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American Indian and Euro-American Impact upon Holocene Vegetation in the Lower Little Tennessee River Valley, East Tennessee

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To the Graduate Council:

I am submitting herewith a dissertation written by Patricia A. Cridlebaugh entitled "American Indian and Euro-American Impact upon Holocene Vegetation in the Lower Little Tennessee River Valley, East Tennessee." I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Anthropology.

Charles H. Faulkner, Major Professor

We have read this dissertation and recommend its acceptance:

Gerald F. Schroedl, Jefferson Chapman, Walter E. Klippel, Paul A. Delcourt, Hazel R. Delcourt

Accepted for the Council:

Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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AMERICAN INDIAN AND EURO-AMERICAN IMPACT UPON HOLOCENE VEGETATION IN THE LOWER LITTLE TENNESSEE RIVER VALLEY, EAST TENNESSEE

A Dissertation

Presented for the

Doctor of Philosophy

Degree

The University of Tennessee, Knoxville

Charlie,
My deepest appreciation
to my academic mento
Pat

Patricia A. Cridlebaugh

March 1984

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ABSTRACT

Paleoethnobotanical remains recovered from Early Archaic through Historic Overhill Cherokee period archaeological sites in the lower Little Tennessee River Valley in Tennessee document prehistoric people's plant-exploitation patterns. This material provides the basis for establishing a model of prehistoric landscape change. Plant species represented by wood charcoal were assigned to bottomland, upland, and disturbed-upland habitats. Indian exploitation of upland favored species remained consistent through time. A progressively deforested landscape is indicated by diminished exploitation of bottomland-favored plant species in contrast to simultaneous increases in Indian utilization of disturbance-favored early successional taxa such as pine (*Pinus* spp.), cedar (*Juniperus virginiana*), and cane (*Arundinaria*).

Pollen and charcoal particle analyses of sediment cores from Black Pond and Tuskegee Pond, located within 3 km of the lower Little Tennessee River Valley archaeological sites, are the basis for reconstruction of the late-Holocene (3,000 B.P. to present) local vegetation. These palynological data provide an independent test of the paleoethnobotanical model of landscape change. These pollen spectra establish evidence of increased percentages of pollen of

disturbance-favored arboreal and herbaceous taxa, especially pine and ragweed (*Ambrosia* type). Four major *Ambrosia* rises mark progressive, intensive land clearance during the Woodland, Mississippian, Historic Overhill Cherokee, and Historic Euro-American periods of occupation. The common precept of a single late-Holocene *Ambrosia* rise occurring solely in conjunction with Euro-American settlement in North America is negated. Moreover, the diversity of human impact on the local vegetation is illustrated by differences in fossil pollen assemblages at Black and Tuskegee ponds. At Tuskegee Pond, 1% to 2% maize (*Zea mays*) pollen is consistently represented from the Middle Woodland through Historic Overhill Cherokee periods. The evidence for maize agriculture on higher terraces as early as the Middle Woodland period is the first documentation that prehistoric maize cultivation was not confined to bottomland habitats.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Background

Current anthropological theory defines culture as a human system that interacts with the environment. Assessment of the relative influences of natural and anthropogenic forcing functions in the natural environment is important to determine cause and effect in cultural process (cf. Ford 1979; McMillan and Klippel 1981; Yarnell 1982). Paleoenvironmental reconstructions are, therefore, necessary in order to assess specific factors which influenced prehistoric peoples' adjustment to the environment.

Reconstruction of the Quaternary environment and interpretations of human responses to and impact upon that environment are primary archaeological concerns. Archaeological palynology represents one reliable method for obtaining relevant data. Archaeological palynology has been conducted most extensively in the southwestern and midwestern United States (Schoenwetter 1962, 1970; Helvy 1964; Martin and Sharrock 1964; Martin and Byers 1965; Bryant 1966, 1978; King and Allen 1977; Baker and Van Zant 1980; Bryant and Holloway 1983). Such research conducted in the southeastern United States has been directed at the resolution of isolated, time-specific environmental and dietary

problems (Schoenwetter 1974; Sears and Sears 1976; Hogan 1978; Sears 1982). No continuous, long-term paleovegetational reconstructions have been established for the fine-scale resolution of archaeological problems. Several limiting factors have restricted research directions for this palynological research. These include the nature of archaeological site deposition, pollen preservation and collection techniques from an archaeological context, a paucity of pollen-bearing sediments collected from non-archaeological sources near archaeological sites, and incomplete analyses of sediments (King et al. 1975; Muto and Gunn 1980; Cowan et al. 1981).

Archaeologists may use the regional framework of late-Pleistocene and Holocene vegetational and climatic patterns established for the southeastern United States as environmental analogues (Watts 1980; Delcourt and Delcourt 1981; Whitehead 1981; Wright 1981). However, these regional reconstructions represent broad temporal and spatial intervals. Local paleoenvironmental reconstructions providing fine-scale records of paleoecologic events are more desirable for local anthropological investigations of human impact. Palynological research can document the varying nature of vegetational records within close geographical proximity to archaeological sites (Davis 1973). Each pollen diagram represents a unique vegetation record reflecting the dynamics of plant communities (Tauber 1965, 1967; Davis

1973; Raynor et al. 1970). Numerous late-Quaternary vegetation records document vegetation at several Southeastern localities (Watts 1971, 1975, 1980; Whitehead 1973; Delcourt 1979; Delcourt 1980a; Delcourt and Delcourt 1981, 1983; Delcourt et al. 1983). Unfortunately, proximity to individual palynological and archaeological sites rarely coincide geographically.

Paleoethnobotanical material provides a second data source for information concerning the availability of prehistoric plant species. These data have been used to determine prehistoric man's patterns for plant exploitation and plant husbandry (cf. Jones 1936; Yarnell 1972, 1978, 1982; Wood and McMillan 1976; Asch and Asch 1977; Marquardt and Watson 1976; Chomko and Crawford 1978; Minnis 1978; Cowan 1978, 1979; Chapman and Shea 1981; Crawford 1982). Paleoethnobotanical material can be used to interpret landscape change. Changes in human utilization of dominant plant species through time may account for mid- and late-Holocene landscape change and progressive impact by man in the lower Little Tennessee River Valley (Chapman et al. 1982).

Research Objectives

The Problem

Archaeological investigations in the lower Little Tennessee River Valley, East Tennessee, offered the unique

opportunity for interdisciplinary research which would correlate a suite of geological, archaeological, paleoethnobotanical, and palynological data. The archaeological significance of the lower Little Tennessee River Valley is established by the location and excavation of human occupation sites which extend from the Early Archaic through Historic cultural periods. Twelve cultural phases, documenting 10,000 years of continuous human occupation, have been defined within this major river drainage.

In conjunction with archaeological excavations, carbonized wood, nutshell, and seed and fruit remains were recovered from sites representative of these cultural phases. Despite depositional, preservation, field recovery, and sampling variables (discussed in Chapter III), a major research goal has been use of the paleoethnobotanical record to develop models of:

1. prehistoric peoples' strategies for plant-habitat exploitation;

2. landscape change and the progressive impact of prehistoric people on the local environment.

The data base is comprised of 21.4 kg of carbonized wood, nutshell, fruit, and seed remains identified to plant species from 360 Archaic, 226 Woodland, 164 Mississippian, and 206 Historic Overhill Cherokee period contexts. Principal sites utilized for this research are illustrated in Figure 1.

Figure 1. Location map of lower Little Tennessee River Valley archaeological and palynological sites.

Legend:

40LD35	Bacon Farm
40LD38	Iddins
40LD105	Morganton
40MR1	Fort Loudoun
40MR2	Chota
40MR3	Mialoquo
40MR5	Tomotley
40MR6	Toqua
40MR7	Citico
40MR16	Pate Mound
40MR17	Niles Ferry Mounds
40MR20	Martin Farm
40MR23	Icehouse Bottom
40MR25	Bacon Bend
40MR40	Patrick
40MR41	Calloway Island
40MR44	Rose Island
40MR50	Tellico Blockhouse
40MR62	Tanasee
40MR64	Tuskegee
40MR66	Howard
40MR71	Virginia Fort
BPT82A	Black Pond
TPT79A	Tuskegee Pond

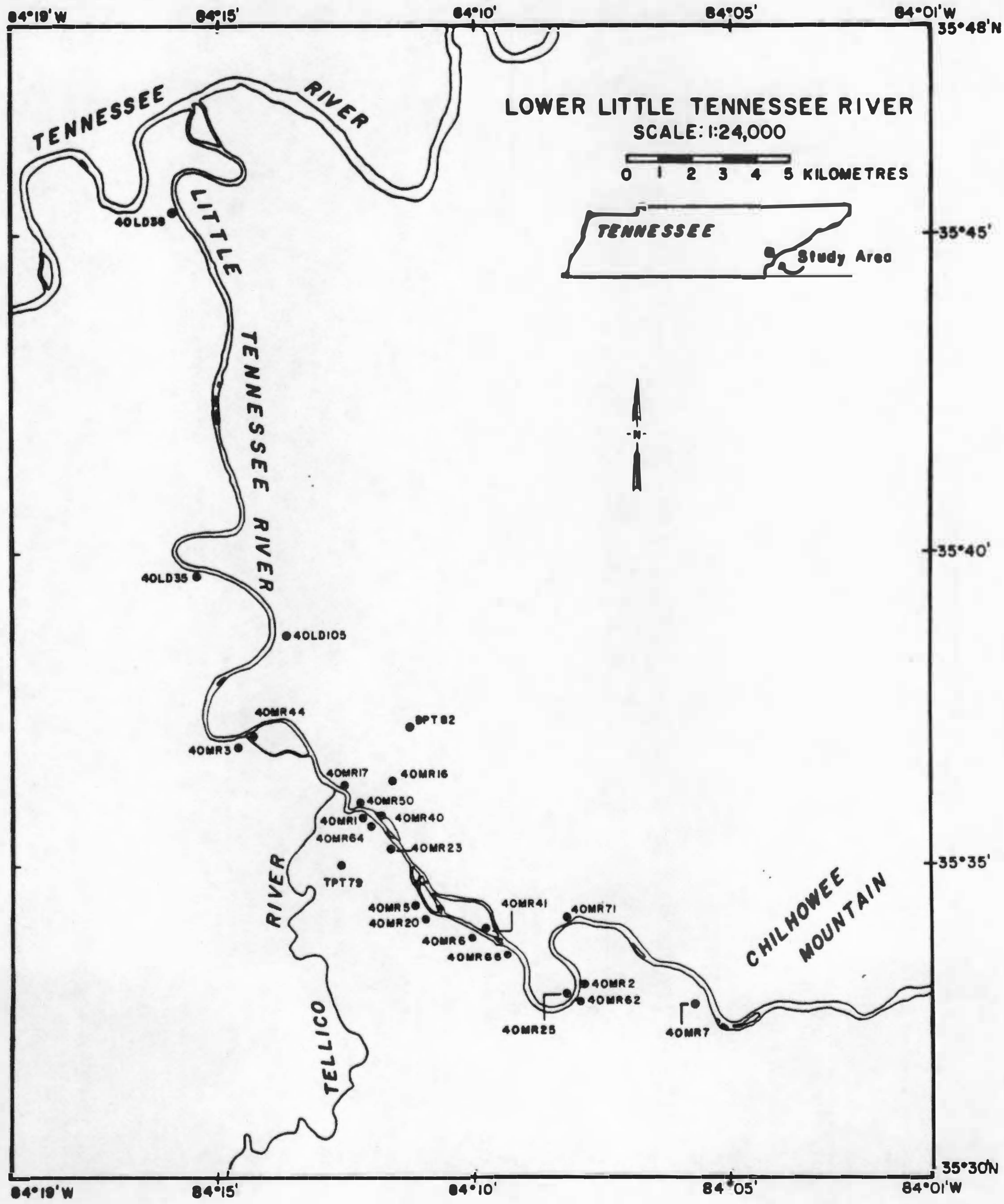
84°19'W
84°15'
84°10'
84°05'
84°01'W
35°48'N
35°45'
35°40'
35°35'
35°30'N
LOWER LITTLE TENNESSEE RIVER
SCALE: 1:24,000
0 1 2 3 4 5 KILOMETRES
TENNESSEE
Study Area
N
TENNESSEE
RIVER
LITTLE
TENNESSEE
RIVER
TELLICO
RIVER
CHILHOWEE
MOUNTAIN
40LD38
40LD35
40LD105
40MR44
40MR3
8PT82
40MR17
40MR16
40MR50
40MR1
40MR40
40MR64
40MR23
TPT79
40MR5
40MR20
40MR41
40MR71
40MR6
40MR66
40MR2
40MR62
40MR25
40MR7

Figure 1.

In order to test the model for landscape change developed from the paleoethnobotanical material, an independent palynological data base is mandatory. Alluvial sediments collected from deeply buried cultural components of Archaic period archaeological sites failed to contain sufficient pollen for acceptable counts (Chapman 1975). Buried gley sediments from the Icehouse Bottom (40MR23) site (Figure 1) contained pollen grains and spores counted for one stratigraphic level dated at 9380±215 years (Chapman 1977:165). Sediment cores for pollen analysis were collected from two ponds located within close geographical proximity to the major archaeological sites. Tuskegee Pond, located 1.6 km south of the Fort Loudoun (40MR1) site (Figure 1), is situated on a third terrace. Black Pond, an upland sinkhole formation, is located approximately 3 km north of Fort Loudoun (Figure 1). Palynological sequences from these two ponds reflect the local vegetation assemblages for the past 2,000 and 3,000 years, respectively. The sequence of information derived from this plant microfossil data also defines the principal goals of this research. Fine-scale reconstruction of local paleovegetation; temporal evidence of paleoenvironmental stability, variability, or perturbations through time; and documentation of fire frequency all provide for resolution of natural and anthropogenic factors for landscape vegetation change. Integration of both palynological and paleoethnobotanical

information then permits detailed reconstruction of the local paleovegetation. Finally, ethnohistoric documents are examined to interpret landscape change caused by nature and human populations. Correlation of this suite of palynological, paleoethnobotanical, and ethnologic data is crucial for understanding human interaction with the landscape in the lower Little Tennessee River Valley.

CHAPTER II

LOWER LITTLE TENNESSEE RIVER VALLEY

Environmental Setting

Geologic Setting

The Little Tennessee River, with its headwaters in the Blue Ridge Mountains of Georgia, is fed by the Nantahala, Oconaluftee, Tuckasegee, and Cheoah Rivers. At Chilhowee Mountain (Figure 1), it emerges from the narrow incised gorge characteristic of the Appalachian Summit area of the Blue Ridge Physiographic Province. From that point to its confluence with the Tennessee River, it forms a broadened channel in the Ridge and Valley Physiographic Province. The lower Little Tennessee River Valley, from approximately River Kilometre 54 to its confluence with the Tennessee River (0 km), is characterized by ridges, a broad alluvial valley, and numerous islands. The major tributary of the lower Little Tennessee River is the Tellico River with its confluence at approximately River Kilometre 34.

The encompassed study area is this 54 km span of river, islands, and adjacent terraces (Figure 1). The area is characterized primarily by floodplain (Terrace 0), river terraces (Terrace 1 to Terrace 9, from youngest to oldest), and upland bedrock surfaces encompassing 13,940 ha of land paralleling the Little Tennessee River in Blount, Monroe, and Loudon counties, Tennessee.

Within the Ridge and Valley Province, bedrock geology consists of folded and faulted units of the Conasauga (Cambrian age) and Knox (Ordovician age) groups (Hardeman et al. 1966). The layers of sedimentary and metasedimentary rocks of these formations are oriented northeast-southwest (Floyd 1965:11) forming the ridges and valleys. Limestones, cherty dolomites, shales, and sandstones are prevalent throughout the area. Carbonate uplands are characterized by karst topography. Detailed descriptions of the physiography and topography of the lower Little Tennessee River Valley are provided in Davis et al. (1982).

