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The Influence of Prehistoric Human-set Fires on Oak-Chestnut Forests in the Southern Appalachians

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ABSTRACT

Fossil pollen and charcoal in peat deposits and pond sediments from three sites in the southern Appalachians yielded evidence for a direct relationship between prehistoric Native American use of fire and increases in the importance of oak-chestnut forest between about 3,000 and 1,000 years ago. At Cliff Palace Pond on the Cumberland Plateau of southeastern Kentucky, Tuskegee Pond, in the Ridge and Valley of East Tennessee, and Horse Cove Bog in the Blue Ridge Mountains of western North Carolina, increases in fire frequency corresponded with the change in Native American activities from hunting and gathering in the Late Archaic cultural period toward more sedentary lifestyles and cultivation of native plants in the Woodland cultural period. Forests of oak and chestnut became dominant on upper slopes, with fire-adapted pines establishing on ridge tops and disturbance-adapted hardwoods invading abandoned Indian old fields. We speculate that prehistoric Native American use of fire would have been an intermediate-scale disturbance regime that would have heightened ecotonal contrast across plant community boundaries and would also have increased biological diversity across the landscape.

INTRODUCTION

Once discounted by ecologists as a factor (Russell 1983), the importance of prehistoric human use of fire in shaping the composition of forests in the southern Appalachian highlands is an issue now reopened because of plant-successional changes following fire suppression in the 20th century (Abrams 1992, Stephenson et al. 1993, SAMAB 1996). In the southern Appalachians, under current climatic conditions the frequency of natural, lightning-set fires is low (Barden and Woods 1974; Martin 1990; Bratton and Meier 1995, 1998; SAMAB 1996). Survival of fire-adapted species prior to EuroAmerican settlement 200 years ago may have been enhanced by Native American-set fires (Martin 1990). Understanding the role of prehistoric Native Americans in influencing forest composition through the use of fire is central to developing guidelines for future management of forest resources that potentially includes selective, prescribed burning to maintain fire-adapted plant communities (SAMAB 1996).

The role of prehistoric Native Americans in influencing the composition of forest communities can be evaluated using paleoecological records in direct comparison with local archaeological records documenting human occupation (McAndrews 1988; Delcourt 1987; Delcourt et al. 1986; Delcourt and Delcourt 1997a, 1997b; Delcourt et al. 1998). Paleoecological methods include documenting forest history through changes in fossil pollen assemblages (Delcourt and Delcourt 1991) and fire history through changes in quantities of charcoal particles (Clark and Royall 1995) preserved in sediments of lakes, ponds, and peat bogs. This record of forest and fire history can be evaluated for correspondence with archaeological records documenting changing utilization of plant resources (Cridlebaugh 1984; Delcourt et al. 1986; Delcourt and Delcourt 1997a, 1997b; Delcourt et al. 1998). In this paper, we review the evidence for prehistoric Native American use of fire in altering the abundances of oaks (*Quercus* spp.) and chestnut

[*Castanea dentata* (Marshall) Borkh.]. In this geographic region, populations of oaks and chestnut were established by 10,000 radiocarbon years ago (the early Holocene) but became dominant constituents of regional forests only after about 6,000 radiocarbon years ago in the middle Holocene (Watts 1979, Delcourt and Delcourt 1987, Johnson and Webb 1989). For the southern Appalachian region, only three locations have thus far been published that have provided fossil pollen data, charcoal data, and archaeological data that in combination can be used to evaluate prehistoric human impacts: (1) the northern Cumberland Plateau of southeastern Kentucky (Cliff Palace Pond, Delcourt et al. 1998), (2) the Little Tennessee River Valley of East Tennessee (Chapman et al. 1982, Delcourt et al. 1986, Chapman 1994), and (3) the southern Blue Ridge Province of western North Carolina (Horse Cove Bog, Delcourt and Delcourt 1997b).

