Fire on the Edge: Prehistoric Fire Along the Escarpment Zone of the Cumberland Plateau

Cecil R. Ison[1]

Abstract

Unlike many areas of the United States, anthropogenic fires are the prime agent for affecting changes in plant and animal species composition in the southern Appalachian Highlands. Although the extensive use of fire by the American Indians has been recognized from the earliest European observers, it is somewhat difficult to determine the impact prehistoric fires had on forest structure. By examining the fossil and charcoal record from Cliff Palace Pond with the archaeological record recovered from nearby prehistoric sites, a 9,500-year record of the vegetational development can be established for the escarpment zone of Eastern Kentucky. This record indicates that anthropogenic fires played a central role in shaping the forest structure, especially after the transition from a hunting and gathering economy to one based on swidden agricultural practices.

Introduction

Most federal land managing agencies are now committed to using ecosystem-based approaches in their land management objectives. Unfortunately, until recently, these approaches were primarily concerned with the physical and the biological components of the ecosystem and usually lacked a comprehensive understanding of the human dimension within the environment. Yet the management of federal lands is not set by nature, but by people (Williams 1993). Just as people shape the management direction of ecosystems today so has it been since the first Paleoindians set foot on the New World. Here in the eastern woodlands, people have been a part of ecosystems since the end of the Pleistocene and have been shaped by, and in turn shaped ecosystems in a number of ways.

On the threshold of the 21st century we are striving as never before to bring a historical context into natural resource management. At long last both land managers and the public are beginning to accept that there is a historical relationship between people and nature, that all human history has a natural context and that we shape the land just as much as the land shapes us (MacCleery 1998). Wildland fires (both natural and those created by people) have long been considered to be an integral part of ecosystems across North America and that the recurring fire disturbances are essential to the functioning of these systems (Mutch 1995). While fire certainly played a role in shaping the forests of the southern Appalachians, the extent that anthropogenic fires played has been poorly understood.

Cumberland Plateau Escarpment Zone

In Kentucky, conglomeratic sandstones outcrop in a belt ranging from 8 to 40 km wide along the western edge of the Cumberland Plateau. Geologically, this area is referred to as the Pottsville Escarpment. Erosion within this belt has created deep narrow stream valleys flanked by steep-sided to precipitous valley walls. Little level land is available along the stream margins but the ridges, ringed by high sandstone cliffs are fairly wide and flat. Nearly 5000 kilometers of cliffline snake through the Daniel Boone National Forest, and often stretch for miles without a break. These natural features led Miller, in his Geology of Kentucky (1919) to refer to the escarpment zone as a “Chinese Wall” that greatly inhibited economic development of the area.

According to a tree census of eight “old forest” stands in the Lower Big Sandy River drainage, the dominant trees of Eastern Kentucky were several oak species (especially the white oak), beech, hickories, pines, maple and poplar (Shaler and Crandall 1876:12-13). Along the narrow stream valleys cane thickets was the dominant understory. Nuttall (1821:29) noted that the northern limit of cane was the southern bank of the Ohio River. It is from the archaeological sites and the natural ponds within this narrow escarpment zone that an understanding of prehistoric fire and its affects on forest structure are beginning to emerge.

Fire History

Wildland fire in the southern Appalachians results from two forces. One is natural, those caused by lightening and the other cultural, those which result from people. Martin (1990:56) reports that along the Cumberland Escarpment, lightening-caused fires account for only two percent of the total fires documented within a 50-year period. Here, the annual lightning fire occurrence is less than five fires per one million acres and usually occur after the month of May when the sap is up in woody plants. Consequentially, these fires usually lack the intensity necessary to affect plant species composition.

Since the natural fire regime was not sufficient to account for the fire-adapted ecosystems noted by early observers it was the anthropogenic use of fire that shaped the ecosystems of the eastern woodlands more so than any other force. Fire ecology has been practiced to various degrees for the last hundred years within the pine forests of the southeast. However, resource management agencies have been reluctant to use anthropogenic fires (prescribed fire) as a tool for managing the central hardwood forests. It has only been within the last decade that prescribed fire in hardwood forests has become accepted and this acceptance is far from universal.

[1]Forest Archaeologist, USDA Forest Service, Daniel Boone National Forest, 1700 Bypass Road, Winchester, KY 40391

A baseline in the fire history of the Cumberland Plateau must begin with the historical literature. Although the pervasiveness of anthropogenic fire makes it a near-universal instrument for analyzing the interaction of people with their environments (Pyne 1994) without the written record as a guide, many of the material conditions observed in the archaeological record may not become apparent. Therefore we must rely on the observations of early writers to provide the foundation of aboriginal fire practices. Wherever early explorers journeyed they remarked on the Indians use fire. These ranged from burning the woods to clear land for cultivation to providing herbage and browse for the white-tailed deer. The deer were considered the cows of the eastern woodland Indians and the burnt woods their pastures (Whitney1994: 109). It has been estimated that this species alone supplied up to 90 percent of the animal protein consumed by the prehistoric inhabitants of eastern Kentucky (Wyss and Wyss 1977:24).

Merely 36 years had lapsed from Columbus' first sighting of the New World until Cabeza de Vaca recorded the first description of the Indian methods of burning the woods (Favata and Fernandez 1993:72). From de Vaca's first written account onward through the 19th century, the historic literature is full of descriptions of Indians burning the woods. Travelers repeatedly remarked on the wildfires they witnessed during the initial settlement of the Ohio Valley in the mid 1700's to early 1800's. In "Images of the Ohio Valley" historian John Jakle (1977) relates how early travelers marveled at the openness of the forest floor and its almost park-like appearance within the oak, hickory and chestnut communities. Fires according to Jakle, "provided the most spectacular forest scenes. Fires burned out of control each fall charring hundreds of thousands of square miles...over a distance of fifty miles the flames reflected on the clouds of smoke (1977:54)."