Geomorphological investigations of the study area have been conducted by Foley and Chapman (1977) and Delcourt (1980b). Between River Kilometre 0 and 54, Delcourt (1980b) mapped the modern floodplain and nine Quaternary alluvial terraces. Characterized by massive to poorly bedded units of non-calcareous, micaceous quartzose silts and fine sand, the alluvial sequences grade upward from basal channel sands and gravels. These are interbedded with fine sands and silts to silty clays (Delcourt 1980b). No chronometric dates are available for the older terraces (Terrace 3 to Terrace 9); but based on radiocarbon dates of Terrace 2 sediments, they are older than 32,330 B.P. Terrace abandonment was the product of downcutting of the Tennessee River during the late Cenozoic Era. Terrace deposition resulted from glacial/interglacial cycles of periglacial

disintegration of bedrock and downslope transport of weathered rock sediments into the valley (Delcourt 1980b). Deposits underlying the second terrace, radiocarbon dated between 27,595±980 B.P. and 32,330±2720 B.P. (Chapman et al. 1982:117), correspond with the late Altonian stadial/early Farmdalian interstadial. Pronounced climatic change, coupled with extensive downslope wash of sediments resulted in the terrace aggradation (Delcourt 1980b; Chapman et al. 1982). The youngest terrace (Terrace 1), 15,000 B.P. to 4,000 B.P., was a product of similar changes dating from the late-glacial/early-Holocene transition. The onset of modern (interglacial) climatic conditions of the Early Holocene resulted in corresponding dominance of Southern Appalachian deciduous forests between 12,500 B.P. and 8,000 B.P. (Delcourt 1979; Delcourt and Delcourt 1981). This in turn stabilized land surfaces, and downslope transport of sediment decreased. The river changed from an aggrading to an eroding system when it incised its modern channel approximately 4,000 B.P. (Delcourt 1980b).

Soils

Principal soils mapped (Hall et al. 1981) along the lower Little Tennessee River from approximately River Kilometre 27 to 40 are Ultisols and Inceptisols. Mollisols and Alfisols occur only over limited areas. The parent material of many soils includes locally weathered limestone, shale, sandstone, siltstone, phyllite, and schist.

Alluvium and colluvium are the primary parent materials of floodplain, lower terrace, and footslope soils.

Soils formed on the alluvial surfaces of the floodplain (Terrace 0), Terrace 1, and Terrace 2 are of the Statler-Staser-Transylvania association (Hall et al. 1981); soils are predominantly of the Transylvania series. Transylvania loam, an Inceptisol of the Cumulic Haplumbrept subgroup, is a fine-loamy, mesic, and well-drained soil. It may be interspersed with patchy areas of sandy soil, 15% or greater gravel, or gray mottles (Hall et al. 1981:59). This soil on slopes of 0-2% predominates the floodplains and first and second terraces of the Little Tennessee River. Statler and Staser series soils occur sporatically, but Statler loam is the principal soil on surfaces of the Terrace 0 and Terrace 1 of the Tellico River. Both the Statler and Staser series are fine-loamy, thermic, and well-drained soils derived from sediments washed from the Great Smoky Mountains.

Soils mapped on the bedrock uplands and terraces older than the Terrace 2 are numerous although discontinuous. Most common are soils of the Decatur-Dewey-Emory association, Dunmore-Dewey association, Tellico-Alcoa-Neubert association, and Etowah, Altavista, Waynesboro, Farragut, Fullerton, and Lobdell series (Hall et al. 1981).

Climate

In the lower Little Tennessee River Valley area, the annual temperature averages 14.4°C; the mean-annual maximum is 20°C and the minimum is 9.4°C. Seasonal extremes are winter lows of -25°C and summer highs of 40°C. The average growing season is approximately 200 days. Severe frosts occur in the region from late October through April (Voorhees 1913). Average annual precipitation is 130 cm (Fribourg et al. 1973). Snow accounts for a small percentage of the precipitation. Thunderstorms are frequent during the spring and summer, and the Blue Ridge Mountains act as barriers to block eastward moving storm fronts.

Vegetation

Post-settlement vegetation of the Ridge and Valley Province of East Tennessee was mapped as an oak-chestnut forest by Braun (1950). Shelford (1964) placed the area in the oak-deer-chestnut faciation with local remnants of mixed mesic forests. Following the local introduction of a blight in A.D. 1925, American chestnut *(Castanea dentata)* has declined in importance in the Southern Appalachian region (Anderson 1974). Woods and Shanks (1958) found that swamp chestnut oak *(Quercus prinus)*, northern red oak *(Quercus rubra)*, and red maple *(Acer rubrum)* replaced chestnut in successional forests of the nearby Great Smoky

Mountains. Local forests of the uplands along the lower Little Tennessee River are now dominated by oak, hickory (*Carya* spp.), tulip poplar (*Liriodendron tulipifera*), and pine (*Pinus* spp.).

Archaeological Setting

Archaeological investigations have been conducted sporatically within the lower Little Tennessee River Valley since the A.D. 1880s (Thomas 1894). Intensive research was initiated in A.D. 1967 when the Tennessee Valley Authority began the construction of the Tellico Dam and Reservoir. The 5,666 ha area to be impounded extended from the confluence of the Little Tennessee and Tennessee Rivers for approximately 54 km up the Little Tennessee River to Chilhowee Dam at Chilhowee Mountain. Salvage excavations were conducted annually by the Tellico Archaeological Project, Department of Anthropology, University of Tennessee, until inundation of the archaeological district in A.D. 1979. Delays and litigation to halt reservoir construction prolonged the project for approximately 13 years. This provided time for the conduct of additional archaeological investigations. Unfortunately, year-to-year uncertainty of the outcome of the reservoir project hampered archaeological planning and promoted a salvage approach to archaeological investigations. Principally, however, diffidence toward and irratic compliance with federal

cultural resources legislation delayed implementation of systematic archaeological site surveys and specific problem-oriented research designs until the late A.D. 1970s (Schroedl et al. 1975). Systematic site surveys (Kimball 1980) and multidisciplinary research (Foley and Chapman 1977; Chapman 1980; Delcourt 1980b) were implemented during the last three years of the project. During A.D. 1980 and A.D. 1981, a probabilistic site survey (Davis et al. 1982) was conducted in the uplands adjacent to the reservoir.

Comprehensive investigations by the Tellico Archaeological Project document major excavations of Early Archaic through Historic period sites. Early investigations were primarily test excavations (Salo 1969; Gleeson 1970). More intensive site excavations were conducted after A.D. 1970 at Archaic, Woodland, Mississippian, Overhill Cherokee, and Historic period sites (Chapman 1973, 1975, 1977, 1978, 1979, 1980, 1981; Schroedl 1975, 1978, 1982; Guthe and Bistline 1978; Polhemus 1979, 1983; Kimball 1980; Davis 1980; Cridlebaugh 1981; Davis et al. 1982; Baden 1983; Russ and Chapman 1983).

Over 500 Archaic, Woodland, Mississippian, and Historic period sites were identified in the inundated portion of the reservoir. Cultural components were excavated at 25 multicomponent and single component sites situated along the narrow river corridor. A variety of archaeological data collected from these investigations included

structural, feature, burial, lithic, ceramic, faunal, and archaeobotanical remains. Analysis and interpretation of these cultural remains provided information regarding the lifeways of prehistoric populations in the lower Little Tennessee River Valley. Location of all sites discussed below is indicated on Figure 1, page 6.

Cultural Sequences

Paleo-Indian Period

No stratified sites dating to the Paleo-Indian period (prior to 10,000 B.P.) have been identified in the Tellico Reservoir study area. Paleo-Indian occupation is, however, confirmed by the recovery of fluted Clovis type projectile points and transitional Hardaway-Dalton type (Coe 1964:64) points from land-surface deposits. A geological strategy for the discovery of Paleo-Indian sites within the sediments of the youngest (Terrace 1) river terrace has been proposed (Chapman 1978; Delcourt 1980b); however, deep-testing surveys (Chapman 1978) of the first terrace produced no evidence of deeply buried Paleo-Indian period sites.

Early Archaic Period

Three phases of the Early Archaic period in the lower Little Tennessee River Valley include the Lower Kirk (9,500-9,300 B.P.), Upper Kirk (9,300-8,800 B.P.), and Bifurcate (8,800-8,100 B.P.) (Chapman 1975, 1977). Diagnostic projectile point types which define these phases are Kirk

Corner Notched (Coe 1964:69; Chapman 1977:41-48) and the bifurcate types, LeCroy (Lewis and Kneberg 1955; Chapman 1975, 1977) and St. Albans Side Notched (Broyles 1966:23-25; Chapman 1975:108-110). Four deeply buried, stratified sites have been extensively excavated from the Terrace 1 deposits; these sites include Icehouse Bottom (40MR23), Rose Island (40MR44), Bacon Farm (40LD35), and Calloway Island (40MR41). Interpretations of Early Archaic settlement and subsistence strategies are based upon site reconnaissance and excavation data. Base camp settlements were situated on aggrading alluvial surfaces of the Terrace 1 and probably occupied from summer through autumn.

Pitted cobbles, hammerstones, and chert debitage provide primary evidence for on-site manufacture of implements made from locally available chert. Projectile points, knives, scrapers, drills, gravers, and _pièces esquillées_ were tools used in animal procurement, meat preparation, bone-working and hide-working activities. Hammerstones, manos, metates, and carbonized nutshell and seed remains provide evidence for human processing of plant foods. Plant fibers were used to weave nets or baskets; net and basketry impressions are preserved on fired clay hearths (Chapman and Adovasio 1977). Fired clay hearths and globular pits filled with wood charcoal provide further evidence of plants used as fuel. In summary, hunting, butchering, fishing, gathering, and fabrication activities

may be inferred from lithic and plant remains recovered from Early Archaic sites in the study area.

Middle Archaic Period

Two phases of the Middle Archaic period, Stanly (8,100-7,500 B.P.) and Morrow Mountain (7,500-6,400 B.P.), have been identified from Terrace 1 deposits at Icehouse Bottom (40MR23), Howard (40MR66), and Bacon Farm (40LD35). These occupations are distinguished from Early Archaic period phases by progressive changes in projectile point morphology and the addition to the tool kit of chipped stone implements manufactured of quartz and quartzite. The introduction of the atlatl weight and distinctive projectile point styles indicate a probable change in hunting technology during the Middle Archaic period.

The Stanly phase is defined by the short-stemmed Stanly (Coe 1964:35) type projectile point/knife, bifacial knives, end scrapers, bifaces, and pièce esquillées. Semi-lunar atlatl weights were manufactured for the first time, and the quantity of notched cobble net weights increased markedly. The later Morrow Mountain phase is distinguished by Morrow Mountain I (Coe 1964:37) type projectile points and tubular atlatl weights. The assemblage of chipped and ground stone implements is more diverse than those affiliated with Stanly phase occupations. Stone implements include a distinctive end scraper type (Cridlebaugh 1977),

large bifacial backed-knives, drills, denticulates, gravers, and spokeshaves.

Feature types, including clay hearths and globular pits, persisted from the Early Archaic through Middle Archaic periods. Settlement strategies included the location of base camps on alluvial surfaces. Both organic and inorganic cultural remains reflect the conduct of hunting, gathering, butchering, and fabrication activities.

Late Archaic Period

Major investigations of the Late Archaic period in the lower Little Tennessee River Valley have been conducted on the youngest terrace (Terrace 1) at the Bacon Bend (40MR25) and Iddins (40LD38) sites. Two phases are represented: Savannah River (4,500-3,800 B.P.) and Iddins (3,800-3,200 B.P.). The Savannah River phase is distinguished by large, broad-stemmed Savannah River Stemmed (Coe 1964:44-45) or Appalachian Stemmed (Kneberg 1957:66) type projectile points and knives manufactured of quartzite and local chert. The Iddins phase is differentiated from the Savannah River phase by the Iddins Undifferentiated Stemmed (Chapman 1981:77) type projectile point. The Iddins phase implement assemblage includes grooved axes, choppers, celts, and large quantities of notched cobble net weights and steatite bowl fragments. Paleoethnobotanical remains from both the Bacon Bend and Iddins sites consist of carbonized wood,

nutshell, fruits, and seeds representative of a variety of arboreal and herbaceous species. The first archaeological evidence of domesticated plants in the lower Little Tennessee River Valley is marked by squash (*Cucurbita pepo*) fragments recovered from the Bacon Bend Savannah River phase component. Fragments of squash and gourd (*Lagenaria siceraria*) have been identified from the Iddins site.

A paucity of lithic implements and debitage may reflect a small seasonal encampment at the Bacon Bend site. Primary cultural activities at the Iddins site, a base camp, were hunting, fishing, butchering, lithic manufacture, and processing and fabrication of plant and animal materials (Chapman 1981:149).

Early Woodland Period

In East Tennessee, the Early Woodland period is marked by the introduction of crushed quartz-tempered Watts Bar phase ceramics. Minor components of the earliest phase, Watts Bar (ca. 2,400 B.P.), have been investigated at Bacon Bend (40MR25) and Martin Farm (40MR20). The subsequent Long Branch phase (2,200-1,750 B.P.) is most extensively represented at three excavated sites: Patrick (40MR40), Calloway Island (40MR41), and Rose Island (40MR44). The Long Branch phase is characterized by limestone-tempered ceramics and triangular projectile points/knives, scrapers, and *pièces esquillées* manufactured of local chert.

Ground and polished stone implements include notched cobble net weights, gorgets, pendants, and pestles. An undefined form of interaction with other Indian cultures is indicated by recovery of Adena style artifacts manufactured of exotic and local raw materials; these artifacts were associated with human cremations at the Calloway Island site (Chapman 1979).

Large quantities of faunal remains were better preserved than was the case for sites of the Archaic period. White-tailed deer (*Odocoileus virginianus*), elk (*Cervus canadensis*), raccoon (*Procyon lotor*), squirrel (*Sciurus* spp.), and beaver (*Castor canadensis*) were commonly procurred animals (Schroedl 1978).

Middle Woodland Period

The Connestee/Candy Creek phase (1,750-1,400 B.P.) of the Middle Woodland period has been investigated at the Icehouse Bottom (40MR23) site. This phase is characterized in the lower Little Tennessee River Valley by prismatic blades manufactured of Flint Ridge, Ohio chalcedony as well as local chert; triangular and stemmed projectile points; sand-tempered and limestone-tempered ceramics; and cut sheets of mica. The recovery of exotic artifacts such as Flint Ridge chalcedony prismatic blades, mica, Hopewell series Chillicothe Rocker-Stamped, Plain Rocked (Prufer 1965:29-31) and Georgia series Swift Creek Complicated

Stamped (Jennings and Fairbanks 1939:1) ceramics indicates participation in the Hopewell exchange network by the Icehouse Bottom site occupants (Chapman and Keel 1979). Although numerous postholes have been identified at the site, no structural patterns have been defined. Faunal remains substantiate animal exploitation patterns similar to those of the Long Branch phase. Paleoethnobotanical remains indicate continued utilization of a variety of indigenous plants as well as the introduction of maize (*Zea mays*) (Cridlebaugh 1981).

Early Mississippian Period

The Early Mississippian period (1,000-700 B.P.) encompasses the transitional (emergent) Mississippian Martin Farm phase and the Hiwassee Island phase. These are the primary phases of the Early Mississippian period identified in the lower Little Tennessee River Valley. The Martin Farm phase has been defined at the Martin Farm (40MR20) type site (Schroedl et al. 1982). Most definitive of a transition from the Woodland to Mississippian period cultures was the introduction of ceramics tempered with a combination of limestone and crushed mussel shells. Artifact assemblages recovered from Early Mississippian period sites include small triangular Hamilton (Kneberg 1956:24) and Madison type projectile points, steatite earspools, limestone-tempered ceramics, and shell-tempered ceramics.

Wall trench structures and limited mound building also characterize this cultural period.

Late Mississippian Period

Excavations of components representative of the Dallas phase (700-300 B.P.) have been conducted at the Citico (40MR7) and Toqua (40MR6) sites. These large Late Mississippian period sites are situated on the lower terraces adjacent to the Little Tennessee River. Locally, this culture was manifested by shell-tempered ceramics, small triangular projectile points, bone implements, ceremonial temple mounds, and large palisaded villages. The permanent villages consisted of mounds, plazas, and dwellings constructed of wattle and daub. Many artifacts recovered from Dallas phase sites include negative-painted effigy vessels, carved and incised marine shell gorgets, and stone and copper plaques illustrated with motifs of the Southern Ceremonial Cult (cf. Waring 1965; Polhemus 1983).