STUDY AREAS

Cliff Palace Pond, Kentucky

Cliff Palace Pond is a small (5 m × 15 m) woodland hollow, with a total catchment area of 0.5 ha (Delcourt and Delcourt 1997a), perched along the crest of a north-south oriented, narrow ridge at 424 m elevation in northeastern Jackson County, southeastern Kentucky (37°31′34″N, 83°55′44″W). The site is situated within the Western Escarpment Section of the northern Cumberland Plateau physiographic province (Smalley 1986), designated the Cliff Section by Braun (1950). The terrain is composed of narrow sandstone ridges, steep cliffs, and lower slopes of stream valleys underlain by calcareous shales and limestone (Smalley 1986). Forests of dry ridge tops are occupied by pines (*Pinus rigida* Miller, *P. virginiana* Miller, and *P. echinata* Miller) intermixed with scarlet oak and chestnut oak (*Quercus coccinea* Muenchh. and *Q. prinus* L.) and with an understory of heaths or grasses (*Andropogon scoparius* Michaux). Chestnut originally occurred primarily on upper slopes on sandstone-derived soils but was absent on calcareous soils (Braun 1950). Mixed mesophytic forests occupy mesic slopes on calcareous soils below the sandstone cliffs (Braun 1950). Lightning-set fires are infrequent in this region of abundant precipitation (115 cm distributed equably throughout the year), with only 10 lightning fires recorded from A. D. 1936 through 1989 within the Berea District of the Daniel Boone National Forest in which Cliff Palace Pond is located (Martin 1990). These fires were located on ridges and southwest- or south-facing upper slopes (Martin 1990).

Cliff Palace Pond is located within an important center for early-prehistoric domestication of native plants, known by archaeologists as the "eastern agricultural complex" (Gremillion 1993). Rockshelter sites located along the Kentucky River and its tributaries contain ethnobotanical records that document the time of most intensive utilization of the shelters from Late Archaic through Woodland cultural periods, from about 3,000 to 1,000 radiocarbon years ago. Cultivated plants included *Cucurbita pepo* L. ssp. *ovifera, Lagenaria siceraria, Chenopodium berlandieri* Moq (*Chenopodium album* L.), *Amaranthus, Polygonum erectum* L., *Phalaris caroliniana* Walter, *Iva annua* L. var. *macrocarpa, Helianthus annuus* L., and *Ambrosia* spp. (Gremillion 1993).

Tuskegee Pond, Tennessee

Tuskegee Pond, 80 m × 40 m in extent, is located at 240 m elevation on a terrace of the Little Tennessee River in Monroe County, Tennessee (35°35′05″N, 84°12′38″W). The terrain consists of stepped river terraces and isolated bedrock knolls carved into limestone bedrock by the Little Tennessee River where it emerges from the Blue Ridge Mountains and enters into the Valley and Ridge physiographic province. Mean annual precipitation is 130 cm (Cridlebaugh 1984). Tuskegee Pond is located in the former oak-chestnut forest region of Braun (1950). More than a dozen species of oak form a complex of hardwood communities on forested ridges within east Tennessee (Ayres and Ashe 1905, Martin 1978, Stephenson et al. 1993).

The extensively documented archaeological record from the lower Little Tennessee River Valley (Chapman 1994, Delcourt et al. 1986) contains evidence for continuous human occupation of lower terraces from 12,000 radiocarbon years ago to historic times. Numerous Late Archaic, Woodland, and Mississippian cultural period sites occur within a 1-km radius of Tuskegee Pond, which is located adjacent the historic Native American village of Tuskegee, birth-

place of Sequoyah, inventor of the written alphabet for the Cherokee. The ethnobotanical record from the Little Tennessee River Valley shows that nut-gathering was largely replaced by cultivation of the eastern agricultural complex after 3,500 radiocarbon years ago. Maize (*Zea mays* L.) was introduced by 1,600 radiocarbon years ago (Chapman 1994).