The earliest historical accounts of wildfire along the escarpment of the Cumberland Plateau were those of Dr. Thomas Walker, an explorer for the Loyal Land Company of Virginia. In 1750, Walker set out from Charlottesville, Virginia to inspect the western country to select the location of the company's 800,000 acre land grant. The first reference to forest fires by Walker was on May 17, 1750 in the vicinity of the divide between the waters of the Rockcastle and South Fork of the Kentucky River in what is now Jackson County, Kentucky. On May 17th he penned in his journal "The woods have been burnt some years past and are now very thick, the timber being almost kill'd" (Johnston 1898). Ironically, this is in the same vicinity of Cliff Palace Pond. The only other reference to wildfire that Walker made during his journey was again along the escarpment. On May 30th while traveling along the headwaters of the north Fork of the Red River Walker notes "The woods are burnt fresh about here and are the only fresh burnt woods we have seen these six weeks" (Johnston 1898).

Sometimes the clues of wildfires come from the most tragic accounts of the early Kentucky pioneers. The rescue party searching for the victims of the 1793 Easter Sunday attack on Morgan's Station for example, noted that two of the victims had been forced to march through a recently burned section of the woods. James Wade recounts that on April 2nd "…just above the head of Little Slate we found Mrs. Becraft and her suckling child 'six or eight months old' lying tomahawked. It was a very plain case. They had marched her that far in her shift, as was visible from the scratches and marks on it from a burnt wood they had passed through. And there she had given out" (Hogan 1991:24-25). This location is very near a large rockshelter known as Newt Cash Shelter, which would later provide the first archaeological evidence of prehistoric anthropogenic use of fire.

With the hundreds of accounts penned by early observers we have no problem accepting the purposeful use of fire by American Indians for a multitude of purposes during the historic era. In fact, it is generally agreed that Native Americans had a sophisticated knowledge of the use of fire (Patterson and Sassaman 1988). The problem arises when we try to provide time depth to the use of fire before the written record. After all, time depth is essential in the overall understanding of the role of fire in ecosystems. Despite this documentary evidence many still hold the view of the early pristine forest, one untouched by the hand of man, where native people lived in the forests without changing the ecosystem in any way. Where do we find the proof to counteract this view? It comes from unlikely sources. It comes from fire-scorched ancient trees, it comes from natural ponds whose sediments hold the record of nearby plant life from the first colonizers at the bottom to the current tenants at the top and it even comes from people's bowel movements preserved in the dry environments of caves and rockshelters over the millennia. But above all else, the proof comes from an interdisciplinary approach. It comes from the cooperative efforts of natural and heritage resource studies.

Archaeological Evidence

Archaeological investigations are essential for providing a diachronic context into the anthropogenic role of fire. In Kentucky, when the field of modern archaeological research was just beginning to become established in the late 1920's (Lewis 1996) early archaeologists realized the importance of the dry rockshelters and caves in recording the story of the human saga. Along the escarpment archaeologists recovered textiles, grass beds, desiccated human feces and other perishable artifacts from the dry rockshelter deposits. These materials provided a wealth of detail to our understanding of the lives of Kentucky's early inhabitants and their effect on landscape ecology. The following brief descriptions of the investigations at four of these rockshelters (figure 1) provide a tantalizing glimpse into anthropogenic fire behavior. The recent analysis of the Cliff Palace Pond sediments has provided a further dimension on fire history studies within the central hardwood region.

Newt Kash Shelter

The earliest clues for the prehistoric use of anthropogenic wildland fire in Kentucky began in the 1930's when Volney Jones, an ethno-botanist at the University of Michigan examined a small sample of vegetal remains recovered the

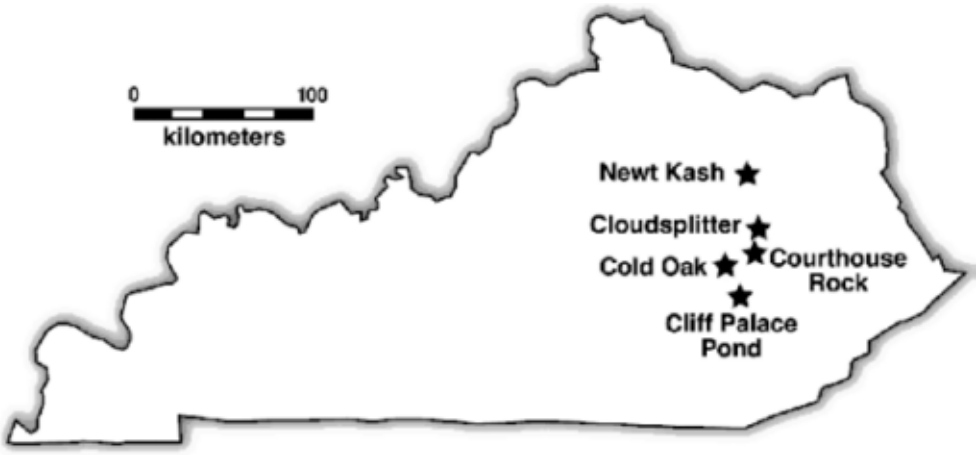

Figure 1.—Escarpment Zone sites discussed in the text.

Newt Kash rockshelter site in Menifee County. Most of the remains analyzed by Jones were from the sleeping beds of the aboriginal inhabitants. These beds were made of a mat-like fabric covering lain over a bed of grass, leaves and straw (Webb and Funkhouser 1939). The bedding also contained all sorts of miscellaneous paraphernalia, which had been accidentally incorporated into the grass mat. Among these were well-preserved seeds, nuts, textile refuse, wood, charcoal and fecal material.

Jones' analysis indicated that the grass, which made up the bulk of the bedding was big bluestem (*Andropogon furcatus*), a robust grass commonly associated with prairie or open woodland environments. Of the identified woods, hickory was the most common followed by chestnut and oak, again species that are uniquely fire adapted. Other trees and shrubs included ash, box elder, sumac and poplar (Jones 1936:160). What intrigued Jones the most about this sample was the preponderance of cultigen seeds including goosefoot (*Chenopodium* sp.), sunflower (*Helianthus annus*), squash (*Cucurbita pepo* var. *melopepo*), marsh elder (*Iva* sp.) and canary grass (*Phalaris caroliniania*).

The paleofecal samples analyzed by Jones also were also quite intriguing. All the cultigens identified within the general contexts of the site with the exception of squash, were represented with the fecal matter. Sunflower for example, while found sparingly elsewhere in the materials examined, comprised a high percentage of the fecal bulk. When combined with the goosefoot, marsh elder and canary grass seeds, plants which were foods grown by simple agricultural methods, comprised the majority of the bulk of the fecal matter.