Indian subsistence was probably strongly based on maize agriculture. Beans (*Phaseolus vulgaris*) first appear in the valley during the Dallas occupation (Chapman and Shea 1981). Exploitation of a diversity of animals included white-tailed deer, bear (*Ursus americanus*), raccoon, and squirrel (Bogan 1982).

Historic Period: Overhill Cherokee

This period (ca. 300-130 B.P.) encompasses Cherokee

occupation prior to European contact until Cherokee removal from the valley following the Hiwassee Purchase Treaty in A.D. 1819. Pre- and postcontact Cherokee settlements were dispersed from South Carolina to Tennessee and designated as Lower, Middle, and Overhill towns. Overhill Cherokee village sites situated on the late Quaternary terraces of the Little Tennessee River were partially mapped by Timberlake (Williams 1928) in A.D. 1762. These towns included Citico (40MR7), Chota (40MR2), Tanasee (40MR62), Toqua (40MR6), Tomotley (40MR5), Tuskegee (40MR64), and Mialoquo (40MR3). Overhill Cherokee sites are characterized by single-post rectangular and oval structures and townhouses. Lithic implements include small triangular projectile points, knives, drills, and scrapers. Metal projectile points (Roberts 1982) and European trade items such as glass beads, silver ornaments, wine bottles, and utilitarian metal items (Newman 1977, Ford 1979, Schroedl 1982b ; Baden 1983) are typical postcontact artifacts recovered from Cherokee sites.

Cherokee subsistence was primarily agriculturally based with cultivation of maize, beans, cucurbits, and peaches (*Prunus persica*), a species introduced from Spain by early Spanish explorers. A diversity of indigenous animal species was exploited as well as European-introduced animals such as the pig (*Sus scrofa*) (cf. Bogan 1980).

Historic Period: Euro-American

Euro-American occupation of the lower Little Tennessee River Valley overlaps with the Overhill Cherokee occupation. It is marked by sustained contact of European traders and travelers who lived in the area with the Cherokee at least as early as A.D. 1673 (Williams 1927). Two Frontier period sites have been excavated in the lower Little Tennessee River Valley. Fort Loudoun (40MR1) was a British fort occupied from A.D. 1756 to A.D. 1760 by a garrison of several hundred soldiers (McDowell 1970; Kunkel 1960). European and American political and military pressure for land in Cherokee Territory intensified following the destruction of Fort Loudoun in A.D. 1760. A major Federal occupation of the lower valley occurred in A.D. 1794 when Tellico Blockhouse (40MR50), a Federal military and trade complex, was established (cf. Polhemus 1978).

Following the A.D. 1819 Hiwassee Purchase Treaty, the land in the lower Little Tennessee River Valley was open for settlement by non-Indian Americans. A few Cherokee retained ownership of tracts of land (Armstrong 1819), but thousands of hectares were acquired by a small number of Caucasian landowners. Morganton (40LD105) (Polhemus 1980), a river town at River Kilometre 22, was a major shipping transfer point populated by 70 residents during the A.D. 1820s and A.D. 1830s. The town rapidly declined

after A.D. 1910 when by-passed by the expanding network of railroads.

Farming was the principal land use in the lower Little Tennessee River Valley until inundation of the lower terraces by the Tellico Reservoir in December A.D. 1979. Prior to that time, large tracts of alluvial land were cleared and utilized to grow maize, soybeans, and tobacco and to pasture livestock. As was the case in the early A.D. 1900s, ridge land was primarily forested with oaks, hickories, and pine at lower elevations (Ayres and Ashe 1902).

Conclusions

Archaeological surveys and excavations document human occupation of the lower Little Tennessee River Valley for the past 10,000 years. Human settlement coincided with Early-Holocene climatic changes which triggered a chain of ecologic and geologic events resulting in stabilized land surfaces in the Little Tennessee River Valley. The river was an aggrading system until it incised its modern channel approximately 4,000 B.P. When the river then became an eroding system, the Terrace 1 surface stabilized and the modern floodplain was established. Settlement strategy of Archaic period (9,500-3,200 B.P.) Indians was on alluvial floodplain surfaces subject to modification by both erosion and intensive deposition of alluvial sediments. This

resulted in deeply buried, stratified archaeological sites. The Archaic period was comprised of seven cultural phases. Each phase is characterized by distinctive forms of projectile points and lithic implement assemblages. Cultural continuity, however, is reflected by similarities in point morphology, lithic manufacturing techniques, and settlement and subsistence patterns. The introduction of steatite vessels and domesticated plants imply increased settlement stability during the Late Archaic period.

This trend toward settlement stability continued and intensified during the Woodland period (2,400-1,000 B.P.) when ceramic vessels and maize cultivation were introduced. Adena and Hopewell traits, such as exotic lithic and ceramic artifacts recovered from the Calloway Island and Icehouse Bottom sites, illustrate an increasing importance of trade and exchange networks.

Participation in exchange networks and ceremonialism was most important during the Mississippian period (1,000-300 B.P.) in the lower Little Tennessee River Valley. The Southern Ceremonial Cult influenced the Dallas culture as indicated by expressions of cult motifs on lithic, marine shell, and ceramic artifacts. Permanent settlement patterns were expressed by the establishment of earthen mound structures, habitation structures, and large villages enclosed within palisades and situated on lower terrace surfaces. Subsistence strategies were based on the

exploitation of white-tailed deer and the cultivation of maize and beans.

Strategies for Overhill Cherokee settlement and subsistence were similar to those practiced by the Dallas phase inhabitants of the lower Little Tennessee River Valley. Political organization of each autonomous town was centered around the Cherokee townhouse. Euro-American encroachment upon Cherokee land and culture began as early as A.D. 1673 and persisted until A.D. 1819 when virtually all the lower Little Tennessee River Valley was purchased from the Cherokee by the United States government.

The chronologies established for the cultural occupation of the lower Little Tennessee River Valley are comparable to coeval cultural development in East and Middle Tennessee (Lewis and Kneberg 1941, 1957; McCollough and Faulkner 1973; Faulkner and Graham 1965, 1966; Faulkner and McCollough 1973, 1974).

CHAPTER III

THE PALEOETHNOBOTANICAL RECORD

The Data Base

Archaeological excavations along the lower Little Tennessee River Valley have produced paleoethnobotanical samples from sites ranging from the Early Archaic period through the Historic Cherokee period. These data provide information regarding plant use by Indian populations for the past 10,000 years. Thirteen Archaic, four Woodland, three Mississippian, and five Cherokee period components provide 21.4 kg of carbonized plant fossils identified to plant genus or species. Gram weight of carbonized plant remains from each site component and context (i.e., feature, midden, or burial) are tabulated by cultural period on Table 1. Specific cultural periods, phases, and sites from which plant remains were derived are listed in Table 2. Appendix A documents the provenience and reference sources of the data base. Final counts and weights of plant remains are tabulated by species in Appendix B.

Archaeobotanical sediment samples of 9.5 l were systematically collected for water flotation from features and middens of all Archaic and Middle Woodland period sites. Identical volumes of sediment were less systematically collected from Early Woodland, Mississippian, and Overhill

Table 1. Cultural period, total number of components, contexts, and total gram weight (21,437.26 g) of paleoethnobotanical material represented in study.

Cultural Period	Number of Components	Number of Contexts	Weight in grams: Wood	Nutshell	Seeds and Fruits
Overhill Cherokee	5	206	4,629.22	448.76	1,892.71
Late Mississippian	1	97	900.13	131.52	82.85
Early Mississippian	2	67	2,590.44	815.16	131.19
Middle Woodland	1	146	466.58	288.98	3.06
Early Woodland	3	80	1,497.06	1,649.77	2.28
Late Archaic	2	130	2,165.95	1,220.62	3.00
Middle Archaic	5	91	781.66	386.55	.50
Early Archaic	6	139	660.32	688.32	.63
Total	25	956	13,691.36	5,629.68	2,116.22

Table 2. Cultural periods, phases, and sites represented by paleoethnobotanical material.

Cultural Period	Phase	Site
Historic Cherokee	Overhill	Chota (40MR2) Tanasee (40MR62) Toqua (40MR6) Tomotley (40MR5) Mialoquo (40MR3)
Late Mississippian	Dallas	Toqua (40MR6)
Early Mississippian	Hiwassee Island	Tomotley (40MR5)
	Martin Farm	Martin Farm (40MR20)
Middle Woodland	Connestee/ Candy Creek	Icehouse Bottom (40MR23)
Early Woodland	Long Branch	Patrick (40MR40) Rose Island (40MR44) Calloway Island (40MR41)
Late Archaic	Iddins	Iddins (40LD38)
	Savannah River	Bacon Bend (40MR25)
Middle Archaic	Morrow Mountain	Howard (40MR66) Icehouse Bottom (40MR23)
	Stanly	Howard (40MR66) Bacon Farm (40LD35) Icehouse Bottom (40MR23)
Early Archaic	Bifurcate	Bacon Farm (40LD35) Icehouse Bottom (40MR23) Calloway Island (40MR41)
	Upper Kirk	Bacon Farm (40LD35) Icehouse Bottom (40MR23)
	Lower Kirk	Icehouse Bottom (40MR23)

Cherokee period sites. Flotation (Struever 1968; Watson 1976) was carried out in the Little Tennessee River where each sediment sample was immersed in a reinforced 1.5 mm mesh-bottomed tub used to concentrate the plant debris. Approximately 90% of the paleoethnobotanical remains from major Mississippian and Cherokee period excavations was recovered by secondary flotation or collection of residue from sediments waterscreened through 6 mm and 1.5 mm mesh; the remaining 10% was recovered through flotation of sediments.

Laboratory analysis of the carbonized plant material was conducted principally by Andrea B. Shea at the Paleoethnobotanical Laboratory, Department of Anthropology, University of Tennessee. Comparative collections of wood charcoal and seeds, in conjunction with reference literature (Martin and Barkley 1961; Panshin and de Zeeuw 1964; Core et al. 1979), were employed as identification aids. Each paleoethnobotanical sample was dried and then sieved through a series of U.S. Standard screens with mesh sizes 2 mm, 1 mm, and 0.5 μm. Plant debris greater than 2 mm was sorted and identified to genus and species. The remaining sieved fractions were examined for seeds, fruits, and cucurbit fragments. Each sieved fraction was examined at 7X-30X magnification with a binocular microscope. The wood charcoal, nutshell, seeds, and fruits were counted, and total gram weight or number of specimens for each sample

was calculated. Each species of nutshell was consistently quantified by gram weight while species of wood were tabulated by number of charcoal fragments. Remains of domesticated plants were quantified by gram weight with intermittent numerical counts; other fruit and seed species remains were counted but not weighed individually.

Variables of differential processing, depositional environment, and preservation of plants and plant residues contribute to problematic paleoethnobotanical interpretations (Munson et al. 1971; Ford 1979; Begler and Keatinge 1979; Minnis 1981; Yarnell 1982; Hally 1983). Seed and fruit remains may be inaccurate representations of actual Indian exploitation practices due to the fleshy characteristics of plant parts collected, consumed, and archaeologically preserved. Much of the preserved material may represent residue or accidentially charred plant remains. Modern sampling biases, differential recovery, and analytical techniques may further complicate interpretations. These remain unresolved variables (Hally 1983) despite, for example, suggestions that a more accurate calibration of acorn to hickory equivalence for food content might be obtained by multiplication of acorn shell by a factor of ten to twenty (Chapman 1975). No uniformly acceptable compensatory calibrations have been derived by paleoethnobotanists; consequently, none are utilized in this research. The percentage of each genus identified from the lower

Little Tennessee River Valley plant material represents a composite value reflecting prehistoric human plant utilization and the variables of deposition, preservation, recovery, and identification.

Interpretation and Results

Plant data derived from the paleoethnobotanical record can be used to characterize the nature of plant communities exploited by Indians during the Early Archaic through Historic Overhill Cherokee periods from sites in the lower Little Tennessee River Valley. Plausible subsistence and economic potential of the nuts, seeds, and fruits, and the plants they represent can be inferred from ethnographic sources and from archaeological occurrence (Yanovski 1936; Yarnell 1974, 1976; Hamel and Chiltoskey 1975). Nutshell, seeds, and fruits are presumed to represent prehistoric food resources. Primary uses for wood include fuel and material for construction of tools, containers, and structures. Cane (*Arundinaria*) and grape (*Vitis* spp.), the only nonarboreal taxa included in the wood charcoal category, contain a woody culm or stem utilized by the Indians for fuel, fiber, implement, and construction material.

Plant Habitat Categories

Charred plant remains were placed in three separate groups: wood, nutshell, and seeds and fruits. The plant

taxa were then categorized by their most typical habitat and diagrams were plotted against both years before present and time-correlated cultural phases (Figures 2, 3, and 4). Percentages illustrated in Figures 2, 3, and 4 are based on number of wood charcoal fragments, nutshell gram weight, and number of fruit and seed remains. Carbonized wood and nutshell percentages of each plant taxon are categorized by habitats such as bottomlands, uplands, and disturbed uplands. Bottomlands comprise Terrace 0 through Terrace 2; mid-level terraces and uplands are Terrace 3 to 9 and bedrock uplands.

Habitat requirements for arboreal plants were derived from Harrar and Harrar (1962), Fowells (1965), Radford et al. (1968), and Martin (1971). These species-habitat associations correspond with nineteenth century (Davis et al. 1982), recent (Martin 1971), and Tennessee Valley Authority (1972) phytogeographic data for the lower Little Tennessee River Valley. Numerous species of oak (*Quercus* spp.), for example, potentially grew in the study area. In the absence of tree census data, oak species documented by early nineteenth century land-survey witness trees (Davis et al. 1982), by Martin (1971), and by the Tennessee Valley Authority (1972) included white oak (*Quercus alba*), red oak (*Quercus rubra; Quercus falcata*), post oak (*Quercus stellata*), black oak (*Quercus velutina*), and scarlet oak (*Quercus coccinea*). These species most typically grow in upland habitats of the southeastern United States (Harrar and

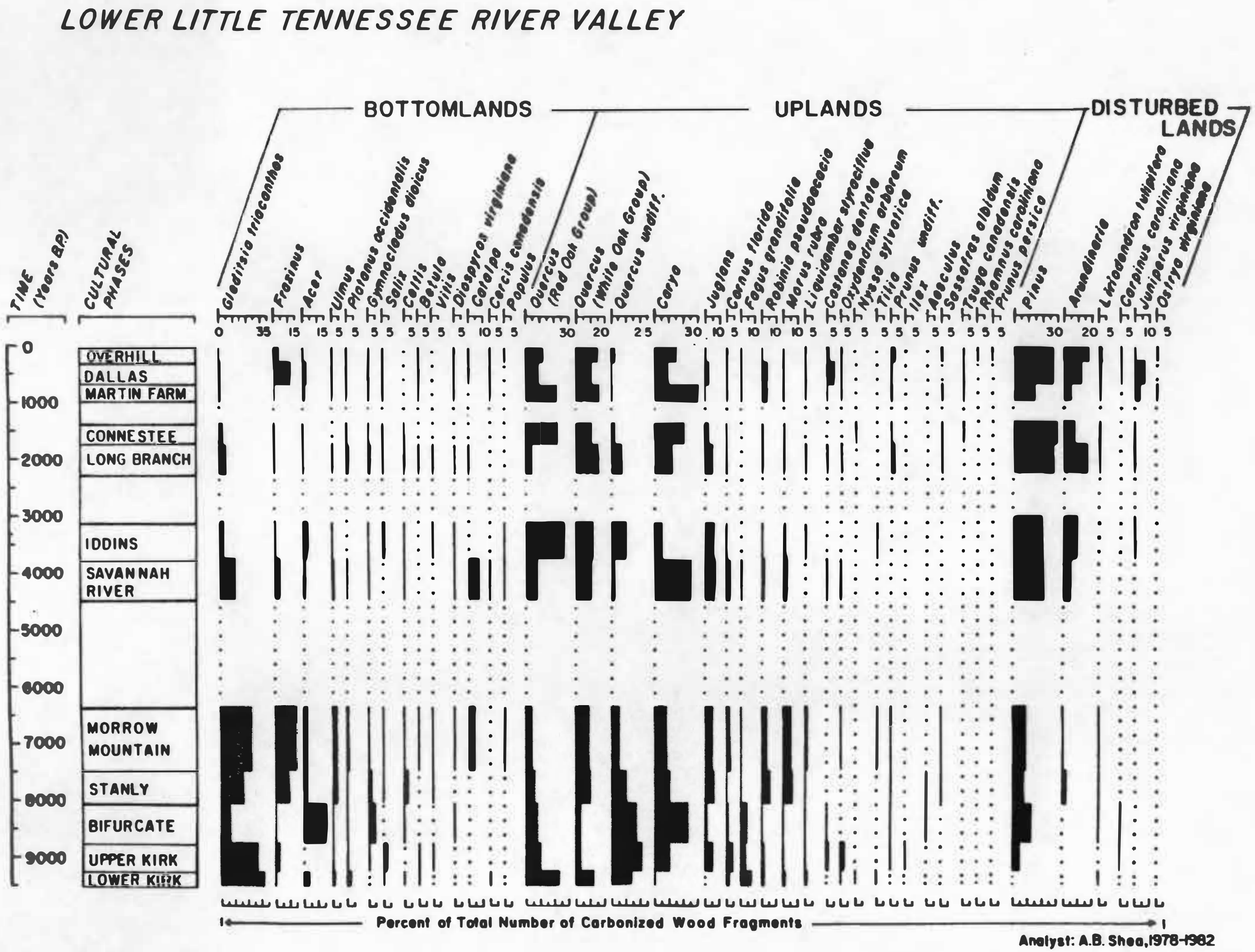

Figure 2. Cultural phase, habitat, and percentage distribution of plant species identified from charred wood recovered from archaeological contexts.