Horse Cove Bog, North Carolina

Horse Cove Bog is a 12-ha wetland located within a 2 km × 0.7 km valley at 887 m elevation in Macon County, North Carolina (35°02′30″N, 83°09′30″W). Horse Cove is situated in the northern Chattooga River watershed along the southeastern Blue Ridge escarpment, where surrounding hill slopes are steep, with gradients up to 80% and >750 m relief. Annual rainfall is 254 cm at nearby Whiteside Mountain near Highlands (Delcourt and Delcourt 1997b). The site is located in the former oak-chestnut forest region (Ayres and Ashe 1905, Braun 1950, Stephenson et al. 1993), and local vegetation is a complex mosaic that includes open oak forests on exposed mountain summits and cove hardwood forests in protected valleys (Stephenson et al. 1993). In the Highlands Ranger District, lightning-set fires occurred in only 5 years between A. D. 1955 and 1994. These fires were limited in aerial extent and were primarily located on ridge tops and on southwest-facing upper slopes, not spreading into sheltered coves or stream valleys (Bratton and Meier 1995, 1998; Delcourt and Delcourt 1997b). Horse Cove Bog is located in the region of maximum annual precipitation in the eastern United States. As in southeastern Kentucky (Martin 1990), most lightning strikes occur during downpours associated with summer thunderstorms and are ineffective in igniting large tracts of timber (Barden and Woods 1974; Bratton and Meier 1995, 1998).

PALEOECOLOGICAL METHODS

Cliff Palace Pond was cored in October, 1996, with a 142-cm sequence of Holocene silty clay retrieved (Delcourt and Delcourt 1997a). Tuskegee Pond was cored in December, 1979; its 172-cm sediment sequence of clayey silt spanned the past 1,600 radiocarbon years (Delcourt et al. 1986). A 40-cm peat section from Horse Cove Bog was excavated in August, 1995, and was radiocarbon-dated from 3,600 years ago to the present. Chronologies were based on radiocarbon dates for Tuskegee Pond (n = 3) and Horse Cove Bog (n = 4). At Cliff Palace Pond, root contamination by buttonbush (*Cephalanthus occidentalis* L.) resulted in a "modern" date at the base of the sediment sequence; hence, the chronology is based upon comparison of fossil-pollen assemblages with six regional Holocene pollen time-lines (Delcourt and Delcourt 1987, 1997a).

Methods for analyzing fossil pollen and charcoal particles followed standard procedures (Faegri and Iversen 1975, Swain 1978) and were similar for all three sites investigated. Sediment samples, each 1 cm^3, were taken throughout each sequence and chemically treated to concentrate fossil pollen grains, spores, and charcoal particles (Cliff Palace Pond, n = 32 stratigraphic levels; Tuskegee Pond, n = 22 levels; Horse Cove Bog, n = 21 levels tabulated for pollen, of which 9 levels were counted for charcoal). For each sample, a minimum of 500 pollen grains and spores was tallied as the basis for the pollen sum. Charcoal particles were tallied as both total number of particles and total cross-sectional area. Charcoal accumulation rates were calculated using sedimentation rates and the ratio of charcoal particles to known concentration of *Eucalyptus* pollen grains added to each sample. Total charcoal accumulation rates (CHAR) were corrected by multiplying cross-sectional area measurements of charcoal flux by a factor of 0.632 to account for differential orientation of charcoal particles on microscope slides (Clark and Hussey 1996). Throughout the text, scientific nomenclature generally follows Radford et al. (1968).

RESULTS

Detailed descriptions of complete pollen and charcoal diagrams for the three sites are available in the following publications: (1) Cliff Palace Pond, Kentucky (Delcourt and Delcourt 1997a, Delcourt et al. 1998); (2) Tuskegee Pond, Tennessee (Cridlebaugh 1984, Delcourt et al. 1986, Delcourt 1987, Delcourt and Delcourt 1988); (3) Horse Cove Bog, North Carolina (Delcourt and Delcourt 1997b). In the discussion that follows (Figure 1), we emphasize the correspondence