The study of the ethno-botanical materials from the Newt Kash Hollow rockshelter led Jones to speculate the occupation of the shelter was during a period of transition of the flora from prairie to forest or reverse (ibid p.165). Although archaeologists in the 1930's had no way of absolutely dating the cultural deposits, Jones felt tempted to place the occupation of the site around 4000 years ago. With the advent of radiocarbon dating in the 1950's the intensive occupation of Newt Kash shelter has been determined to be circa 3,000 years ago (Smith and Cowan 1987, Gremillion 1997). Never the less, Jones' work was a keystone for the use of botanical remains from archaeological sites in examining floristic changes upon the landscape.

Cloudsplitter Shelter

It would be over forty years before the well-preserved materials beneath the secluded cliffs of eastern Kentucky once again gained prominence. Although the information gleaned by the early excavations of the 1920s and 1930s had been used to formulate hypotheses concerning the development of horticulture in eastern North America, the precision of the early excavations made it difficult to address synchronic research topics (Cowan and others 1981:60). This changed in 1978 when the National Science Foundation funded excavations at the Cloudsplitter Rockshelter. One of the specific goals of the excavations was to address how human cultural disturbance, especially early horticultural practices affected or altered the local environment. This protected overhang, perched 250 meters above the deeply entrenched Red River floodplain in Menifee County, Kentucky provided the first well-recognized quantitative data sets on early horticultural transitions within the eastern woodlands

The careful excavation of the complex cultural layers at Cloudsplitter provided a 9000-year record of human habitation and interaction with their local environments. At the time of initial occupation the shelter circa 7,000 B.C. the people were faced with a still-evolving postglacial landscape where a dense stand of hemlock shielded the front of the overhang. Today, the mature hemlock first occurs midway down the slope from the site. However, by 1,000 B.C. the deposits of Cloudsplitter, like Newt Kash began to reveal anthropogenic modifications of the local floristic communities. Non-economic plant remains recovered from the Late Archaic deposits (circa 1,000 B.C.) which are indicative of a fringe environment in an otherwise closed

canopy forest led Cowan (1985:330-343) to speculate that areas within the immediate vicinity of the shelter had been cleared away. The several cultivars recovered from the Late Archaic deposits including squash (*Cucurbita pepo*), gourd (*Lagenaria siceria*), sunflower (*Helianthus annuus*), and goosefoot (*Chenopodium berlandieri*) probably reflects upland garden plots within the clearings (Ison 1991).

Cold Oak Shelter

In 1984, the Forest Service undertook salvage excavations at the severely vandalized Cold Oak Shelter located at the head of a remote hollow in Lee County, Kentucky. While heavily disturbed by looters, the investigations documented two cultural occupation zones containing a suite of cultigens similar to those recovered from Cloudsplitter and Newt Kash. The pattern that began to emerge from Newt Kash and Cloudsplitter was repeated at Cold Oak. Once again, the earliest component containing the cultivars was a Terminal Archaic horizon dated to circa 1,000 B.C. (Ison 1988, O'Steen and others 1991). It was beginning to become apparent that by the first millennium B.C. the forests surrounding these sites were undergoing major changes at the hands of people.

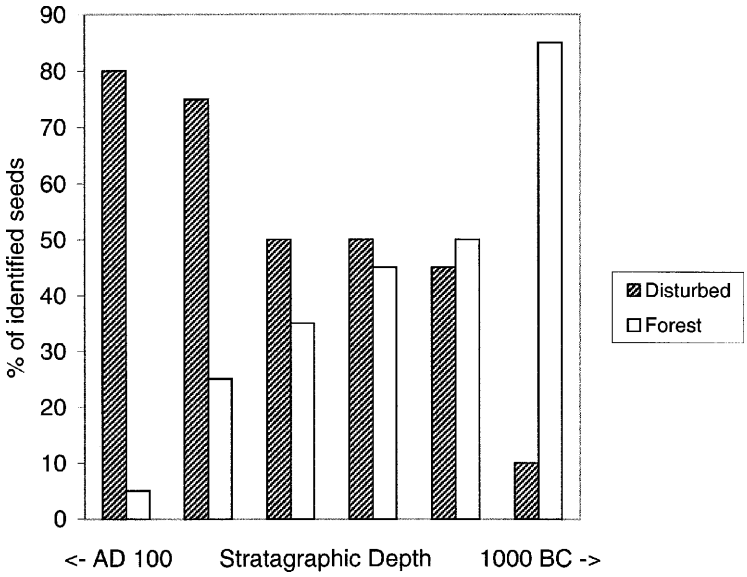

Figure 2.—Forest and disturbed seed taxa from Cold Oak shelter cultural deposits. Adapted from Gremillion 1998.

Ten years later, under the sponsorship of the National Geographic Society, more in-depth excavations were undertaken at Cold Oak (Gremillion 1995, 1998). Building on the earlier investigations, the focus of 1994 data recovery project was to examine the changes in the ecological relationships between people and the plants under their management (Gremillion 1998). The investigations revealed that the quantities of seeds of cultivated plants increased dramatically in the post-1000 B.C. deposits concomitantly with the decrease of seeds represented by taxa of forested habitats (Gremillion 1998). In other word, the analysis of the seed data indicated a general increase in anthropogenic habitats such as gardens and clearings near the habitation sites (figure 2).

Courthouse Rock

The pattern of early plant domestication along the escarpment of the Cumberland Plateau was once again substantiated with the investigations at Courthouse Rock, a sandstone overhang situated approximately 5 kilometers west of Cloudsplitter. The normal suite of seeds representing cultivated plants were recovered from cultural deposits radiocarbon dated between circa 500 and 1000 B.C. While specimens of cultivated plants made up the largest percentage of the identified seeds, the overall assemblage indicated a canopy opening near the site that permitted colonization by sun-loving plants (Gremillion 1999:48). This is most likely the result of preparation of upland garden plots.