LOWER LITTLE TENNESSEE RIVER VALLEY

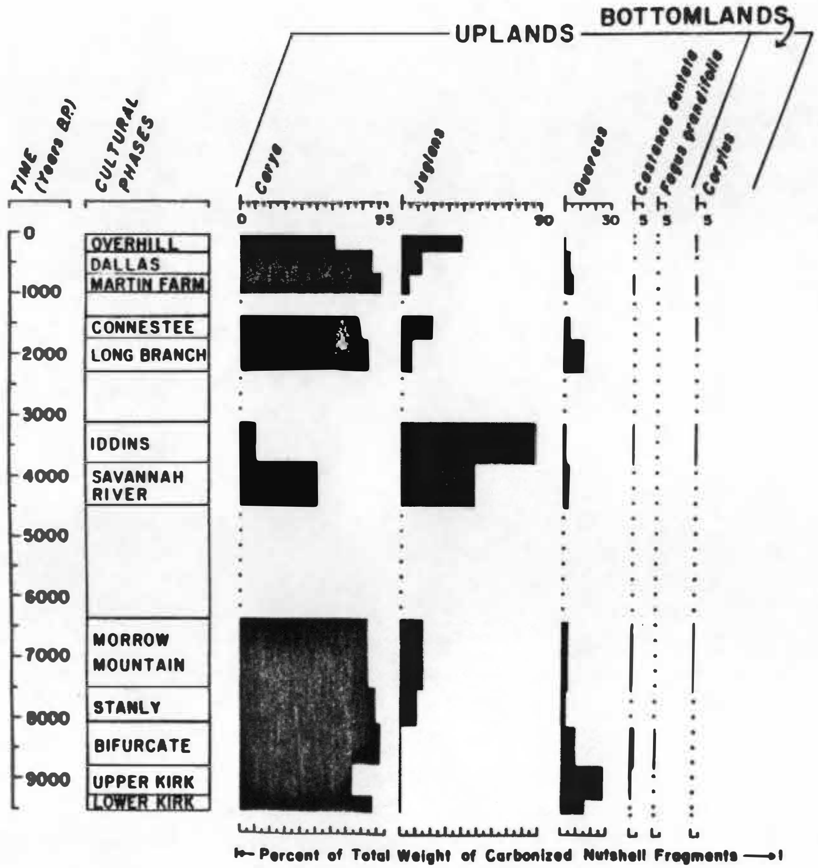

Figure 3. Cultural phase, habitat, and percentage distribution of plant species identified from charred nutshell recovered from archaeological contexts.

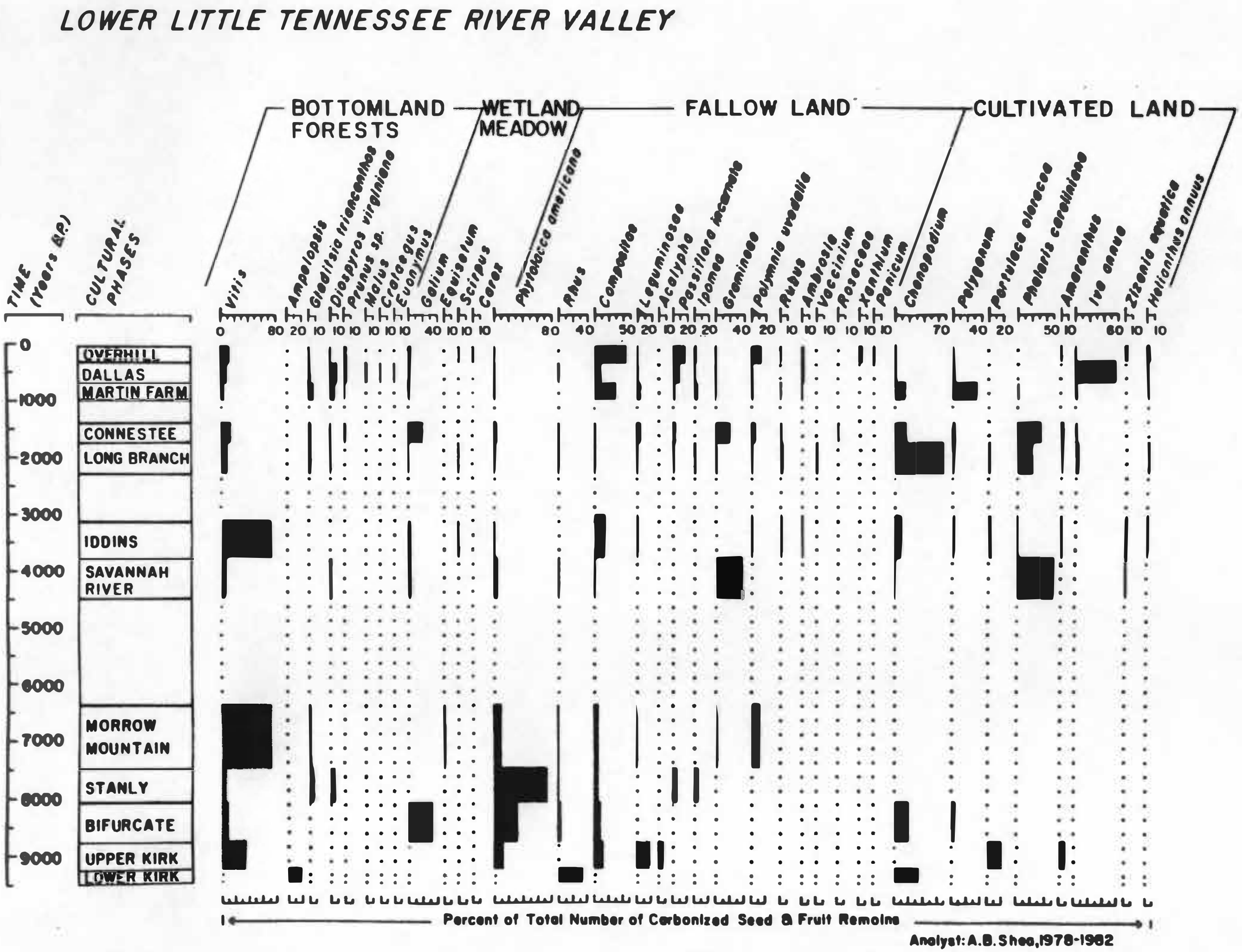

Figure 4. Cultural phase, habitat, and percentage distribution of plant species identified from charred fruits and seeds recovered from archaeological contexts.

Harrar 1962; Fowells 1965) or, more specifically, upland soil association and slope aspects of the lower Little Tennessee River Valley (Martin 1971). Moreover, witness trees recorded in A.D. 1755 by DeBrahm (DeVorsey 1971) include upland oaks in the Fort Loudoun area.

Plant genera represented by carbonized seed and fruits were assigned to bottomland forests, wetland/meadow, fallow land, and cultivated land habitats (Martin and Barkley 1961; Harrar and Harrar 1962; Reed 1971; Struever and Vickery 1973; Asch and Asch 1977, 1978). Probable domesticated plants may have grown in fallow fields or cultivated land. This plant category refers to those taxa such as maygrass (*Phalaris caroliniana*) (Cowan 1978) and sumpweed (*Iva annua*) (Yarnell 1978; Asch and Asch 1978) which were facilitated by human disturbance and were used but may or may not have been intentionally cultivated. Domesticated plants or cultigens are those plants, such as maize (*Zea mays*), which require cultivation and modification by humans. Gram weight and percentage of domesticated plant remains recovered from the study area are indicated by cultural phase in Table 3.

Plant Remains of the Early Archaic Period

Carbonized wood, nutshell, and fruit and seed spectra and percentages are indicated by habitat in Figures 2, 3, and 4. Forty-three individual taxa are represented in the

Table 3. Cultural phase, gram weight, and percentage distribution of domesticated plant species (cultivated land habitat), lower Little Tennessee River Valley.

Cultural Phase	Plant Species	Gram Weight	Percentage
Overhill (ca. 300-160 B.P.)	Cucurbitaceae	2.28	0.12
	Cucurbita pepo	1.05	0.06
	Lagenaria siceraria	.12	0.006
	Phaseolus vulgaris	89.27	4.7
	Prunus persica	620.70	32.8
	Zea mays	1169.35	62.1
Dallas (ca. 700-300 B.P.)	*Cucurbita pepo*	.12	0.10
	Phaseolus vulgaris	1.25	1.8
	Zea mays	69.61	98.1
Martin Farm (ca. 1,000-700 B.P.)	Cucurbitaceae	.12	.1
	Zea mays	122.41	99.9
Connestee (ca. 1,750-1,400 B.P.)	*Zea mays*	1.18	100.0
Long Branch (ca. 2,200-1,750 B.P.)	*Cucurbita pepo*	.40	93.0
	Lagenaria siceraria	.03	7.0
Iddins (ca. 3,800-3,200 B.P.)	*Cucurbita pepo*	.40	90.9
	Lagenaria siceraria	.04	9.1
Savannah River (ca. 4,500-3,800 B.P.)	*Cucurbita pepo*	.02	100.0

139 Early Archaic paleoethnobotanical samples analyzed from six components of the Lower Kirk, Upper Kirk, and Bifurcate phases. Of the total number of carbonized wood fragments (n=2,423) identifiable to genus or species, 35.4% is from the red oak and white oak groups (Quercus spp.). Honey locust (Gleditsia triancanthos) contributes 17.4%; hickory (Carya), 14%; maple (Acer), 8.3%; and pine (Pinus), 7.8%. A variety of habitats is well-represented by these taxa, but the majority (60.7%) of wood charcoal is of species derived from upland habitats. Twelve genera, representing 31% of the total are affiliated with bottomlands and three disturbance-favored taxa contribute the final 8.3%.

Upland hickory dominates the carbonized nutshell spectra at 88.7%. Oak, chestnut (Castanea dentata), walnut (Juglans), and beech (Fagus grandifolia) constitute the remainder.

The species richness of the fruit and seed spectrum is illustrated by 12 taxa. Each whole and fragmentary specimen was quantified as one (1) with a total of 109 specimens. Bedstraw (Galium), pokeweed (Phytolacca americana), goosefoot (Chenopodium), and grape (Vitis) are principal constituents of the sample. The majority, 62.4%, of the material is affiliated with disturbed habitats. These plants, commonly growing in disturbed areas or old fields, include pokeweed, knotweed (Polygonum), sumac (Rhus), goosefoot, and purslane (Portulaca oleracea).

Plant Remains of the Middle Archaic Period

The 2,518 carbonized wood fragments representative of two phases of the Middle Archaic period were derived from five components. The most substantial contributions to this spectrum are from the red and white oak groups, 20.3%; honey locust, 19.9%; and ash (Fraxinus), 12.3%. Thirteen species from upland and bottomland habitats constitute 46.3% and 43.4% of the total. Pine (8.5%), cane (Arundinaria), and tulip poplar (Liriodendron tulipifera) comprise the least represented (10.3%) disturbance-favored category.

Habitat representation of nutshell genera is similar to that characteristic of the Early Archaic; upland hickory comprises 83.5% of the total. Oak, walnut, and chestnut are present, but walnut is most prevalent at 13.3% of the total.

The 171 seed and fruit specimens are represented by 12 genera. Even though 65% (n=111) of the total specimens derive from bottomland species, the greatest proportion is grape (Vitis) (n=107). Eight disturbance-favored taxa comprise 34.5% (n=59) of the total; pokeweed (Phytolacca americana) is most abundant.

Plant Remains of the Late Archaic Period

As was the case during the previous cultural periods, richness of bottomland arboreal species was high (n=13) during the Late Archaic period. Overall contributions of bottomland species, however, total only 15% of the wood

charcoal. Dominant genera include upland and disturbance-favored taxa such as oak, 35.7%; hickory, 14.7%; and pine, 17.1%. The wood charcoal spectrum is dominated by 60.6% upland species. Disturbance-favored plants are well-represented by a total of 24.5% pine, cane, and cedar (*Juniperus virginiana*).

Walnut, a species which favors an open forest canopy, comprises 75.7% (n=924.41 g) of the carbonized nutshell. Upland hickory constitutes 22.5% and oak and chestnut contribute the additional 2% of the total.

The seed and fruit sample consists of 965 whole and fragmentary specimens from 22 individual taxa. Compositae (n=100), goosefoot (*Chenopodium*) (n=48), and maygrass (*Phalaris caroliniana*) (n=131) contribute significantly to herbaceous plants most commonly occurring in fallow soil or disturbed habitats. The first evidence of domesticated plants in the lower Little Tennessee River Valley was during the Savannah River phase, 4,390 B.P. (Chapman 1981:39). Cucurbits (Cucurbitaceae), squash (*Cucurbit pepo*) (n=179 or 0.42 g), and gourd (*Lagenaria siceraria*) (n=10 or 0.04 g) constitute approximately 13% of the seed and fruit spectrum gram weight.

Plant Remains of the Early Woodland Period

Fewer Woodland period sites were excavated than were Archaic period sites. Paleoethnobotanical data were obtained from three Early Woodland sites. Of the total

number of carbonized wood specimens (n=2,727) from the Early Woodland Long Branch phase, 26.7% is of the red and white oak groups; 27.5%, pine; 15.5%, cane; and 12.7%, hickory. Approximately 47% (n=1,290) of the forest species are associated with upland habitats while species common in disturbed upland habitats account for 43.6% (n=1,190) of the remaining charcoal. A relatively high species richness (n=12) characterizes bottomland taxa, although in total number of specimens, they account for only 9.1% of the wood charcoal.

Hickory, commonly associated with dry upland habitats, comprises 82.8% (1366.51 g) of the carbonized nutshell. The remaining 17.2% of the nutshell is represented by acorn (11.6%) and walnut (5.6%).

The seed and fruit sample consists of 2,181 whole and fragmentary remains. Frequency distributions indicate that fruits of tree species in bottomland areas or at the forest edge comprise a total of 7.6% (n=166). The greatest number of nonarboreal plant remains are of species derived from fallow and cultivated habitats. Of these taxa, goosefoot represents 66.1% (n=1,442) and maygrass, 19.7% (n=429) of the total charred seeds. Three domesticated taxa, squash, sunflower (Helianthus annuus), and gourd, were probably associated with garden plots on lower terraces and bottomlands. They comprise approximately 19% of the total seed

and fruit gram weight. Squash fragments constitute 0.40 g of the total 2.28 g of seeds.