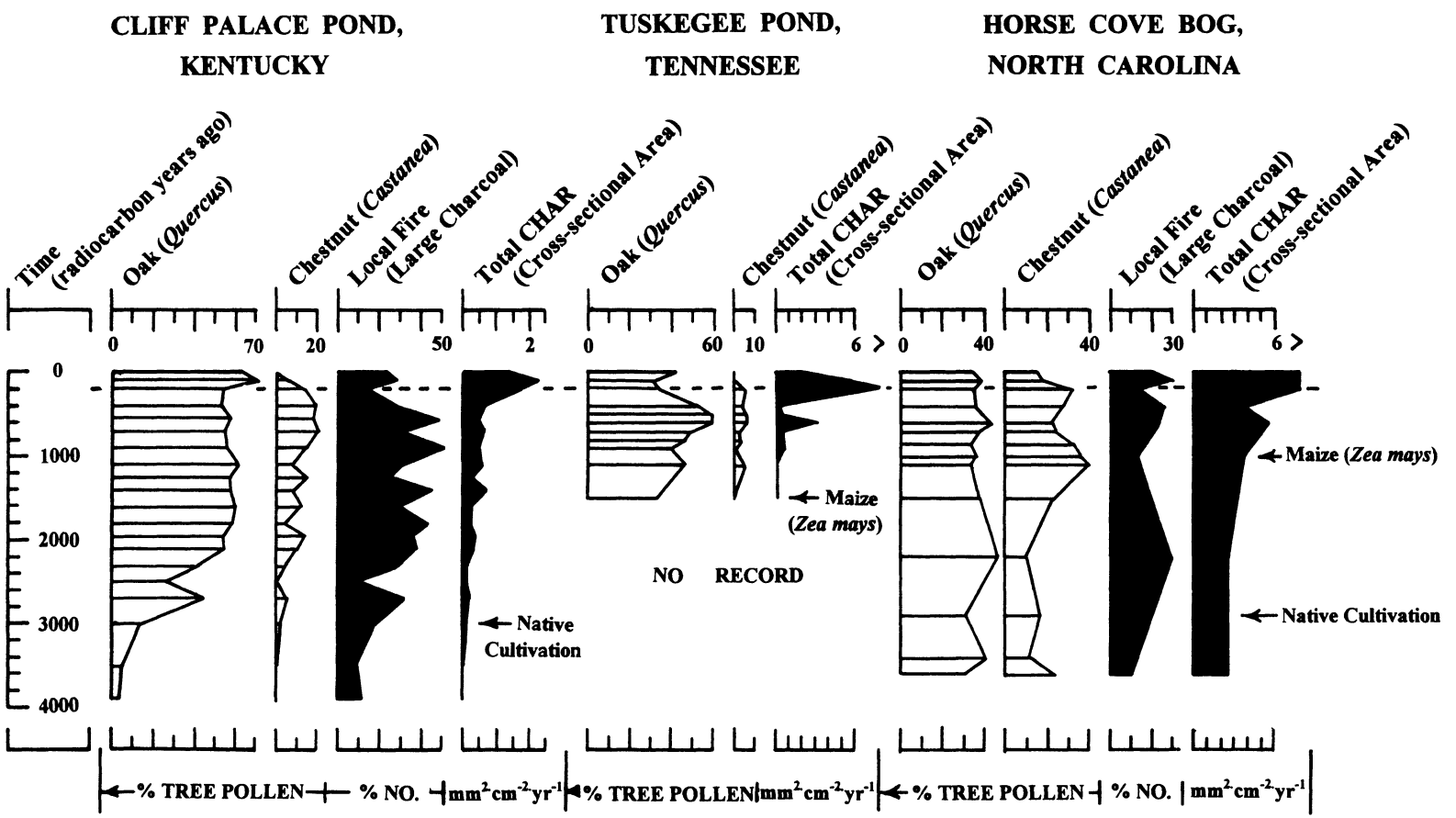

Figure 1. Selected curves for percentages of oak and chestnut pollen and of large charcoal particles (>50 μm in longest dimension), and charcoal accumulation rates (CHAR, expressed as mm^2 of charcoal cross-sectional area per cm^2 of pond surface per year) for three sites in the southern Appalachians dating from the past 4,000 radiocarbon years. The horizontal dashed line at 200 years ago marks the boundary between prehistoric time and the onset of historic forest clearance, slash burning, and settlement by EuroAmerican pioneers.

between changes in the abundances of oak and chestnut pollen, the percentages of large charcoal particles (>50 μm diameter) that indicate local fires, total CHAR representing the cumulative magnitude of local, watershed, and regional fires, and the timing of prehistoric human impact in the form of (a) cultivation of plants in the eastern agricultural complex that were grown in local garden plots near each site and (b) more widespread disturbance indicated by cultivation of maize in cleared fields and increases in populations of ruderal weeds such as ragweed (*Ambrosia* pollen type).