Green Sulphur Spring

Even open sites that do not maintain the preservation characteristics of dry rockshelter sites can provide data on anthropogenic forest changes. At the Green Sulphur Spring Site Complex in southern West Virginia differential wood types were noted between the Middle Woodland component (circa A.D. 200 – 400) and the Late Woodland Component (circa A.D. 400 – 800). In sharp contrast to the dominance of hardwood charcoal (99.3 percent) within the Middle Woodland deposits pines represent over 83 percent of the Late Woodland charcoal. This shift in forest composition is thought to have been the result human-induced changes due to land clearing associated with horticulture. As the fields became exhausted or overgrown after several years of cultivation or from periodic abandonment of the site, the fields reverted to forest again with pine being the initial succession species (Rossen 1985, Rossen and Ison 1986).

Hill-side Farming

If these sites are accepted as providing a reasonably accurate indication of prehistoric horticultural endeavors, then the next question is to what extent fire played in the clearing of areas for forest farming. Although there are numerous conditions affecting the decision making process that went into the placement of Kentucky's first garden plots, there are two major underlying cultural mechanisms responsible for their location. These are the "Slug Principal" and "Jones' Law". The Slug Principal dictates that there will be a gravitation toward least effort to produce a food crop (Binford 1983:200-201) while Jones' Law states that "with any given society, the amount of energy obtained in overall subsistence activities must equal or exceed the amount of energy expended in those activities' (Cowan 1988:459). Given these two assumptions, combined with the technology available at the time of early plant domestication, the conditions that most greatly affected development of early horticultural practices along the Cumberland Escarpment were the local topography and the use of fire.

Along the escarpment, little level land is available along the stream margins and where available it is covered by a luxuriant growth of moisture tolerant species. These included the dense stands of cane (*Arundinaria* sp) mentioned by the early explorers of Eastern Kentucky (Filson 1969:318). During the Terminal Archaic Cultural Period (circa 1500 – 500 B.C.) the digging stick was the tool of use, not the hoe. Armed with only this simple implement, it was not practical to create and maintain bottomland fields.

Forest farming depends almost entirely upon the aspect of fire for success unless a sufficient labor bank is available to clear and maintain the plot by other means. Since the direct effect of fire in agricultural endeavors was to clear the surface of refuse and kill most of the plants above the soil, hillside plots were preferred over narrow floodplain plots. The increased fuel moisture along the bottomlands would have greatly reduced the fire's intensity resulting in ineffective burns and therefore more competition with the planted crops. In contrast, the use of fire on hillside plots would have been much more effective for several reasons. Among these are the greatly reduced moisture tolerant understory and a faster curing rate for the one hour and 10 hour fuels. Even with comparable vegetation types within floodplain and hillside plots, the fire will usually be more intense on a slope due to increased heat transfer through convection and radiation to the fuels ahead of the flame front.

Slash and burn agriculture along the Cumberland Escarpment, which had its beginnings over 3000 years ago was a common practice for farming the hill slopes well into the current century (Otto 1983). During the 19th century forest farming was the major cause of wildfires that burned millions of acres of Kentucky's timberlands. In 1880, for example, 10 documented fires burned over 556,000 acres of woodlands in the state. Nearly half of these fires were the result of land clearing exercises (Sargent 1884:491).

It is somewhat paradoxal that while most primitive societies claim a preference for meat, their diet for the most part consisted of plants. As previously noted, Jones' (1936) analysis of the Newt Kash human fecal remains indicated that the inhabitants were chiefly vegetarian. The food supply of these people came primarily from cultivated plants and those gathered from the wild. A similar pattern was reported by Watson (1974) from the fecal data of the Mammoth Cave area where over 50 per cent of the diet were products of horticulture. Thus it seems that by the close of the first millennium B.C. domesticated plants were a very important component of the prehistoric diet. The use of broadcast fire, an essential agent for forest clearing, especially in upland environments of the Cumberland Plateau for agricultural endeavors resulted in a transformation of the forest toward more fire tolerant species.

Palynological Evidence

On of the oldest and still most effective methods used for environmental reconstruction is the retrieval, identification and counting of fossil pollen grains (Butzer 1982:173). By knowing which plants were present and their relative quantities, it is possible to draw conclusions about the climatic and environmental conditions prevailing at the time of deposition (Faegri and Iversen 1989). Quantification of charcoal particles by both size and quantity can be employed as an indicator of past fire histories. For example, charcoal fragments less than 10mm in diameter are considered as indicators of regional fires, whereas those greater than 50mm are assumed to have been generated from forest fires within the immediate vicinity.

Cliff Palace Pond

Cliff Palace Pond is a small woodland pond, perched along the crest of north-south oriented narrow ridge at 424 m elevation in northeastern Jackson County, southeastern Kentucky. This narrow ridge, known locally as Keener Point, is ringed by a high, nearly continuous sandstone cliffline. The sandstone cap is underlain by calcareous shales and limestone that form the lower slopes and stream valleys. Today, the dry ridgetop forest cover is composed by pines (*Pinus rigida*, *P. virginiana* and *P. echinata*) intermixed with scarlet and chestnut oak (*Quercus coccinea* and *Q. prinus* L.). During the historic era chestnut (*Castanea dentata*) occupied the ridgetops on the sandstone derived soils but was absent on calcareous soils (Braun 1950). Mixed mesophytic forests occupied the mesic slopes on calcareous soils below the sandstone cliffs. Since the pond is located within an important center of early-prehistoric plant domestication the deposits offered an opportunity to examine the relationship between prehistoric Native America use of fire and plant production that was retrieved from the surrounding archaeological sites.

The pond was cored in October 1996 resulting in the recovery of a 142-cm sequence of Holocene deposits. The sediment sequence was placed in firm synchronic age classes based on well dated Holocene pollen diagrams elsewhere (Delcourt and Delcourt 1987, 1997, 1998 and Delcourt and others 1998). Charcoal particles, recorded by size class, were also tabulated for each of the distinctive pollen zones. Pollen diagrams were calculated as percentages, representing fire-tolerant trees and shrubs (figure 3) and fire-intolerant trees and shrubs (figure 4) based on the sm totals of pollen grains and spores identified in the sediment core. Figure 5 represents the charcoal diagram in comparison with the major plant taxa represented in the core sample. The following is a brief paleoecological interpretation for each of the distinctive pollen zones.

Interval 9500 to 7300 Years Before Present.