Plant Remains of the Middle Woodland Period

Carbonized plant remains from the Connestee phase were recovered from 146 contexts at a single site, Icehouse Bottom. The most common taxa comprising the carbonized wood category are the red and white oak groups at 34.5%; pine, 29.5%; hickory, 20.4%; and cane, 7.1%. Taxa growing in an uplands habitat account for 58.7% (n=1,250); 37.2% (n=792) of the wood is from disturbance-favored species. Genera typically growing in a bottomlands habitat constitute 4.1% (n=88) of the charred wood specimens.

Approximately 78% of the nutshell is hickory; 19%, walnut; and 3%, acorn (*Quercus*). A minor percentage (<1%) of hazelnut (*Corylus americana*) is from bottomland habitats.

A total of 440 whole and broken seeds was recovered from the Middle Woodland component. Like the Early Woodland seed spectra, almost all seeds represent plants with economic or subsistence value as indicated by archaeological or ethnographic evidence. The procurement of seeds and fruits at Icehouse Bottom clearly indicates selection of plants from disturbed lower-terrace environs. The most numerous specimens are maygrass (n=131) and maize (*Zea mays*). The 107 maize fragments (1.18 g) (Cridlebaugh 1981:174) provide the first evidence of this domesticated plant at

1,545 B.P. (Chapman and Shea 1981:72) in the lower Little Tennessee River Valley. Maygrass may well have been growing in abandoned garden areas or in direct association with the maize.

Plant Remains of the Early Mississippian Period

Charred wood recovered from two Early Mississippian period sites representative of the Hiwassee Island/Martin Farm phase consists of 5,180 fragments. Most prevalent are oak, 36.2%; hickory, 29.8%; and pine, 15.2%. Approximately 5% of the total is cane. Ranked by habitat, species representative of mesic and xeric upland habitats constitute 72.1%; disturbance-favored, 23%; and bottomland, 4.9%.

Less than 1% of the 815.16 g of nutshell is from a bottomland-favored species. The majority is comprised of upland-favored hickory, acorn, walnut, and chestnut.

Fruits of honey locust, persimmon, cherry, and grape account for 10.5% of the fruit and seed material. Nine plant species typical of disturbed lands and old fields (i.e., fallow land) provide 41.2% (n=609) of the total. Five species classified as probable domesticated plants growing in old or cultivated fields comprise 47% (n=692). Particularly abundant are knotweed (32.4%) and goosefoot (12.1%). Plants such as Compositae, morning glory *(Ipomea)*, and passionflower *(Passiflora incarnata)* which grow in old field habitats are abundant as 41.2% of the total.

Principal fruit and seed remains, however, are domesticated cucurbits and maize. Maize comprised over 93% (122.41 g) of the total weight (131.19 g) for fruits and seeds.

Plant Remains of the Late Mississippian Period

Paleoethnobotanical material was recovered from 97 contexts at one Dallas phase site, Toqua. Charred wood fragments of 28 taxa are principally of disturbance-favored (43.9%) and upland-favored (41%) species. The remaining 15.1% represent genera which commonly grow in bottomland habitats. Specifically, most numerous are pine, 27.1%; red and white oak groups, 20.1%; cane, 11.5%; ash, 11.2%; and cedar, 5.3%.

Hickory is highly abundant at 85.2% of the total nutshell remains. Walnut and acorn constitute approximately 12% and 3% of the total.

The percentage of indigenous fruit and seed remains such as persimmon (Diospyros virginiana) (8.9%), grape (7.9%), and passionflower (8.2%) indicate bottomland and disturbance-favored species were common during the Late Mississippian period. Quantities of sumpweed (Iva annua) (n=445), the first evidence (ca. 600 B.P.) in the area of beans (Phaseolus vulgaris) (1.25 g), and 69.61 g of maize suggest probable domesticated plants and domesticated plants growing in old fields and cultivated fields were of significant importance in the diet. Calculated by total

fruit and seed gram weight, domesticated species comprise approximately 86% (n=70.93 g) of the total (82.85 g) sample.

Plant Remains of the Historic Cherokee Period

Thirty-three arboreal taxa are represented in the wood charcoal identified from 206 Overhill Cherokee archaeological contexts. Twelve of these are bottomland taxa which represent only 4.2% of the total. Fifty percent of the material is from species which typically grow in upland habitats; most common are fragments of the red and white oak groups (29%) and hickory (14.9%). Disturbance-favored taxa are well-represented as 45.8% of the total wood material. The two most abundant species are pine, 27.4%, and cane, 16.9%.

As during the previous Mississippian occupation, hickory is the most common nutshell at 61.3% (275.15 g). Walnut is quite abundant at 38.3% (172.09 g) while acorn (1.48 g) and hazelnut (0.04 g) are insignificant.

Approximately 80% of the seed and fruit remains are of species which grow on disturbed or fallow soil. Although only 4.7% are probable domesticated plants, cucurbits (3.45 g), beans (89.27 g), maize (1169.35 g), and peaches (Prunus persica) (620.7 g) predominate the seed and fruit spectra. These domesticated plants comprise 99.5% of the total gram weight (1892.71 g) of seed and fruit remains recovered from Overhill Cherokee components.

Summary

These paleoethnobotanical data document specific plant species exploited by prehistoric humans in the lower Little Tennessee River Valley. Indian plant utilization patterns are illustrated for each cultural phase of the Early Archaic through Historic Cherokee periods. Plant species within their specific habitat categories indicate progressive landscape vegetation change through time. Upland species, represented by charred wood and nutshell fragments such as oaks, hickory, and walnut, were utilized consistently through time. Patterns in the procurement of wood of bottomland and disturbed land species, however, reversed from the Early Archaic to Historic Cherokee periods. The continuous increase from the Late Archaic Savannah River phase to the Historic Overhill Cherokee phase in use of wood of species (pine) which characteristically grow on disturbed land was accompanied by an increase in probable domesticated and domesticated plants. Thus, progressive landscape clearance is suggested by increased representation of early-successional plants affiliated with an open, disturbed habitat.

CHAPTER IV

THE PALYNOLOGICAL RECORD

Introduction

Records of continuous vegetation change through time are established by plant micro- and macrofossils preserved in sediments (Faegri and Iversen 1975). Charcoal particles, deposited and preserved with pollen, provide data concerning fire history (Swain 1973). Pollen, differentially dispersed by plant species, is most typically mixed by atmospheric turbulence and deposited as a "pollen rain" (Birks and Birks 1980). The pollen rain is comprised of pollen grains and spores which originated from the plant community at one time. The pollen spectrum, therefore, provides a spatial and temporal representation of vegetation; a stratigraphic sequence of pollen spectra may be used to reconstruct past vegetation and climatic conditions. Variables of pollen release (Ogden et al. 1969), dispersal (Currier and Kapp 1974), deposition (Tauber 1965; Raynor et al. 1970; Davis 1968, 1973; Davis and Brubaker 1973), and preservation (Sangster and Dale 1964; Cushing 1967; Havinga 1967; Hall 1981) have been investigated extensively.

If pollen sampling sites can be located within close geographical proximity to archaeological sites, opportunities can be enhanced for the identification, in palynological

data sets, of local, fine-scale paleoenvironmental conditions. Evidence for vegetation and land-use patterns is provided by sediment lithology in conjunction with assemblages of plant fossils. Changes in sedimentation rate may be as strong an indicator of human-induced landscape change as are pollen of indicator plant species. Davis (1976) and Brugam (1978) documented variation in sediment deposition rates which correlated with human settlement. Brugam (1978) found that marked increases in sedimentation rate at Linsley Pond, Connecticut corresponded with the first appearance of indicator plant species (i.e., *Ambrosia* and *Rumex*) for Euro-American settlement.

Palynological studies can also be effective for the identification of prehistoric archaeological sites. McAndrews et al. (1974) identified maize (*Zea mays*) pollen dating from A.D. 1330 to A.D. 1509 in sediments from Crawford Lake, Ontario. This evidence of nearby maize agriculture precipitated archaeological survey, location, and subsequent excavation of an Iroquoian village situated approximately 180 m northwest of the lake (McAndrews et al. 1974:7; Finlayson 1973).

Fieldwork

A major research objective was recovery of fossil pollen-bearing sediment cores from within 3 km of archaeological sites in the lower Little Tennessee River

Valley. One sample of pollen-bearing buried gley sediments had been recovered from Icehouse Bottom (40MR23) during backhoe archaeological and geomorphological testing, but this did not constitute an adequate sample. Therefore, geologic and topographic maps of the Tellico Project area prepared by the Tennessee Valley Authority and the United States Geological Survey were examined to locate natural ponds within the research area. Several small ponds within the vicinity of prehistoric human occupation sites were evaluated. Recent pond history was ascertained through interviews with local landowners and informants. Natural ponds with no known historic alterations or periods of drying were selected for testing. A Davis Corer was used to probe the sediments of ponds for the recovery of samples at a sediment depth of 1 m or greater for preliminary analyses of well-preserved plant micro- and macrofossil assemblages.

Site Descriptions

Tuskegee and Black ponds were selected for subsequent detailed studies. These ponds are situated within 3 km of major archaeological sites.

Tuskegee Pond (Figure 5) is located in Monroe County, Tennessee at 35°35'5" N. and 84°12'38" W. at an elevation of 240 m above mean sea level. Prior to inundation by the Tellico Reservoir, this 80x40 m pond was situated in the scourpool of the abandoned river channel on the third

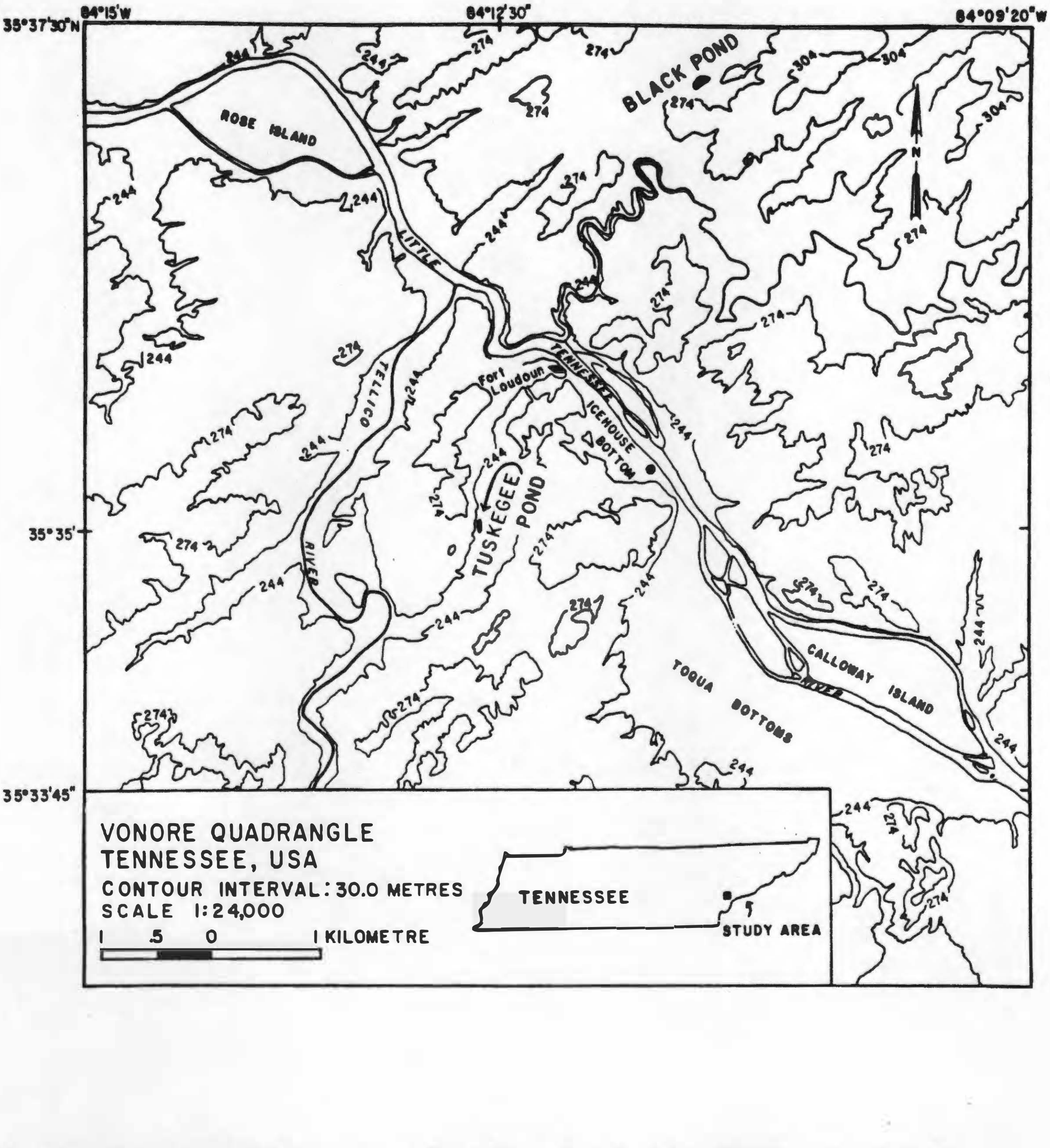

Figure 5. Location map of palynological sites, Icehouse Bottom, Tuskegee Pond, and Black Pond, in relation to reference site, Fort Loudoun; lower Little Tennessee River Valley.

terrace surface (Delcourt 1980b). Modern vegetation in the immediate vicinity of the pond consists of second-growth forests of oak (*Quercus* spp.), hickory (*Carya* spp.), and Virginia pine (*Pinus virginiana*) on the nearby bedrock uplands. Maize (*Zea mays*) and soybeans (*Glycine max*) were cultivated in fields on the Terrace 3 surface.

The second palynological site, Black Pond, is located 4.5 km northeast of Tuskegee Pond in Loudon County, Tennessee at 35°37'15" N. and 84°11'12" W. (Figure 5). Black Pond, an upland sinkhole, is situated at 262 m above mean sea level. This 160x80 m pond is spring-fed. Modern vegetation of the pond marsh includes cat-tail (*Typha latifolia*), arrowhead (*Sagittaria* sp.), grasses (Gramineae), and willow (*Salix* spp.). Grasses, knotweed (*Polygonum* sp.), willow, sweetgum (*Liquidambar styraciflua*), and sycamore (*Platanus occidentalis*) grow in the aquatic littorial zone. Grasses, clover (*Trifolium* spp.), sedges (Cyperaceae), weedy nightshade (*Solanum* spp.), knotweed, sweetgum, sycamore, willow, and persimmon (*Diospyros virginiana*) grow at the pond margins. Vegetation of the moderate to steep upland slopes consists of hickory, oak, walnut (*Juglans nigra*), cedar (*Juniperus virginiana*), pine, hophornbeam (*Ostrya virginiana*) and flowering dogwood (*Cornus florida*).

Coring Technique

A platform raft was anchored for coring at the

geographic center of each pond. Core segments 5 cm in diameter and lengths up to 1 m were obtained with a modified Livingstone square-rod piston corer (Wright 1967). A 1.4 Mg chain hoist facilitated recovery and extrusion of sediment cores. Lithology and sediment color (Munsell 1975) were described for each core segment. Each segment was wrapped in plastic wrap and aluminum foil to retard water loss and oxidation and then transported to the University of Tennessee, Knoxville, for processing.

Laboratory Analyses

Each sediment core was subsampled for pollen analysis, plant macrofossil analysis, and radiocarbon determinations. The Tuskegee Pond core was also sampled for loss-on-ignition (LOI) analysis. Prior to subsampling, the outer core surface was scraped clean to a depth of approximately 2 mm to insure an uncontaminated surface. A 1-cm^3 calibrated brass sampler (Birks 1976) was used to obtain paired sediment samples at regular depth intervals (typically 2.5 cm or 5 cm intervals) from cores for loss-on-ignition (LOI) and pollen analyses. Nineteen samples for loss-on-ignition, according to Dean's (1974) procedure, were processed from Tuskegee Pond (TPT79A) for determination of organic matter, minerals, water content, and bulk density. Samples were successively heated at 100°C, 550°C, and 1,000°C to remove water, organic matter, and carbonate minerals, respectively. Noncarbonate minerals

comprised the final residue. LOI data are presented in Appendix C. A total of 22 sediment samples for pollen analysis was taken from the TPT79A core; 43 levels were sampled for pollen in the Black Pond core (BPT82A).