Cliff Palace Pond, Kentucky

At Cliff Palace Pond, the transition from Late Archaic to Woodland cultural periods at about 3,000 radiocarbon years ago is marked by substantial increases in representation of both oaks and chestnut in the pollen record (Figure 1). Prior to 3,000 years ago at this site, upland forests were primarily red cedar (*Juniperus virginiana* L.) and ash (*Fraxinus nigra/quadrangulata* pollen type) (Delcourt and Delcourt 1997a). After about 3,000 radiocarbon years ago, oak and chestnut increased. Between 3,000 and 1,000 radiocarbon years ago, the time of most intensive human occupation of nearby Cliff Palace Rockshelter (situated 60 m west of the pond) was marked by the consistent occurrence of pollen of sunflower (*Helianthus* type), sumpweed (*Iva* type), and chenopods (*Chenopodium* type), representing the eastern agricultural complex. Percentages of large charcoal particles (the proportion of particles greater than 50 μm relative to the total number of charcoal particles) also increased in the Cliff Palace Pond record after 3,000 radiocarbon years ago.

Tuskegee Pond, Tennessee

The pollen record from Tuskegee Pond spans the latter part of the Woodland cultural period (1,500 to 1,000 radiocarbon years ago), the Mississippian cultural period (1,000 to 300 radiocarbon years ago), and the historic Cherokee cultural period (300 years ago to the present). In Woodland times (Figure 1), oak increased from 33 to 46% of the arboreal pollen, and chestnut increased from 1 to 5%, with southern pines representing 30 to 36%. Ragweed (*Ambrosia* type) increased from 19 to 40% of the upland pollen sum and maize (*Zea mays*) was represented continuously (Cridlebaugh 1984, Delcourt et al. 1986). Oak and chestnut continued to increase through the Mississippian cultural period, then declined in the last 300 years. Maize increased to 2% and ragweed increased to over 50% during Mississippian times, then decreased to 0.5% and 12%, respectively, after Indian fields were abandoned in the historic period (Cridlebaugh 1984, Delcourt et al. 1986). Charcoal accumulation rates were about 0.3 $mm^2\ cm^{-2}\ yr^{-1}$ in Woodland times, fluctuated from 1 to 3 $mm^2\ cm^{-2}\ yr^{-1}$ in Mississipan times, peaked at 20 $mm^2\ cm^{-2}\ yr^{-1}$, and then declined to about 2 $mm^2\ cm^{-2}\ yr^{-1}$ in historic times (Figure 1).

Horse Cove Bog, North Carolina

The pollen record from Horse Cove Bog shows 25 to 40% oak through the past 3600 radiocarbon years, with an increases in chestnut from a low of about 10% 2,000 radiocarbon years ago to nearly 40% of the arboreal pollen after 1,600 radiocarbon years ago, corresponding with the interval during which cultivation of native plants and maize is documented at the site (Figure 1). In general, an overall trend toward an increase in charcoal-particle representation corresponds with increases or sustained high levels of oak and chestnut (Figure 1). Both very small charcoal particles that indicate regional fires and large charcoal particles that would have been produced by local fires near the bog are abundantly represented in the charcoal particle record, whereas charcoal particles from intermediate size ranges are infrequent (Delcourt and Delcourt 1997b).

DISCUSSION

Increases in accumulation rates of large charcoal particles at Cliff Palace Pond after 3000 radiocarbon years ago indicates an increase in the use of fire by prehistoric Native Americans. We interpret increases in total CHAR throughout the Woodland cultural period as a consequence of a regional increase in use of fire by human populations dispersed throughout the

Cliff Section of the northern Cumberland Plateau. These increases in charcoal representation corresponded with a shift in forest composition to dominance by oaks and chestnut. Mixed mesophytic forest species, including tulip poplar (*Liriodendron tulipifera* L.), basswood (*Tilia*), sugar maple (*Acer saccharum* Marshall), beech (*Fagus grandifolia* Ehrhart), butternut (*Juglans cinerea* L.), and black gum (*Nyssa sylvatica* Marshall) were also represented in the pollen record as minor constituents of the overall forest composition after 3,000 radiocarbon years ago. As they cleared land for garden plots on mid-slopes near rock shelters, prehistoric Native Americans would have made forest openings similar in size to single-tree and multiple-tree light gaps (Barden 1981, Runkle 1985). Certain mixed mesophytic forest species, such as tulip poplar, may have regenerated in successional stands on such abandoned garden plots.