During the early Holocene interval the forests near Cliff Palace Pond were composed of cool-temperate to boreal trees including spruce (probably red spruce, *Picea rebens*), which made up nearly 5 percent of the forest composition. The vegetation was dominated by cedar thought to have been northern white cedar (*Thuga occidentalis*). Cedar pollen, which reaches a maximum of 68 percent within this interval would have been favored by the highly seasonal climate of cold winters and warm summers. Hornbeam (*Ostrya/Carpinus* type) alder (*Alnus rugosa* type) and birch

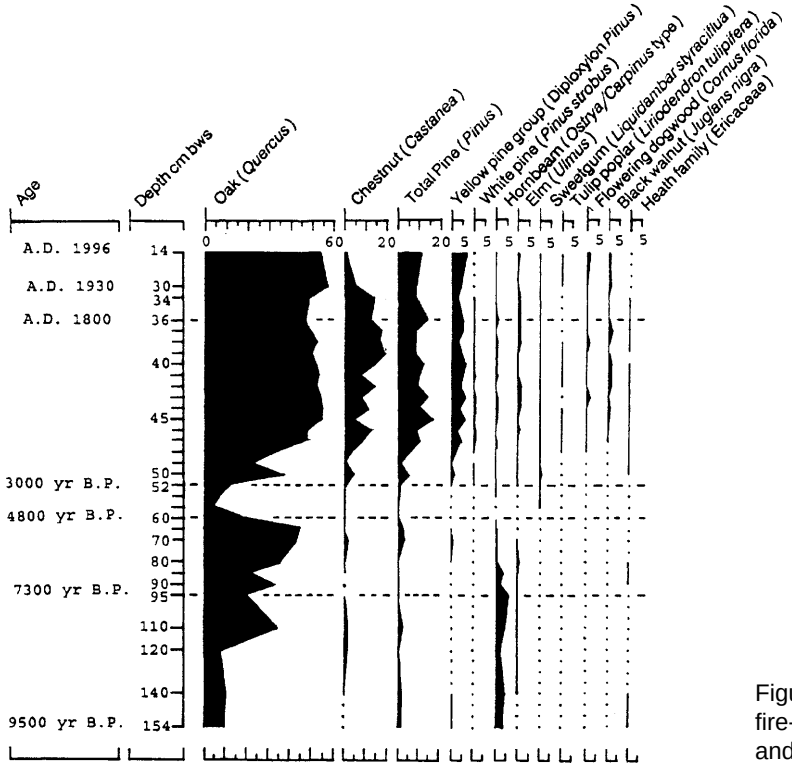

Figure 3.—Cliff Palace Pond pollen diagram, fire-tolerant trees and shrubs. From Delcourt and others 1998.

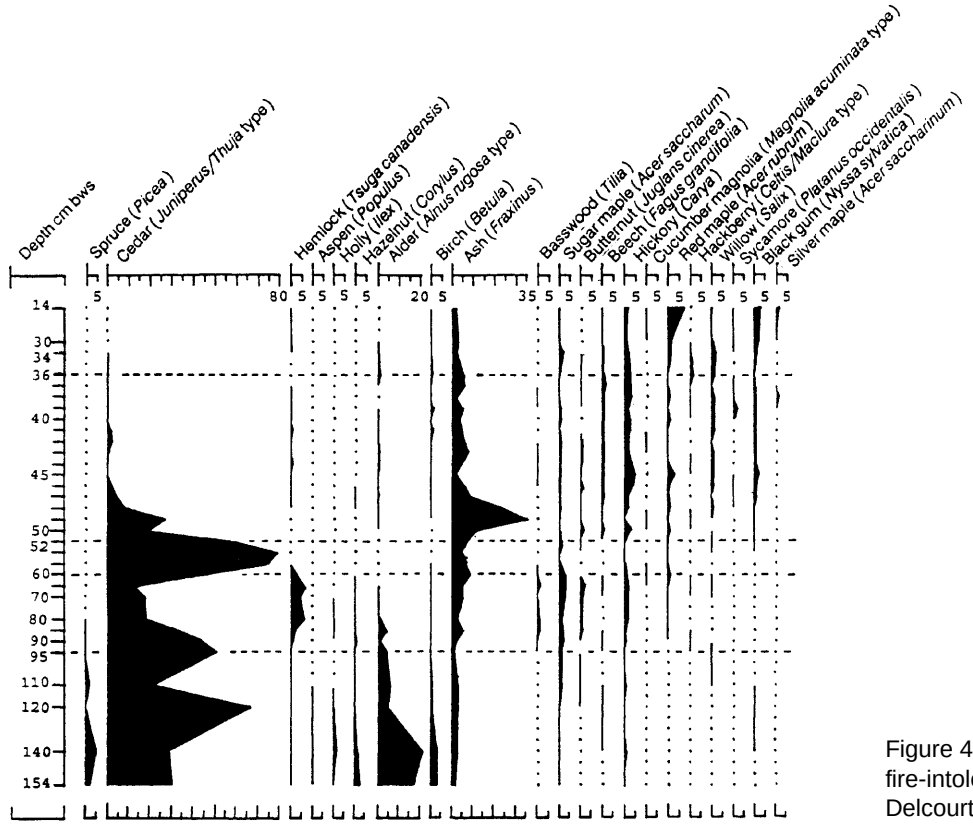

Figure 4.—Cliff Palace Pond pollen diagram, fire-intolerant trees and shrubs. From Delcourt and others 1998.