Palynological Analyses

Eucalyptus pollen tablets were weighed on an Ainsworth balance and added to each sediment sample at the initial stage of chemical preparation. The *Eucalyptus* tablets (Batch # 903722; Stockmarr 1971) contain 16,180± *Eucalyptus* pollen grains per whole tablet (Maher 1977). These exotic pollen grains are routinely added to each sediment sample in order to calibrate concentration and influx for indigenous pollen and charcoal particles. The chemical procedure for concentration of pollen grains, following that of Delcourt and Delcourt (1981) as modified from Faegri and Iversen (1975) and Cushing (1977), accomodates sediment high in clay and silt-sized silicate minerals. This laboratory procedure was applied to pollen preparations for both Tuskegee and Black ponds and is described below.

1. Transfer sediment and *Eucalyptus* pollen tablet to a 15 ml polypropylene centrifuge tube with 5 ml to 10 ml 10% hydrochloric acid (HCL), stir, heat several minutes in boiling water bath until chemical reaction with calcareous sediments and carbonate matrix of the *Ecalyptus* tablet ceases, add 1 ml tertiary butyl alcohol (TBA), centrifuge

for two minutes, decant supernatant into a polypropylene bucket containing sodium bicarbonate.

2. Add 8 ml to 10 ml 10% potassium hydroxide (KOH), stir, heat for two minutes in boiling water bath, stir occasionally, add 1 ml TBA, centrifuge for two minutes, decant.

3. Wash with 10 ml distilled water until supernatant is clear, stir, add 1 ml TBA, centrifuge for two minutes, decant. This step of washing with distilled water was generally repeated six to eight times.

4. Add 10 ml 10% HCL, stir, add 1 ml TBA, centrifuge for two minutes, decant.

5. Add 5 ml concentrated hydrofluoric acid (HF), stir, heat in boling water bath 20 minutes (stir after 10 minutes), add 5 ml 95% ethyl alcohol (ETOH) to reduce liquid density, add 1 ml TBA, centrifuge for four minutes, decant. If quartz particles remained in the sediments, this step was repeated one time.

6. Add 5 ml concentrated HCL, stir, heat in boiling water bath for 12 minutes (stir after six minutes), add 5 ml ETOH, centrifuge for four minutes, decant. This step removes silicofluoride gel that forms from HF reaction with silicate-rich sediments. This step was repeated one time for samples initially rich in quartz.

7. Rinse with 10 ml glacial acetic acid to further dehydrate sample, stir, add 1 ml TBA, centrifuge two minutes, decant.

8. Acetolyze sample by adding 4.5 ml acetic anhydride, then add 0.5 ml concentrated sulfuric acid, and then stir well; heat one minute in boiling water bath (stir after 30 sec, add 5 ml glacial acetic acid, stir, centrifuge two minutes, decant.

9. Rinse with 10 ml glacial acetic acid to remove the acid-soluble products of acetylation; stir, add 1 ml TBA, centrifuge for two or three minutes, decant.

10. Rinse with 7 ml distilled water and 3 ml 10% KOH to neutralize liquid and disperse residue material, stir, add 1 ml TBA, centrifuge for two minutes, decant.

11. Add 10 ml distilled water, stir, add 1 drop 0.5% Safranin O stain; stir, add 1 ml TBA, centrifuge for two minutes, decant.

12. Wash with 10 ml TBA to dehydrate residue, stir, centrifuge for two minutes, decant.

13. Transfer to labeled 1 dram vials with TBA (vials must be clean and dry before use); add TBA if necessary, centrifuge for two minutes, decant.

14. Add a few drops of silicone oil (viscosity of 12,000 centistokes), stir, allow TBA to evaporate overnight in a dust-free environment.

Slides were prepared for counting by mixing silicone oil (12,000 centistokes viscosity) and pollen residue on a microscope slide covered with a 22x22 mm coverslip (No. 1 Thickness). Each corner of the coverslip was anchored in

position with clear fingernail polish. This permitted pollen grains to be rolled in orientation with minimum lateral displacement. Transects for pollen counts were regularly made across the whole coverslip at systematic non-overlapping intervals to eliminate sampling bias.

Pollen and spore grains were counted on a Leitz Dialux 20 microscope at a magnification of 600X (numerical aperture 40) and, for detailed resolution under oil immersion, at 1,250X (numerical aperture 100) magnification. Primary palynological identification keys and reference sources included Kapp (1969), McAndrews et al. (1973), Bassett et al. (1978), Erdtman (1966), Lieux (1980; 1982), Belling and Heusser (1974) and the reference slide and literature collection of the Program for Quaternary Studies at the University of Tennessee, Knoxville.

Four major categories of pollen and spores were quantified. A minimum of 300 grains of arboreal pollen (AP) was counted for each sediment level. This sum has been established by Hazel Delcourt (1979) as the minimum number of arboreal pollen (AP) for reproducible results in the southeastern United States. Each bladder (or bladder with attached cap fragment) of a conifer pollen grain was tabulated as 0.5 grain. Whole and partial tetrads of Ericaceae and Typha latifolia were recorded, but each occurrence was counted as one dispersible unit (i.e., one grain) in the AP Sum. Nonarboreal pollen (NAP) consist of

shrubs, vines (lianas), upland herbs, upland ferns, horsetails, club mosses, and unknown pollen and spores. Morphologically intact and well-preserved specimens that could not be identified to plant taxon were tallied as grains of unknown pollen or spores. A third palynomorph category is obligate aquatics. The final category, indeterminate grains, consists of grains rendered morphologically unidentifiable as a product of corrosion, degradation, mechanical damage, or concealment (classification following Delcourt and Delcourt 1980). Native and exotic pollen and spores were tabulated on a denominator tally counter. Final pollen and spore counts are included in Appendices D, E, and F.

Percentages of arboreal pollen were calculated from the sum of arboreal pollen grains, while the Sum for Upland Pollen and Spores (i.e., AP and NAP) was used to calculate percentages for shrubs, vines, upland herbs and ferns, horsetails, club mosses, and unknown pollen and spores. Percentage values for aquatic pollen and spores were calculated based upon the combined total for the upland sum plus total for aquatic pollen and spores. Indeterminable pollen percentages were calculated based upon the combined total for the Upland Sum plus all aquatic grains plus all indeterminable grains. Native pollen and spore concentrations and influxes were calculated according to the following two formulae in Table 4.

Table 4. Formulae used to calculate native pollen and spore concentrations and influxes, Tuskegee Pond (TPT79A) and Black Pond (BPT82A), Tennessee.

Palynomorph Concentration

$$C= \frac{a}{b} X \frac{c X d}{e}$$

Where: C= Concentration
a= Total sum for all pollen and spore grains tallied
b= Number of *Eucalyptus* grains tallied
c= *Eucalyptus* grains (16,180 per tablet)
d= Number of *Eucalyptus* tablets
e= 1 cm^3 sediment

Palynomorph Influx

$$I= c X r$$

Where: I= Influx (units of grains/cm^2 sediment/year)
c= Concentration
r= Deposition rate (units of cm/year)

Charcoal particles were quantified using microscope slides made from the palynological residues. Particles of wood charcoal were recognized as dark-brown and black (carbonized) particles with outermost translucent, red perimeters (criteria following Swain 1978). Charcoal particles were counted along with Eucalyptus pollen within each transect. Number and cross-sectional area of charcoal particles were tallied within 18 particle diameter groups greater than from 5.7 μm (Appendix G). Particles with a longest diameter of less than 5.7 μm were not recorded. Swain's (1978) method was used for determining total cross-sectional area of charcoal particles. The number of particles within each size (cross-sectional area) group was multiplied by the average (mid-point) cross-sectional area for each group. Total cross-sectional area was summed for all charcoal groups for each stratigraphic level (Appendix G). Charcoal concentration and influx were determined by applying the appropriate palynomorph formulae for cencentration and for influx.

Tuskegee Pond

Sediment Lithology

Two sediment cores laterally spaced 1 m apart were recovered during December 1979 from the geographic center of Tuskegee Pond. Core TPT79A extended from 40 cm to 212 cm below the water surface. Core lithology with

Munsell (1975) color designations is described in Table 5. Loss-on-ignition curves (Figure 6) indicate values for bulk density which fluctuate from 1.1 g/cm^3 of sediment (60 cm depth) to 1.3 g/cm^3 (75 cm depth) between the core interval from 55 to 100 cm. Greatest values for bulk density (1.4 to 1.6 g/cm^3) occur in clayey silt and sandy silt deposits from 110 cm to 120 cm depth. Minerals generally comprise over 90% of the dry weight of sediments with values ranging from 0.6 to 1.9 g/cm^3 (Figure 6). Overall, organic matter values range from 0.05 to 0.09 g/cm^3 (Figure 6).

Table 5. Lithologic description of sediment Core TPT79A, Tuskegee Pond, Tennessee.

Depth (cm) Below Water Surface	Sediment Lithology
40	Sediment-water interface
40-53	Water-saturated, unconsolidated sediment; 10YR 3/3 (dark brown).
53-119	Consolidated, slightly silty clay; 10YR 3/3 (dark brown).
119-151	Silty clay; 10YR 3/2 (very dark grayish brown).
151-185	Clayey silt; 10YR 4/2 (dark grayish brown).
185-199	Slightly sandy clayey silt; 10YR 3/3 (dark brown).
199-205	Clayey sandy silt; 10YR 4/3 (dark brown).
205-212	Clayey silty sand; 10YR 5/4 (yellowish brown).

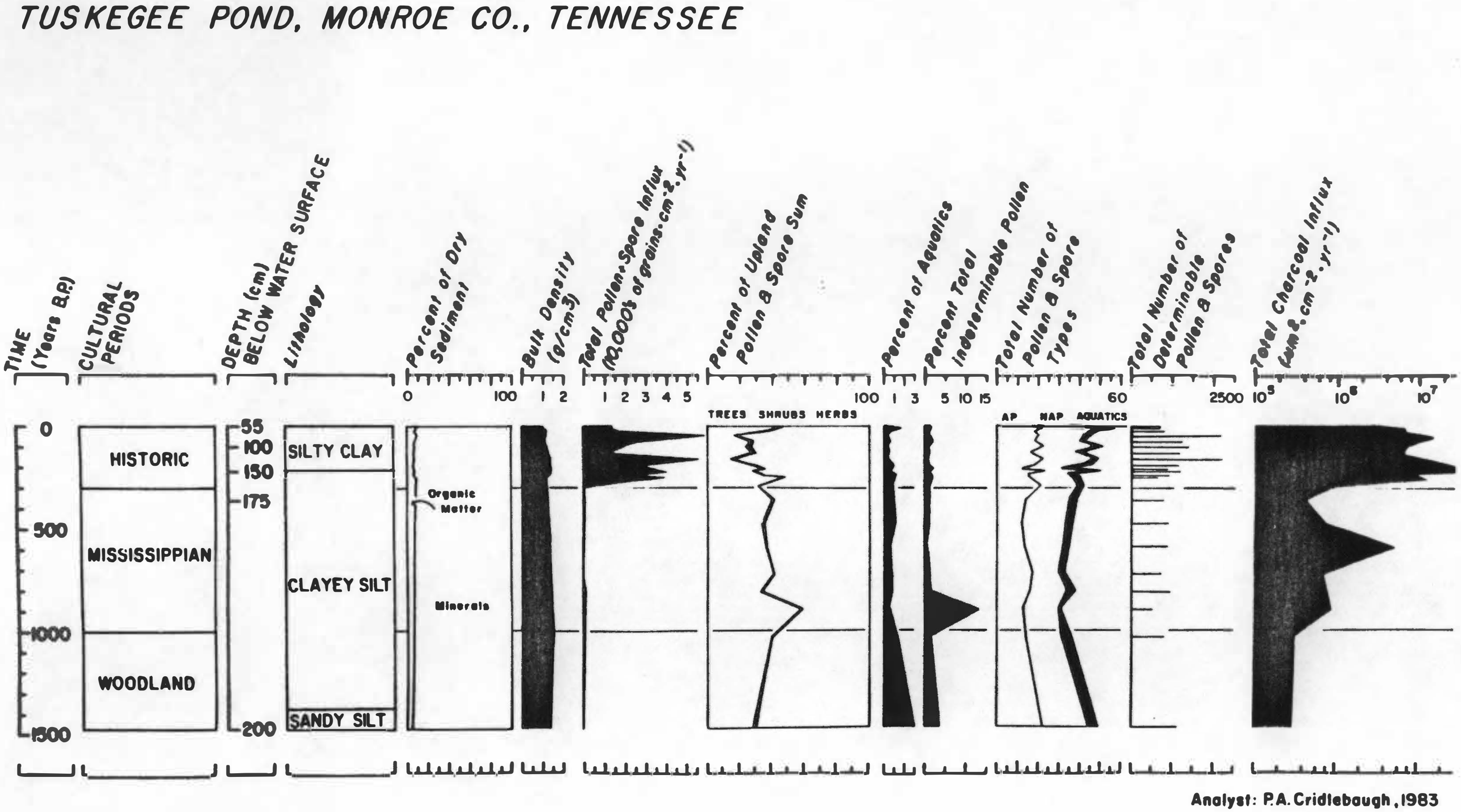

Figure 6. Summary diagram of sediment lithology, loss-on-ignition, pollen, and charcoal analyses of Core TPT79A, Tuskegee Pond, Monroe County, Tennessee.

Chronology

Three core segments, each 5 cm in diameter, were submitted for radiocarbon dating to the Radiocarbon Laboratory at the Center of Climatic Research, University of Wisconsin, Madison. Depth intervals of the core segments, radiocarbon age, and deposition rates are summarized on Table 6. The age of each pollen sample was calculated by linear interpolation between known ages. Holocene infilling of Tuskegee Pond commenced approximately 2,000 B.P., possibly reflecting a minor climatic change with increased precipitation and increasing water depth in the pond basin.

Deposition of sediments was gradual from 1,630 B.P. to 250 B.P. with an average deposition of 0.022 cm/yr. The slow sedimentation rate during this interval is reflected in low values of pollen influx from 304 to approximately 1,000 grains$\cdot$cm$^2\cdot$yr (Figure 6). Rapid deposition occurred from 250 B.P. to the present with rates ranging from .790 to .349 cm^2/yr. During this 250 B.P. to present time interval, pollen influx rose to values greater than 50,000 grains$\cdot$cm$^2\cdot$yr.

Pollen Spectra

Pollen diagrams for Tuskegee Pond (Figures 7 and 8) are plotted against time expressed in radiocarbon years B.P. Thus, these pollen diagrams document changes in arboreal, nonarboreal, and aquatic plant assemblages at Tuskegee

Table 6. Depth intervals, radiocarbon determinations, and deposition rates for Tuskegee Pond, Core TPT79A.

Depth Interval (cm)	Midpoint Depth (cm)	Age (yr B.P.)	Laboratory Number	Time Span (yr)	Sediment Thickness (cm)	Deposition Rate (cm/yr)
53.0 (Surface of consolidated sediment)	53.0	0 [a]		229 (29+200)	80.0	0.349
130.0 to 136.0	133.0	200±70	WIS-1307			
				50	39.5	0.790
170.0 to 175.0	172.5	250±70	WIS-1306			
				1,380	31.0	0.022
195.0 to 212.0	203.5	1,630±80	WIS-1313			
212.0	212.0	2,016 [b]				

[a]Cored in A.D. 1979; 29 years after C-14 base date of A.D. 1950.

[b]Age extrapolated from deposition rate of 0.022 cm/yr.