The pollen record from Tuskegee Pond shows high percentages of ragweed and continuous representation of maize pollen beginning 1,500 radiocarbon years ago, indicating extensive development of agricultural fields within 1 km of the active channel of the Little Tennessee River during Woodland and Mississippian times. Pines probably formed successional stands on abandoned Indian old-fields. Oaks and chestnut would have been dominant on bedrock knolls. The charcoal-particle record from Tuskegee Pond shows that regional fires were important, with large increases in CHAR occurring with each change of cultural period, from Woodland to Mississippian (beginning 1,000 radiocarbon years ago) to historic (300 years ago). We interpret these increases in CHAR as reflecting increasing human use of fire in the valley of the Little Tennessee River (Delcourt and Delcourt 1988).

Archaeological investigations in the southern Blue Ridge Province (Bass 1977, Purrington 1983) have documented three components to prehistoric human settlement beginning in the late Archaic cultural period: (1) primary population centers with plant gathering and fishing within the major river valleys; (2) plant-collecting groups seasonally dispersed to more isolated coves in the upper headwaters; and (3) hunting groups occupying temporary campsites along ridge crests. Archaeological sites dating from the Woodland cultural period indicate continued use of the higher elevations for mining of minerals for trade goods, and of increasing sedentism with plant husbandry that included cultivation of garden plots near campsites (Purrington 1983). Late Archaic peoples probably used Horse Cove as a seasonal hunting and plant-gathering site. Incidence of fire, especially local fires, was relatively low, although the charcoal evidence and high percentages of bracken fern [*Pteridium aquilinum* (L.) Kuhn] and grass (Poaceae) (Delcourt and Delcourt 1997b) indicate that fires probably occurred on at least the upper slopes of the watershed. During the Woodland cultural period, oak increased substantially, a dramatic increase occurred in the relative abundance of chestnut, and percentages of grass and bracken fern declined. Ruderals such as ragweed and brambles increased, and cultigens were represented by native taxa such as sumpweed (Delcourt and Delcourt 1997b). Maize occurred in the pollen record at 1,000 radiocarbon years ago (Figure 1). During the Woodland cultural period, Native Americans developed settlements near Horse Cove Bog and cultivated garden plots including both native and exotic cultigens, and they maintained seasonal hunting and mining camps in the surrounding uplands. Fires set on the watershed of Horse Cove by Woodland people may have promoted increases in the abundance and flowering of chestnut, which probably resprouted vigorously after fires. Oak-chestnut forests may have existed in relatively open, orchard-like groves on the upper slopes of mountains in the Highlands area of the southern Blue Ridge Province (Rostlund 1957).

At both Cliff Palace Pond and Horse Cove Bog, although fire-tolerant trees increased in representation through Woodland times, mesic, fire-intolerant trees did not decrease markedly during this time period. Therefore, from 3,000 to 1,000 radiocarbon years ago, the portions of the landscape most clearly affected by burning would have included exposed ridge tops and upper slopes, as well as local hill slope patches near the cliff overhangs of rock shelters (Cumberland Plateau) and settlements located in alluvial bottoms (Little Tennessee River; Horse Cove). Mesic lower slopes, occupied by mixed mesophytic or cove hardwood communities, may have remained relatively protected from the spread of Indian-set fires during this time interval. Overall, the records from Cliff Palace Pond, Tuskegee Pond, and Horse Cove Bog support the interpretation that, at least prior to the introduction of maize into a particular locality and the

development of extensive agricultural fields, prehistoric Native Americans served as a form of intermediate disturbance that would have increased biological diversity in the southern Appalachians by locally augmenting a fine-grained patchwork of forest canopy gaps through clearance of garden plots. Prehistoric human disturbance would also have enhanced the landscape contrast across vegetational ecotones distributed from hill crests to valley or cove bottoms (Delcourt and Delcourt 1997b). The selective use of fire by prehistoric Native Americans was effective in increasing the abundances of oaks and chestnut on upper slopes. After the cultural introduction of new crops such as maize and more widespread use of fire for forest clearance, a threshold in forest fragmentation was reached (Gardner and O'Neill 1991) and both oaks and chestnut decreased. Finally, after EuroAmerican settlement, widespread deforestation, and introduction of the deadly chestnut blight and fire suppression during the 20th century, the composition of oak-chestnut forests changed to include a number of shade-tolerant, successional tree species such as hickories (*Carya* spp.), red maple (*Acer rubrum* L.) and black gum throughout what is now the Appalachian oak region (McCormick and Platt 1980, Stephenson et al. 1993, SAMAB 1996).