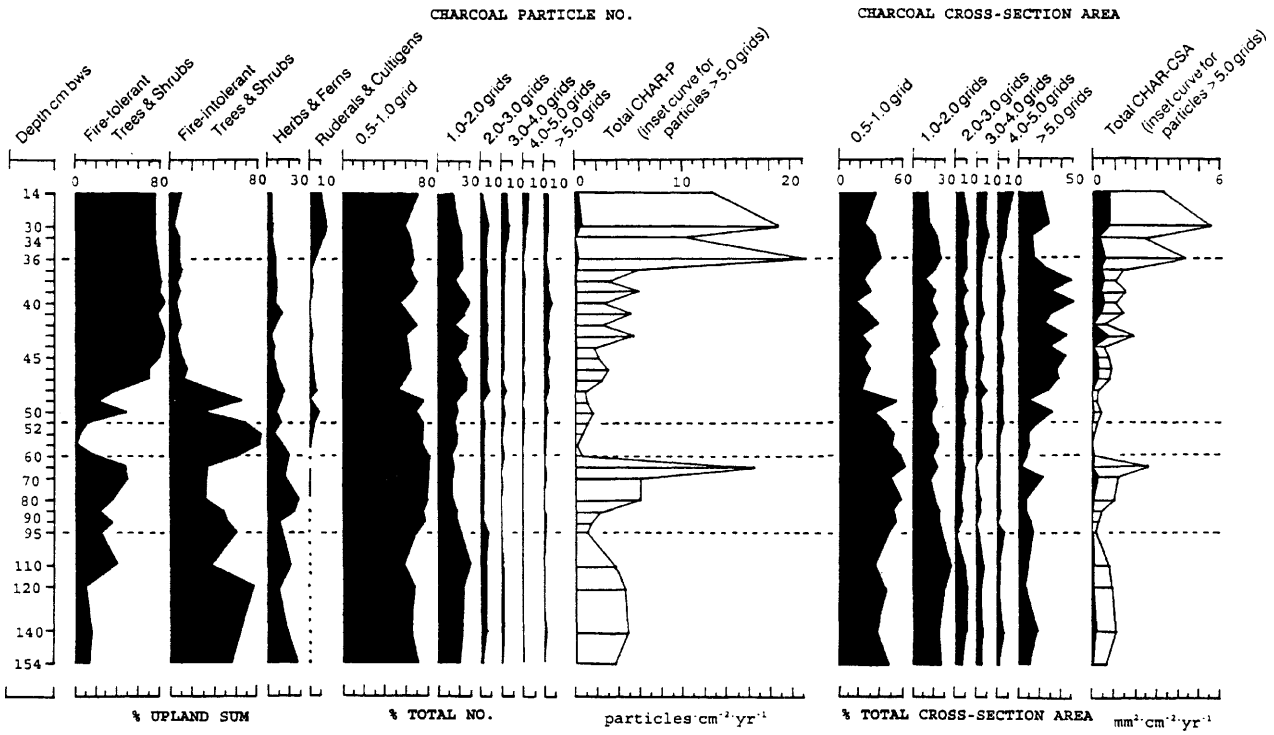

Figure 5.—Cliff Palace Pond charcoal diagram and major plants represented by pollen grains and spores in sediment core. The charcoal particles are tabulated in size classes of cross-sectional area, ranging from 0.5 grid to >5.0 grids (1 square grid = 165.12 μm^2). After Delcourt and others 1998.

(*Betula*) also grew in abundance within the vicinity of Cliff Palace Pond. Pines are represented by up to 2 percent and oaks increase from 10 percent up to 35 percent within this pollen zone. Pollen sums for fire-tolerant trees and shrubs during this interval range from 7 to 20 percent with fire-intolerant species comprising between 19 to 38 percent of the assemblage.

During this period the native people are becoming less nomadic and more territorial. Although they tended to live for longer periods of time in one place, they were still nomadic peoples, never staying in one place longer than a few months. Their camps were placed within areas rich in a variety of natural resources. Anthropogenic fires were used primarily for game drives.

Interval 7300 to 4800 Years Before Present.

The Middle Holocene climate was warm but with lessened extremes in temperature. The shifting storm patterns associated with the “Hypsithermal Interval” resulted in increased precipitation for southeastern Kentucky although it was a time of warmth and drought in the midwestern portions of the U.S. Within the vicinity of Cliff Palace Pond the northern white cedar and spruce became locally extinct and was replaced by the immigration and establishment of temperate trees creating a mixed mesophytic forest community including hemlock (1 to 6 percent), ash (up to 5 percent), basswood (1 percent) sugar maple (up to 4 percent), butternut (1 to 2 percent) and beech (trace amounts). Oaks increase to 45 percent while pines remains at less than 5 percent.

Although this is a time of increased moisture, the total values for fire-tolerant taxa range from 8 to 25 percent. The range of fire-intolerant taxa with a range between 16 to 31 percent shows a slight decrease. These differences are thought to reflect the steady increasing Native American populations’ continued use of fire to promote hunting and foraging.

Interval 4800 to 3000 years Before Present.

This interval begins with a major decline in the hemlock composition of the forest community. Throughout its range in eastern North America a widespread dieback of hemlock has been observed around 4800 years ago. This is thought to have been the result of an infestation of the hemlock looper (Davis 1981). Coincident with the hemlock decline is a large peak in the charcoal accumulation rates at Cliff Palace Pond indicating a major fire event. Following the hemlock decline and the catastrophic fire, extensive stands of eastern red cedar (*Juniperus virginiana*) were established on Keener Point. Cedar pollen dominates the pollen assemblage at 80 percent, with oaks persisting at 3 to 6 percent and ahs at 5 percent. Fire-tolerant trees and shrubs decrease to a minimum of 2 percent, whereas fire-intolerant taxa increase to a maximum of 82 percent.

Interval 3000 to 200 years Before Present.

Cedar declined dramatically in importance falling from 60 percent to trace amounts. Its demise was followed briefly by a succession of ash (increasing from 6 t 36 percent, then dropping to 5 percent). Subsequently, the forests of Keener Point were dominated by oaks, rising from 11 to 55 percent; chestnut, from 1 to 19 percent; and pine from 1 to 17 percent. During this interval pollen grains of both cultigens within the "eastern agricultural complex" and weedy or ruderal species such as ragweed that invade forest openings made by humans activities appear within the record.

Paradoxically, during the Late Holocence time of climatic cooling and increased participation, the forest on and around Keener Point was dominated by fire-adapted taxa. The overall values for fire-tolerant woody plants increase up to 82 percent, while fire-intolerant trees and shrubs diminish to less tan 5 percent. This complete shift in forest composition is considered to have been brought about in large part to Native Americans bringing several plants under domestication. The charcoal record for this interval shows a steady increase in large charcoal particles indicating local fires occurred within the immediate vicinity of Cliff Palace Pond. This is in line with the slash and burn agriculture techniques that would have been employed by the prehistoric framers to clear their upland garden plots.

Interval A.D. 1800 to 1996.