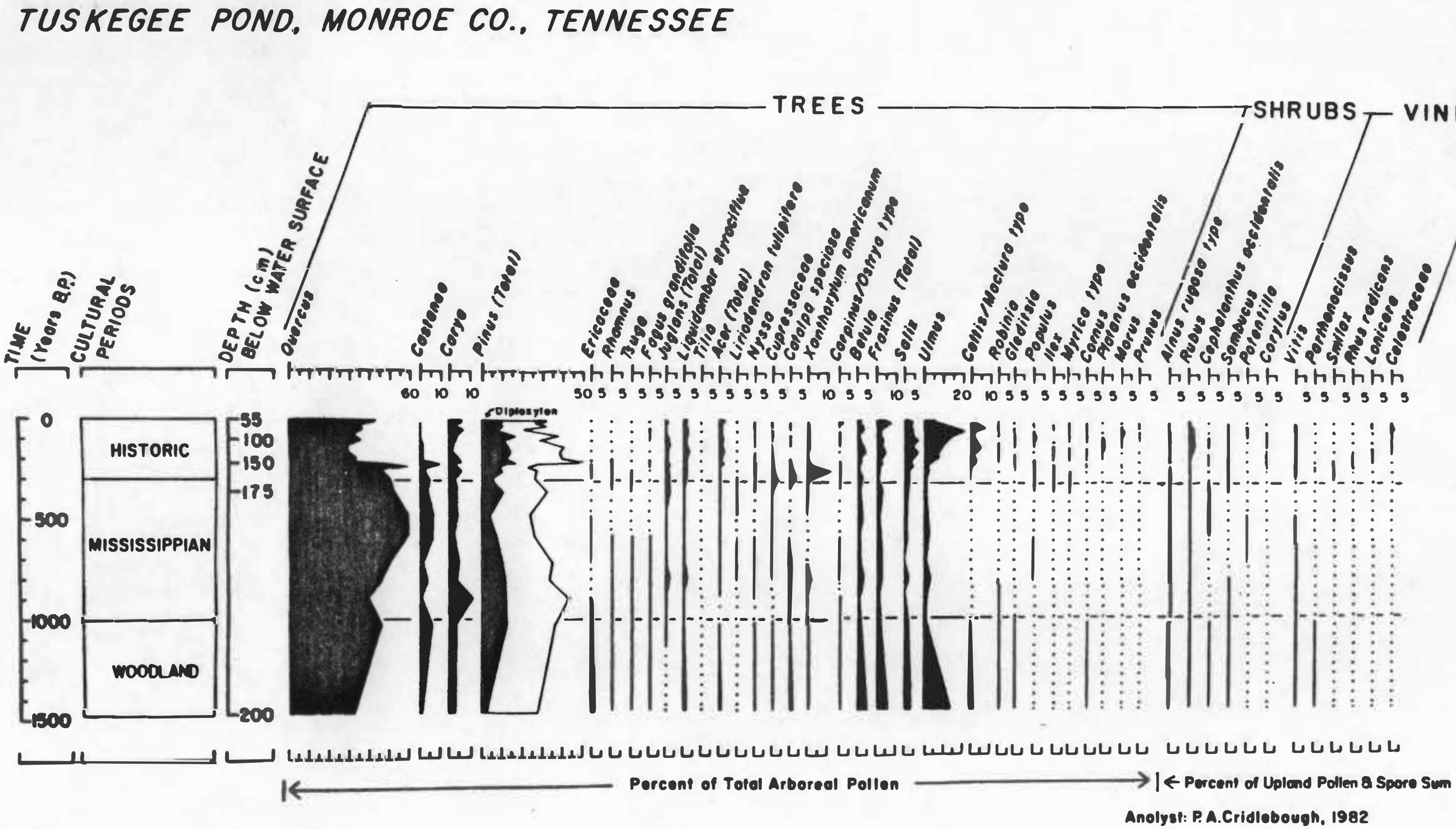

Figure 7. Summary diagram of pollen of trees, shrubs, and vines, Tuskegee Pond, Monroe County, Tennessee.

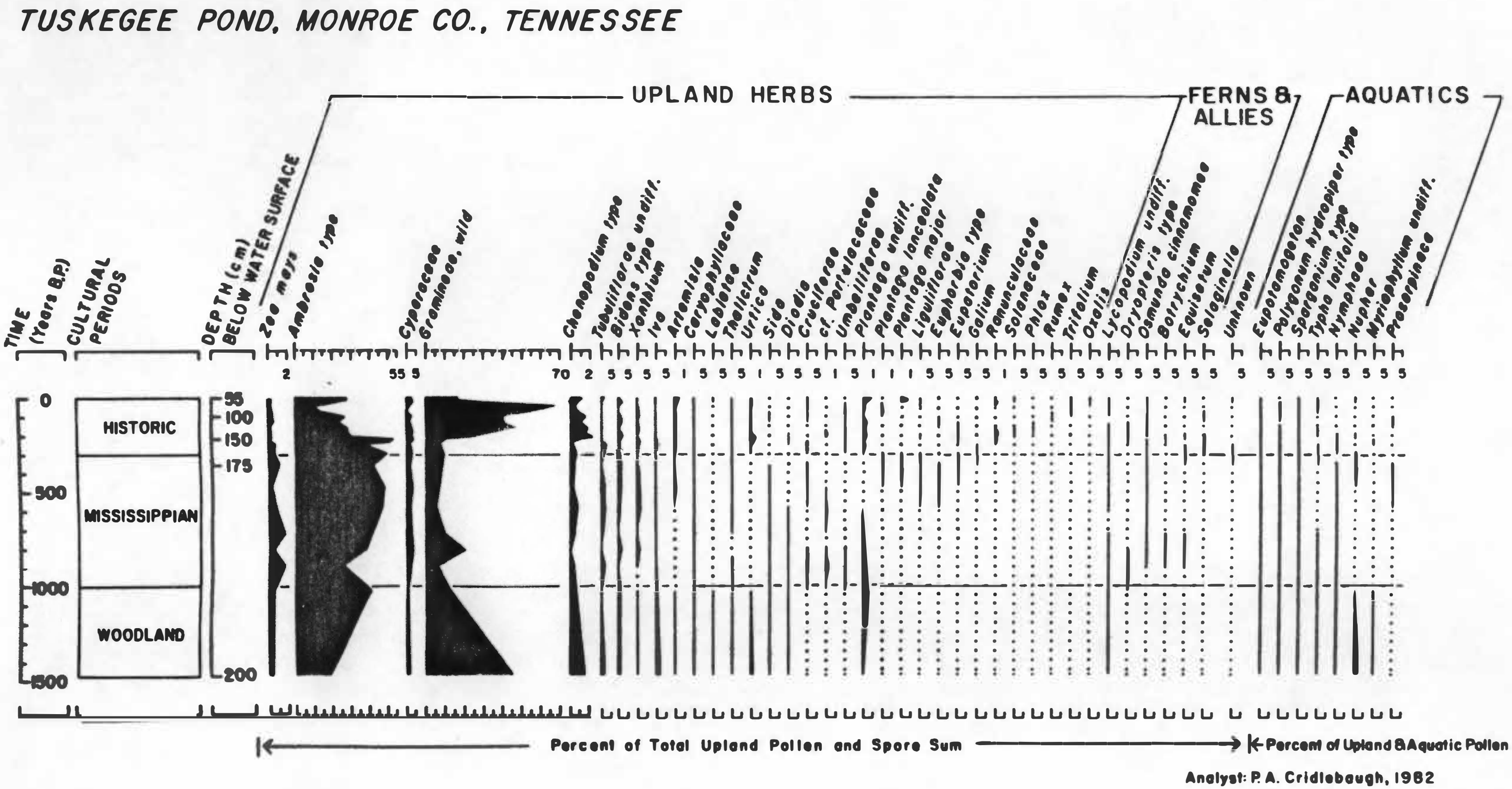

Figure 8. Summary diagram of pollen and spores of upland herbs, ferns and fern allies, and aquatics, Tuskegee Pond, Monroe County, Tennessee.

Pond for the past 1,500 years. Throughout this time, the pollen spectra were consistently dominated by four taxa, *Quercus* (29-59% of the AP Sum), *Pinus* (21-50% of the AP Sum), *Ambrosia* type (10-53% of the Upland Sum), and wild Gramineae (6-68% of the Upland Sum) (Figures 7 and 8). The diagrams are divided into informal pollen-assemblage zones that are concomitant with the prehistoric and historic cultural periods archaeologically defined within the lower Little Tennessee River Valley.

Woodland Period, ca. 1,500-1,000 B.P. (200 to 190 cm)

Quercus and *Pinus* dominated the arboreal pollen (AP) spectra during the Woodland period. Several percent of *Carya, Castanea,* Ericaceae, *Salix, Celtis/Maclura* type, and *Liquidambar styraciflua* occurred consistently throughout the period. Pollen of *Rhamnus, Tsuga, Fagus grandifolia, Acer, Nyssa,* Cupressaceae, *Catalpa speciosa, Xanthoxylum americanum, Carpinus/Ostrya* type, *Robinia, Gleditsia,* and *Cornus* were present in minor percentages. *Quercus* and *Pinus* accounted for approximately 30% and 25% of the AP Sum, respectively, during the late portion of the Middle Woodland period (ca. 1,500 B.P.). *Ulmus, Betula,* and *Fraxinus* were present at values of 1 to 10%. During the remainder of the Woodland cultural period, *Quercus, Pinus,* and *Castanea* increased in abundance while *Ulmus, Fraxinus,* and *Betula* pollen decreased.

The nonarboreal pollen (NAP) spectra were dominated by wild or nondomesticated Gramineae and *Ambrosia* type together with consistent occurrence of *Bidens* type, *Iva*, *Urtica*, and Cyperaceae. Traces of shrubs such as *Alnus rugosa* type, *Rubus*, and *Cephalanthus*; the lianas of *Vitis* and *Parthenocissus*; and a variety of herbs including *Artemisia*, Caryophyllaceae, *Thalictrum*, *Sida*, and *Diodia* occurred in this zone. *Zea mays* and *Plantago* (undifferentiated) pollen increased concurrently with a peak in *Ambrosia* type at 190 cm, during the transitional Late Woodland/Early Mississippian period.

Mississippian Period, ca. 1,000 to 300 B.P. (190 to 173.5 cm)

In the Early Mississippian period (ca. 1,000 to 900 B.P.), *Quercus* and *Castanea* pollen declined in percentage representation. At that time, *Pinus* increased to 43% and *Carya* increased to 11% of the AP Sum. *Betula*, *Fraxinus*, and *Salix* continued to decline gradually in abundance. At the 183 cm depth interval, circa 715 B.P., *Quercus*, *Castanea*, *Juglans*, *Liquidambar styraciflua*, *Xanthoxylum americanum*, *Betula*, *Fraxinus*, *Salix*, and *Ulmus* pollen increased in abundance. Nonarboreal pollen such as *Alnus rugosa* type, *Rubus*, *Sambucus*, *Vitis*, *Iva*, *Thalictrum*, Caryophyllaceae, *Sida*, and *Diodia* continued in trace amounts. *Ambrosia* type and Gramineae percentages declined at 900 B.P. (187 cm) while *Zea mays* peaked as 1.7% of the Upland Sum; these trends reversed by 800 B.P. (185 cm).

During the early portion of the Late Mississippian cultural period, circa 700 to 450 B.P., a major rise occurred in the abundance of Quercus up to 59% of the AP Sum. Pinus pollen fluctuated but exhibited a trend of decreasing abundance. Percentages of disturbance-favored taxa such as Liriodendron tulipifera and Cupressaceae (probably Juniperus virginiana) remained relatively constant during this time. A significant rise in Ambrosia type of up to 48% of the Upland Sum was accompanied by a slight increase in other Compositae types and in Chenopodium type. Percentages of Zea mays fluctuated from less than 1% to approximately 2% of the Upland Sum. During the latter portion of the Mississippian period (circa 450 to 300 B.P.), Catalpa speciosa, Juglans (both J. nigra and J. cinerea), Pinus, Cupressaceae, and Liriodendron tulipifera pollen each increased by a few percent. Ambrosia type declined in abundance and Zea mays increased slightly at approximately 360 B.P.

Historic Period, 300 B.P. to Present (173.5 to 53 cm)

Quercus pollen fluctuated between 45% and 59% of the AP Sum during the early stage of the Historic period; in contrast, Pinus averaged 26% of the AP Sum. By about 200 B.P. (140 cm depth), Pinus constituted 50% of the AP Sum and continued to be prevalent until about 45 B.P. (80 cm depth) when it decreased to 21% of the AP Sum. Ulmus contributed substantially to the spectra, ranging up to 20%.

Pollen grains of Castanea, Carya, Betula, Fraxinus, Salix, Acer, Juglans, Celtis/Maclura type, and Liquidambar styraciflua were present throughout the Historic period. Cupressaceae, Catalpa speciosa, and Xanthoxylum americanum pollen were most plentiful during the early portion of the Historic period but subsequently occurred in only minor amounts. Clumps of pollen grains of Xanthoxylum americanum in a pollen sample at the 170 cm depth reflected their limited dispersal from a nearby plant population.

Nonarboreal pollen taxa included Alnus rugosa type, Sambucus, Rubus, Chenopodium type, Urtica, and several species of Plantago (P. lanceolata and P. major). Zea mays persisted but in smaller percentages than during prehistoric times. Ambrosia type pollen constituted up to 53% of the Upland Sum during the early Historic period. After about 220 B.P., Ambrosia type decreased to less than 30% of the Upland Sum with Gramineae dominating the pollen spectra during the most recent Historic times.

Black Pond

Sediment Lithology

Two sediment cores laterally spaced 3 m apart were recovered in the deepest pool of water in the geographic center of Black Pond. During coring in July 1982, the water depth in Black Pond was 48 cm. Lithology of the sediment core is described in Table 7.

Table 7. Lithologic description of sediment Core BPT82A, Black Pond, Tennessee.

Depth (cm)	Sediment Lithology
0-103	Silty clay; 5Y 4/4 (olive gray); 0-10 cm flocculant, unconsolidated sediment; 10-103 cm consolidated sediment with carbonized plant macrofossils dispersed throughout interval.
103-171	Clayey silt; 5Y 4/2 (olive gray); carbonized plant macrofossils concentrated in horizontal layers.
171-186.5	Clayey silt; 2.5Y 4/2 (dark grayish brown); carbonized plant macrofossils dispersed throughout.
186.5-214	Clayey silt; 2.5Y 2/0 (black); plant macrofossils common throughout.
214-238	Clay; 2.5Y 3/0 (very dark gray); interbedded with fibrous peat.
238-257	Silty clay; 2.5Y 3/0 (very dark gray); with mottles 2.3Y 5/0 (gray) extending in subvertical wedges from 238-248 cm; sparse plant macrofossils from 248-257 cm.
257-269	Silty sand; 2.5Y 3/0 (very dark gray); grades from sandy silt to silty sand toward core base.

Chronology

Three 10 cm long segments from core BPT82A were submitted for radiocarbon dating to the Laboratory of Isotope Geochemistry, University of Arizona, Tucson. Radiocarbon dates from Black Pond represent the depth midpoint of each sample (Table 8). The sedimentation rate was 0.438 cm/yr between the sediment-water interface (A.D. 1982) and the radiocarbon date at 430$\pm$90 B.P. Examination of the pollen spectra indicates known ages for the European introduction of plant species (i.e., *Rumex*) (Kapp 1969; Reed 1971) in circa A.D. 1700 and the American chestnut (*Castanea dentata*) decline, circa A.D. 1925, (Anderson 1974) correlate well with interpolated ages (*Rumex*: 120 B.P., 70 cm depth; *Castanea*: 30 B.P., 30 cm depth) of sediment samples calculated from 430 B.P. to present. The 3,320$\pm$100 B.P. date is considered anomalous (Austin Long, personal communication 1982); it is older than the stratigraphically lower date of 2,840$\pm$150 B.P. at the 264 cm depth. The base of the core (269 cm) was extrapolated as 3,032 B.P.

Sediment deposition from circa 3,000 B.P. through 430 B.P. was consistently low, averaging 0.026 cm/yr. Mineral and organic deposition increased markedly to 0.438 cm/yr from 430 B.P. (at the 202.5 cm depth) to the present. Influx rates of pollen grains and charcoal particles show broadly parallel trends through time,

Table 8. Depth intervals, radiocarbon determinations, and deposition rates for Black Pond, Core BPT82A.

