-34. New York: Harper and Row.

Stanturf, J.A., D.D. Wade, T.A. Waldrop, D.K. Kennard, and G.L. Achtemeier. 2002. Background paper: Fire in southern forest landscapes. In D.N. Wear and J.G. Greis (eds.), *Southern Forest Resource Assessment*, 607-622. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station.

Stoddard, H. 1931. The use and abuse of fire on southern quail preserves. In H.L. Stoddard, Sr. (ed.), *The Bobwhite Quail: Its Habits, Preservation, and Increase*, 401-414. New York: Charles Scribner's Sons.

Stoddard, H. 1935. Use of controlled fire in southeastern upland game management. *Journal of Forestry* 33, 3, 336-351.

Stoddard, H. 1936. Relation of burning to timber and wildlife. *Proceedings of the North American Wildlife Conference* 1, 399-403.

Strachey, W. 1998 (1612). The history of travel into Virginia Britannia. In E.W. Haile (ed.), *Jamestown Narratives* 381-443. Champlain, VA: RoundHouse.

USDA. 2004. *Smokey Bear and Fire Prevention*. http://www.fs.fed.us/r9/wayne/facts/smokey_bear.html.

Van der Donck, A. 1656. A description of the New Netherlands. New York. *Historical Society Collection Series* 2, 1 (1841), 125-242.

Van Lear, D.H. and T.A. Waldrop. 1989. *History, Uses, and Effects of Fire in the Appalachians*. General Technical Report SE-54. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station.

Vayda, A.P. 2005. *Both Ends of the Fire Stick: Interdisciplinary Research on Forest Fires*. Unpublished abstract.

Vose, J.M., W.T. Swank, B.D. Clinton, R.L. Hendrick, and A.E. Major. 1997. Using fire to restore pine/hardwood ecosystems in the Southern Appalachians of North Carolina. In J.M. Greenlee (ed.), *Proceedings: First Conference on Fire Effects on rare and endangered species and habitats*, 149-154. Fairfield, WA: International Association of Wildland Fire.

Waldrop, T.A.and P.H. Brose. 1999. A comparison of fire intensity levels for stand replacement of Table Mountain Pine (*Pinus pungens* Lamb.). *Forest Ecology and Management* 113, 155-166.

White, J. 1600. The fifth voyage of John White, 1590. Cited in E.W.B. Russell 1983. Indian-set fires in the forests of the northeastern United States. *Ecology* 64, 1, 78-88.

Williams, C.E. 1998. History and status of Table Mountain pine-pitch pine forests of the southern Appalachian Mountains (USA). *Natural Areas Journal* 18, 1, 81-90.

Williams, G.W. 2002. *Aboriginal Use of Fire: Are There any "Natural" Communities?* Washington, DC: U.S. Department of Agriculture, Forest Service, Washington Office.

Williams, R. 1643. *A Key into the Language of America*. Providence: RI: Tercentenary Committee.

Wood, W. 1634. *New England's Prospect*. Boston: Prince Society of Education Boston.