During the last 200 years, a series of changes in forest composition occurred following the total replacement of Native American populations by the EuroAmerican settlement of eastern Kentucky. The chestnut blight of the 1930s results in almost total eradication of this tree. This is offset by an increase for oaks (54 to 58 percent), red maple (7 percent) and black gum (3 percent). Total pine pollen remains at about 10 percent but Virginia pine (*Pinus virginiana*) increases locally. Following deforestation and conversion of large portions of the landscape to agriculture ragweed increases to 12 percent and exotic species introduced from Europe such as plantain, dock and purslane (*Portulaca*) are found within the pollen record for the first time.

For the first 100 years of this period, fire activity increased as forested lands were cleared and burned for new agricultural fields. Slash and burn agriculture, practiced by the American Indians continued only on a larger scale. During the last 100 years fire prevention programs have dramatically reduced large-scale fire occurrences.

Conclusion

As previously noted, the reconstruction of vegetational histories must come from an interdisciplinary approach between natural and cultural resource studies. Historic accounts for example, can offer a multitude of facts about an area with regards to the vegetative cover, fire occurrences, climate, wildlife, land-use practices, etc. but within the New World can only cover the last 500 years. Archaeological sites often contain enormous amounts of ethnobotanical remains that provide insights into the selection and utilization of economically important plants over several millennia. These can range from the selection of firewood and construction materials to the propagation of plant food resources. However, archaeological sites often lack the spatial framework necessary to extract a record of how the human groups affected their environments beyond the immediate vicinity of the site. Pollen and charcoal analysis from geologically deposited sediments on the other hand is a very effective technique for reconstructing the vegetational and fire history of a broader area but in most cases cannot determine the causal factors for the change. Each of these approaches provides a unique dimension to reading the landscape. It is only through a multidisciplinary approach that the tangible effects of fire on the landscape can be viewed within a diachronic perspective.

The interaction of prehistoric human activities and forest dynamics on the landscape took place by the way of the interrelationships among the cultural use of fire, cultivation of plants and forest succession. The changes upon the landscape for the most part, occurred very gradually over hundreds or thousands of years. The transition from on forest type to another was so gradual that for those who didn't keep diaries, logs, or oral traditions, the change was barely noticed. It is through archaeological and palynological investigations that the murky waters of past forest conditions become clear.

Through the combination of archaeological data from sites within the general vicinity with the pollen and charcoal analysis of Cliff Palace Pond, a link between forest composition, fire history and the interaction of people with their environment is beginning to emerge. The strong coincidence of a temporal link between the domestication of native plants, the prehistoric human use of rockshelters and the increase of local fires as evident from the charcoal record of Cliff Palace Pond argues for a cause-and-effect relationship between Native American activities and changes in forest composition. Within the Escarpment Zone of the Cumberland Plateau prehistoric Native Americans began to concentrate their activities in and near rockshelters on the upper slopes and on ridgetops (Cowan 1985a,b; Ison 1988). The use of fire especially in the preparation of the garden plots adjacent to these campsites resulted in a fine-grained patchwork of vegetation that included fire-adapted and fire tolerant species on the upper slopes and ridgetops while still allowing for the persistence of mixed mesophytic forest communities on the lower slopes.

It should be quite clear that environmental reconstructions cannot be accomplished without including people into the equation. That fire undoubtedly shaped the ecosystems of the southern Appalachians is evidenced by numerous examples. The historical, archaeological and palynological evidence from the Cumberland Escarpment has provided us with the data we have for so long desired. It is now up to land managers to put this data to work. Given the documented fire history for the area we must once again allow fire to play its natural role. If we do not, we will be the progenitors of a forest that has never existed on the landscape before.

Literature Cited

Binford, Lewis R. 1983. **In oursuit of the past: decoding the archaeological record.** Thames and Hudson, New York.

Butzer, Karl W. 1982. **Archaeology as human ecology: method and theory for a contextual approach.** Cambridge University Press, New York.

Cowan, C. Wesley 1985a. **From foraging to incipient food production: subsistence change and continuity on the Cumberland Plateau of Eastern Kentucky.** Department of Anthropology, University of Michigan, Ann Arbor. Dissertation

Cowan, C. Wesley 1985b. **Understanding the evolution of plant husbandry in Eastern North America: lessons from botany, ethnography and archaeology.** In: Ford, Richard I., ed. Prehistoric Food Production in North America. Anthropological Papers No. 75. Museum of Anthropology, University of Michigan, Ann Arbor: 205-243.

Cowan, C. Wesley 1988. **Obituary: Volney Hunt Jones, 1903-1982.** American Antiquity. 53(3): 455-456.

Cowan, C. Wesley; Jackson, H. Edwin; Moore, Katherine; Nickelhoff, Andrew; Smart, Tristine L. 1983. **The Cloudsplitter Rockshelter: Menifee County, Kentucky: a preliminary report.** Southeastern Archaeological Conference Bulletin. 24: 60-75.

Davis, M.B. 1981. **Outbreaks of forest pathogens in quaternary history.** Proceedings of the IV International Palynological Conference, Lucknow (1976-1977). 3: 216-227.

Delcourt, Paul A.; Delcourt, Hazel R. 1987. **Long-term forest dynamics of the temperate zone.** Ecological Studies 63, Springer-Verlag, New York.

Delcourt, Paul A.; Delcourt, Hazel R. 1997. **Report of paleoecological investigations, Cliff Palace Pond, Jackson County, Kentucky, in the Daniel Boone National Forest.** Report to USDA Forest Service, Daniel Boone National Forest, Winchester, Kentucky.

Delcourt, Paul A.; Delcourt, Hazel R. 1998. I**nfluence of Prehistoric Human-set Fires on Oak-Chestnut Forests in the Southern Appalachians.** Castanea. 63(3): 337-345.

Delcourt, Paul A.; Delcourt, Hazel R.; Ison, Cecil R.; Sharp, William E.; Gremillion, Kristen J. 1998. **Prehistoric human use of fire, the eastern agricultural complex, and Appalachian oak-chestnut forests: paleoecology of Cliff Palace Pond, Kentucky.** American Antiquity. 63(2): 263-278.

Faegri, Knut.; Iversen, J. 1989. **Textbook of pollen analysis.** John Wiley and Sons, New York.

Favata, Martin A.; Fernandez, Jose B. (Translators). 1993. **The account: Alvar Nunez cabeza de vaca's relacion.** Arte Publico Press, Houston, Texas.