The paleoecological records from Cliff Palace Pond, Kentucky, Tuskegee Pond, Tennessee, and Horse Cove Bog, North Carolina are all consistent with the interpretation that prehistoric Native Americans affected forest composition within portions of the former oak-chestnut forest region of Braun (1950). Further studies combining fossil pollen analysis, charcoal particle analysis, and archaeological data are needed across the central deciduous forest region in order to test the hypothesis that prehistoric humans influenced forest composition over a broad region of eastern North America through the use of fire.

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LITERATURE CITED

ABRAMS, M.D. 1992. Fire and the development of oak forests. Bioscience 42:346–353.

AYRES, H.B. and W.W. ASHE. 1905. The southern Appalachian forests. U.S. Geol. Surv. Prof. Paper No. 37 (Series H, Forestry, 12):1–291.

BARDEN, L.S. 1981. Forest development in canopy gaps of a diverse hardwood forest of the southern Appalachian Mountains. Oikos 37:205–209.

BARDEN, L.S. and F.W. WOODS. 1974. Characteristics of lightning fires in the southern Appalachian forests. Proc. Ann. Tall Timbers Fire Ecol. Conf. 13:345–361.

BASS, Q.R., II. 1977. Prehistoric settlement and subsistence patterns in the Great Smoky Mountains. M.S. thesis. Department of Anthropology, University of Tennessee, Knoxville.

BRAUN, E.L. 1950 (reprinted 1974). Deciduous forests of eastern North America. Hafner, New York.

BRATTON, S.P. and A.J. MEIER. 1995. The natural disturbance history of the Chattooga watershed: written records. Report submitted to the U.S. Forest Service, Chattooga River Demonstration Project, Clemson, South Carolina.

BRATTON, S.P. and A.J. MEIER. 1998. The recent vegetation disturbance history of the Chattooga River Watershed. Castanea 63:372–381.

CHAPMAN, J. 1994. Tellico archaeology: 12,000 years of Native American history, revised edition. Report of Investigations No.43, Department of Anthropology, University of Tennessee, Knoxville.

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 Archaeol. 1:115–121.

CLARK, J.S. and T.C. HUSSEY. 1996. Estimating the mass flux of charcoal from sedimentary records: effects of particle size, morphology, and orientation. The Holocene 6:129–144.

CLARK, J.S. and P.D. ROYALL. 1995. Transformation of a northern hardwood forest by aboriginal (Iroquois) fire: charcoal evidence from Crawford Lake, Ontario, Canada. The Holocene 5:1–9.

CRIDLEBAUGH, P.A. 1984. American Indian and Euro-American impact upon Holocene vegetation in the lower Little Tennessee River Valley, East Tennessee. Ph.D. dissertation. Department of Anthropology, University of Tennessee, Knoxville.

DELCOURT, H.R. 1987. The impact of prehistoric agriculture and land occupation on natural vegetation. Trends Ecol. Evol. 2:39–44.

DELCOURT, H.R. and P.A. DELCOURT. 1988. Quaternary landscape ecology: relevant scales in space and time. Landscape Ecol. 2:23–44.

DELCOURT, H.R. and P.A. DELCOURT. 1991. Quaternary ecology, a paleoecological perspective. Chapman and Hall, New York.

DELCOURT, H.R. and P.A. DELCOURT. 1997b. PreColombian Native American use of fire on southern Appalachian landscapes. Conserv. Biol. 11:1010–1014.

DELCOURT, P.A. and H.R. DELCOURT. 1987. Long-term forest dynamics of the Temperate Zone. Ecological Studies 63, Springer-Verlag, New York.

DELCOURT, P.A. and H.R. DELCOURT. 1997a. 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, P.A., H.R. DELCOURT, C. ISON, K.J. GREMILLION, and W. SHARPE. 1998. In press. Prehistoric human use of fire, the Eastern Agricultural Complex, and Appalachian oak-chestnut forests: paleoecology of Cliff Palace Pond, Kentucky. Amer. Antiquity.