Filson, John 1969. **The discovery, settlement, and present state of Kentucky.** In: A topographical description of the Western Territory, by Gilbert Imlay. Augstus M. Kelley, New York. Originally published 1784, J. Debrett, London. 307-337.

Gremillion, Kristen J. 1995. **Archaeological and paleoethnobotanical investigations at the Cold Oak Shelter, Kentucky.** Report submitted to National Geographic Society by the Ohio State University. Grant Number 5226-94.

Gremillion, Kristen J. 1997. **New perspectives on the paleoethnobotany of the Newt Kash Shelter.** In: Gremillion, Kristen J., ed. People, plants and landscapes: studies in paleoethnobotany. The University of Alabama Press, Tuscaloosa, Alabama. 23-41.

Gremillion Kristen J. 1998. **Changing roles of wild and cultivated plant Resources Among the Early Farmers of Eastern Kentucky.** Southeastern Archaeology. 17(2): 140-157.

Gremillion, Kristen J. 1999. **National register evaluation of the Courthouse Rock Shelter (15PO322), Powell County, Kentucky.** Report submitted to the USDA Forest Srvice, Daniel Boone Natinal Forest, Winchester, Kentucky.

Hogan, Roaeann R., ed. 1991. **Buffaloes in the corn: James Wade's account of pioneer Kentucky.** The Regiser of the Kentucky Historical Society, Vol. 89(1): 1-31.

Ison, Cecil R. 1988. **The Cold Oak Shelter: providing a better understanding of the termnal archaic.** In: Hockensmith, Charles D.; Pollack, David; Sanders, Thomas N., eds. Paleoindian and Archaic Research in Kentucky. Kentucky Heritage Council, Frankfort: 205-220.

Ison Cecil R. 1991. **Prehistoric upland farming along the Cumberland Plateau.** In: Hockensmith, Carles D., ed. Studies in Kentucky archaeology. Kentucky Heritage Council, Frankfort: 1-10.

Jakle, John A. 1977. **Images of the Ohio Valley.** Oxford University Press.

Johnston, J. Stoddard 1898. **First explorations of Kentucky.** Filson Club Publications No. 13.

Jones, Volney H. 1936. **The vegetal remains of Newt Kash Hollow Shelter.** In: Webb, W.S.; Funkhouser, W.D., eds. Rock Shelters in Menifee County, Kentucky, Reports in Archaeology and Anthropology University of Kentucky, Lexington. 3(4): 147-165.

Lewis, R. Barry, ed. 1996. **Kentucky archaeology.** The University Press of Kentucky, Lexington.

MacCleery, Douglas W. 1998. **When is a landscape natural?** Forest history today. Forest History Society, Durham, N.C. 39-41.

Martin, William H. 1988. **The role and history of fire in the Daniel Boone National Forest.** Report submitted to USDA-Forest Service, Daniel Boone National Forest, Winchester, Kentucky.

Miller, Arthur McQueston 1919. **Geology of Kentucky.** The Kentucky Geological Survey, Series 5, Bulletin No. 2, Frankfort.

Nuttall, Thomas 1821. **A journal of travels into the Arkansa Territory, during the year 1819.** Thomas H. Palmer, Philadelphia.

Osteen, Lisa D.; Gremillion, Kristen J.; Ledbetter, R. Jerald. 1988. **Archaeological testing of five sites in the Big Sinking Creek Oil Field, Lee County, Kentucky.** USDA Forest Service, Daniel Boone National Forest, Stanton, Kentucky.

Otto, John S. 1983. **The decline of forest farming in southern Appalachia.** Journal of Forest History. 27: 18-27.

Patterson, W.A. III; Sassaman, K.E. 1988. **Indian fires in the prehistory of New England.** In: Nichols, G.P., ed. Holocene Human Ecology in Northeastern North America. Plenum Publishing Company: 107-135.

Pyne, Stephen J. 1994. **Maintaining focus: an introduction to anthropogenic fire.** Chemosphere. 29(5): 889-911.

Rossen, Jack. 1985. **Botanical remains.** In: Ison, Cecil R.; Railey, Jimmy A.; Henderson, A. Gwynn; Ison, Betty S.; Rossen, Jack. Archaeological Investigations at the Green Sulphur Springs Site Complex, West Virginia. University of Kentucky, Program for Cultural Resource Assessment, Archaeological Report 108, Lexington.

Rossen, Jack; Ison, Cecil R. 1986. **Environmental degradation during the late woodland period at GreenSulphur Springs.** West Virginia Archaeologist Vol. 38(2): 48-51.

Sargent, Charles R. 1884. **Report on the forests of North America.** U.S. Department of Interior, Washington, D.C.

Shaler, Nathaniel S.; Crandall, A.R. 1876. **Report on the forests of Greenup, Carter, Boyd and Lawrence Counties, in Eastern Kentucky.** Geological Survey of Kentucky, Series 2, Vol. 1. Frankfort.

Smith, Bruce D.; Cowan, C. Wesley. 1987. **Domesticated chenopodium in prehistoric Eastern North America: new accelerator dates form Eastern Kentucky.** American Antiquity. 52(3): 355-57.

Watson Patty Jo, ed. 1974. **Archaeology of the Mammoth Cave Area.** Academic Press, New York.

Webb, W.S.; Funkhouser, W.D. 1936. **Rock shelters in Menifee County, Kentucky.** Reports in Anthropology and Archaeology 3(4). University of Kentucky, Lexington.

Whitney Gordon G. 1993. **From coastal wilderness to fruited plain: a history of environmental change in temperate North America from 1500 to the present.** Cambridge University Press, New York.

Williams, Gerald W. 1993. **Ecosystem Management: Putting the People Back.** In: Paper presented at the Bureau of Land Management's "Arid Land Management: An Ecosystem Approach Workshop" in Hood River, Oregon April 6-9, 1993.

Wyss, James D.; Wyss, Sandra K. 1977. **An archaeological assessment of portions of the Red River Gorge, Daniel Boone National Forest, Kentucky.** Report submitted to the UDSA Forest Service, Daniel Boone National Forest, Winchester, Kentucky by Ohio Valley Archaeological Research Associates, Lexington, Kentucky.