DELCOURT, P.A., H.R. DELCOURT, P.A. CRIDLEBAUGH, and J. CHAPMAN. 1986. Holocene ethnobotanical and paleoecological record of human impact on vegetation in the Little Tennessee River Valley, Tennessee. Quat. Res. 25:330–349.

FAEGRI, K. and J. IVERSEN. 1975. Textbook of pollen analysis, 3rd ed. Hafner, New York.

GARDNER, R.H. and R.V. O'NEILL. 1991. Pattern, process and predictability: the use of neutral models for landscape analysis. p. 289–307. *In*: Turner, M.G. and R.H. Gardner (eds.). Quantitative methods in landscape ecology. Springer-Verlag, New York.

GREMILLION, K.J. 1993. Plant husbandry at the Archaic/Woodland transition: evidence from Cold Oak Shelter, Kentucky. Midcont. J. Archaeol. 18:162–189.

JOHNSON, W.C. and T. WEBB, III. 1989. The role of blue jays (*Cyanocitta cristata* L.) in the postglacial dispersal of fagaceous trees in eastern North America. J. Biogeogr. 16:561–571.

MARTIN, W.H. 1978. White oak communities in the Great Valley of Tennessee—a vegetation complex. p. 39–61. *In*: Pope, P.E. (ed.). Central Hardwood Conference Proceedings II. Purdue University, Lafayette, Indiana.

MARTIN, W.H. 1990. The role and history of fire in the Daniel Boone National Forest. Report to USDA Forest Service, Daniel Boone National Forest, Winchester, Kentucky.

MCANDREWS, J.H. 1988. Human disturbance of North American forests and grasslands, the fossil pollen record. p. 673–697. *In*: Huntley, B. and T. Webb III (eds.). Vegetation history. Kluwer Academic, Dordrecht.

MCCORMICK, J.F. and R.B. PLATT. 1980. Recovery of an Appalachian forest following the chestnut blight or Catherine Keever—you were right! Amer. Midl. Naturalist 104:264–273.

PURRINGTON, B.L. 1983. Ancient mountaineers: an overview of prehistoric Archaeology of North Carolina's western mountain region. p. 83–194. *In*: Mathis, M. A. and J. J. Crow (eds.). The prehistory of North Carolina. North Carolina Division of Archives and History, Department of Cultural Resources, Raleigh.

RADFORD, A.E., H.E. AHLES, and C.R. BELL. 1968. Manual of the vascular flora of the Carolinas. University of North Carolina Press, Chapel Hill.

ROSTLUND, E. 1957. The myth of a natural prairie belt in Alabama: an interpretation of historical records. Ann. Assoc. Amer. Geogr. 47:392–411.

RUNKLE, J.R. 1985. Disturbance regimes in temperate forests. p. 17–33. *In*: Pickett, S.T.A. and P.S. White, (eds.). The ecology of natural disturbance and patch dynamics. Academic Press, Orlando, Florida.

RUSSELL, E.W.B. 1983. Indian-set fires in the forests of northeastern United States. Ecology 64:78–88.

SAMAB (SOUTHERN APPALACHIAN MAN AND THE BIOSPHERE). 1996. The Southern Appalachian Assessment Terrestrial Technical Report. USDA Forest Service Southern Region, Atlanta, Georgia.

SMALLEY, G.W. 1986. Classification and evaluation of forest sites on the northern Cumberland Plateau. USDA Forest Service General Technical Report SO-60, Southern Forest Experiment Station, New Orleans, Louisiana.

STEPHENSON, S.L., A.N. ASH, and D.F. STAUFFER. 1993. Appalachian Oak Forests. p. 255–303. *In*: Martin, W.H., S.G. Boyce, and A.C. Echternacht (eds.). Biodiversity of the southeastern United States: upland terrestrial communities. John Wiley and Sons, New York.

SWAIN, A.M. 1978. Environmental changes during the past 2,000 years in north-central Wisconsin: analysis of pollen, charcoal, and seeds from varved lake sediments. Quat. Res. 10:55–68.
WATTS, W.A. 1979. Late Quaternary vegetation of central Appalachia and the New Jersey coastal plain. Ecol. Monogr. 49:427–469.