Depth Interval (cm)	Midpoint Depth (cm)	Age (yr B.P.)	Laboratory Number	Time Span (yr)	Sediment Thickness (cm)	Deposition Rate (cm/yr)
0.0 (Sediment-water interface)	0.0	0[a]				
				462	202.5	0.438
197.5 to 207.5	202.5	430±90[b]	A-3064			
				2410	61.5	0.026
259.0 to 269.0	264.0	2,840±150	A-2977			
269.0	269.0	3,032[c]				
ANOMALOUS DATE:						
225.0 to 235.0	230.0	3,320±100				

[a]Cored in A.D. 1982; 32 years after C-14 base date of A.D. 1950.

[b]430 years before A.D. 1950.

[c]Age extrapolated from deposition rate of 0.026 cm/yr.

as illustrated in Figure 9. Influx rates were relatively low at no greater than 900 grains$\cdot$cm$^2\cdot$yr from 3,000 B.P. to 430 B.P. These rates subsequently increased up to 53,000 grains$\cdot$cm$^2\cdot$yr in the Late Mississippian and Historic periods.

Pollen Spectra

Pollen spectra at Black Pond document the nature of vegetation change from approximately 3,000 B.P. to present (Figures 10 and 11). Arboreal and nonarboreal taxa that dominated the palynological sequence from Black Pond include *Quercus* (17 to 45% of the AP Sum), *Pinus* (17 to 68% of the AP Sum), and *Osmunda regalis* type (up to 39% of the Upland Sum). *Salix* primarily comprised a few percent of the arboreal pollen but was the dominant pollen type for an interval of approximately 120 years between 380 B.P. and 260 B.P. (180 to 130 cm depth) when it comprised 54% of the spectrum. *Ambrosia* type was less than 3% of the Upland Sum until 400 B.P. (190 cm depth), after which it increased in abundance of up to 61% of the total upland pollen.

Late Archaic Period, ca. 3,000 to 2,850 B.P. (269-265 cm)

Quercus was the most abundant pollen type in sediments dating from the Late or Terminal Archaic period. *Pinus* pollen fluctuated between 33% (269 cm depth) and 26% (267.5 cm depth) of the AP Sum during this period.

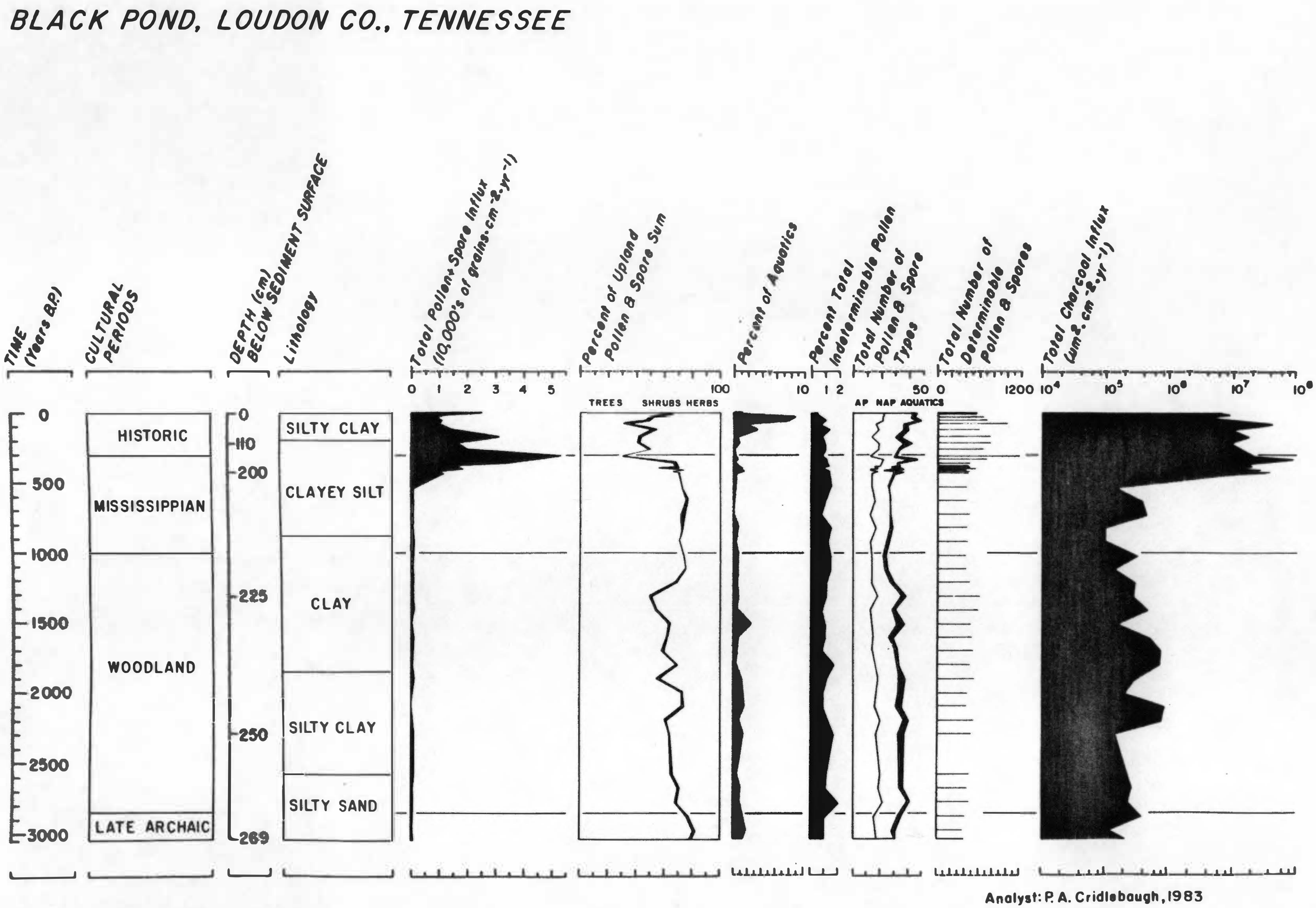

Figure 9. Summary diagram of sediment lithology, pollen, and charcoal analyses of Core BPT82A, Black Pond, Loudon County, Tennessee.

BLACK POND, LOUDON CO., TENNESSEE

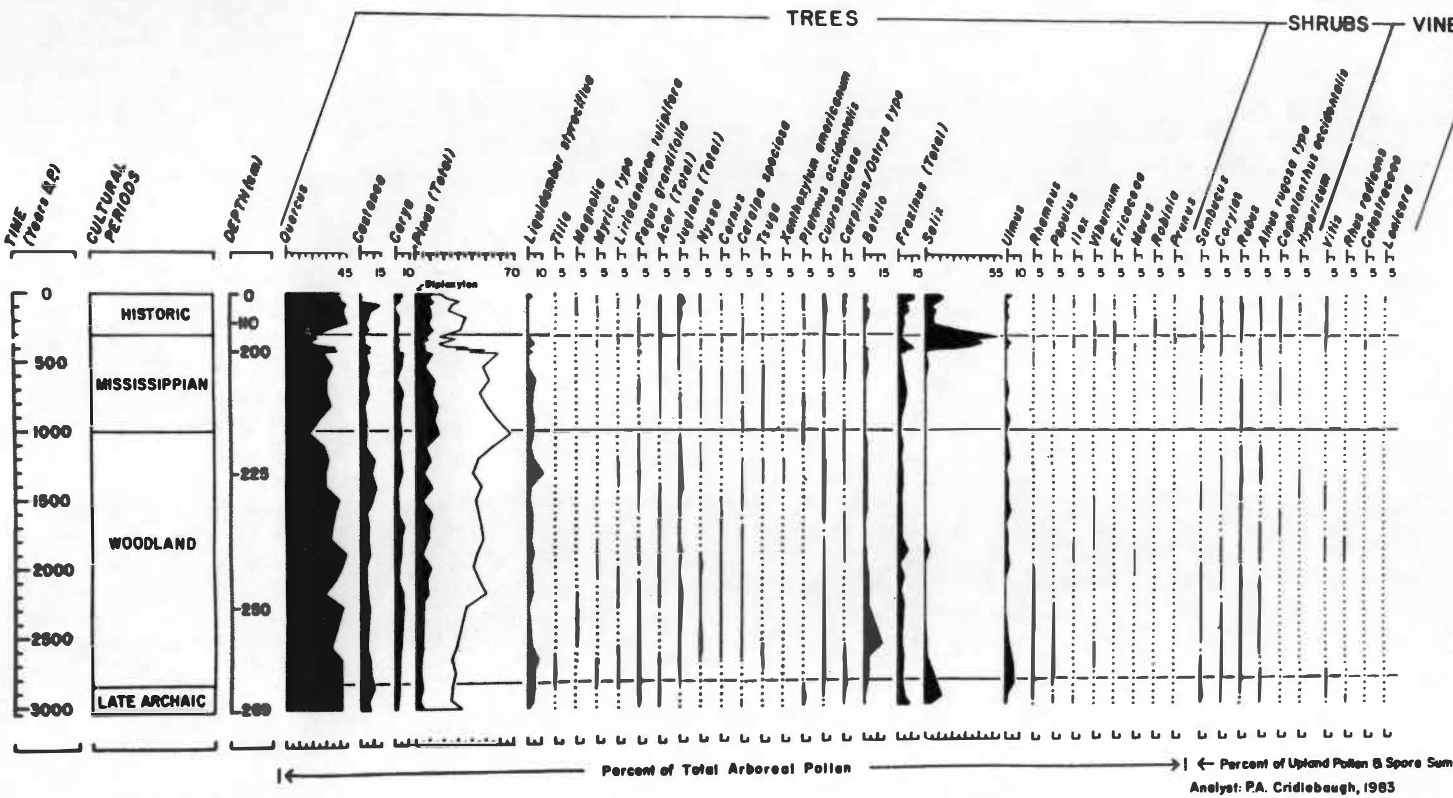

Figure 10. Summary diagram of pollen of trees, shrubs, and vines, Black Pond, Loudon County, Tennessee.

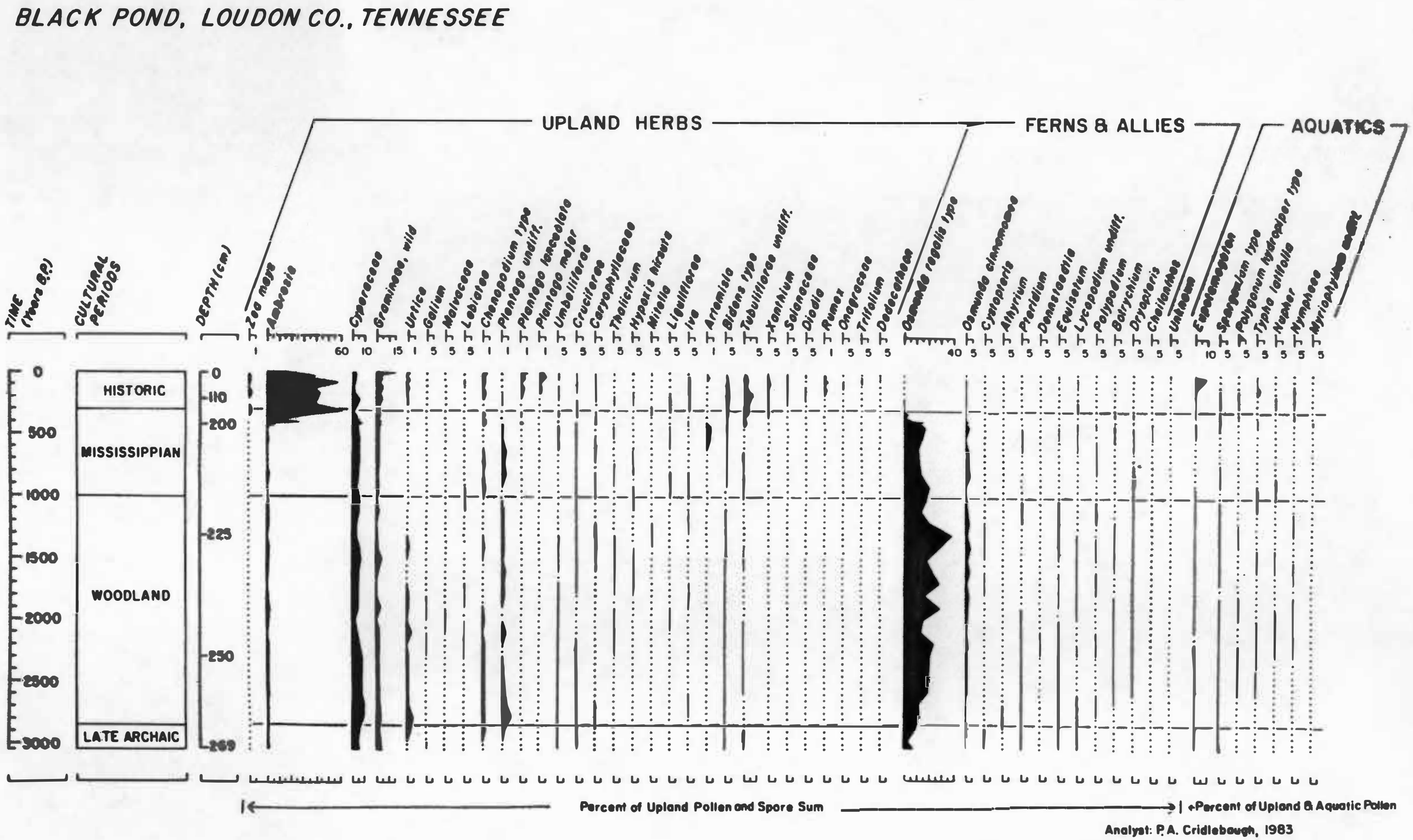

Figure 11. Summary diagram of pollen and spores of upland herbs, ferns and fern allies, and aquatics, Black Pond, Loudon County, Tennessee.

Castanea pollen occurred at 5 to 10% of the AP Sum along with 5 to 12% *Salix*, 5 to 8% *Fraxinus*, and 1 to 6% *Ulmus*. *Carya*, *Liquidambar styraciflua*, and *Betula* also comprised a few percent of the total arboreal pollen. Nonarboreal pollen constituted no greater than 35% of the total Upland Sum. NAP types consistently represented were *Osmunda regalis* type (5-12% of the Upland Sum), Cyperaceae, *Sambucus*, Gramineae, *Urtica*, *Chenopodium* type, *Plantago*, *Ambrosia* type, and *Osmunda cinnamomea*.

Woodland Period, ca. 2,850 to 1,000 B.P. (265 to 217.5 cm)

Pinus increased from 27 to 50% of the AP Sum at 2,200 B.P. during the Early Woodland period. A second peak of 68% *Pinus* occurred during the Late Woodland period. *Quercus* pollen fluctuated between 45% and 29% of the total AP Sum. *Castanea* and *Carya* remained relatively constant, between 4% and 7% of the arboreal pollen. *Castanea* was most abundant during the Middle to Late Woodland period transition about 1,400 B.P. (227.5 cm depth). Other upland taxa such as *Tilia*, *Magnolia*, *Liriodendron tulipifera*, *Fagus grandifolia*, *Rhamnus*, *Catalpa speciosa*, *Xanthoxylum americanum*, and *Tsuga* occurred in trace amounts. Bottomland taxa, including *Liquidambar styraciflua*, *Juglans* (*J. nigra* and *J. cinerea*), Cupressaceae (probably *Juniperus virginiana*), *Fraxinus*, *Salix*, and *Ulmus* each represented several percent of the arboreal pollen sum. *Betula* pollen

persisted at 2 to 3% except for a 17% spike in the AP Sum at the 257.5 cm depth level (Early Woodland, 2,590 B.P.). Upland pollen and spores were dominated by 12 to 39% Osmunda regalis type. Cyperaceae, Ambrosia type, Gramineae, Urtica, Chenopodium type, Plantago, and Osmunda cinnamomea each represented several percent of the upland pollen spectra. Sambucus, Corylus, Rubus, Alnus rugosa type, Cephalanthus occidentalis, Umbelliferae, Cruciferae, and Iva were present in trace amounts.

Mississippian Period, ca. 1,000 to 300 B.P. (217.5 to 150 cm)

Until the latter portion of the Late Mississippian period (450 to 300 B.P.), the arboreal and nonarboreal pollen spectra were similar to those of the Woodland period. Percentages of each plant taxon fluctuated slightly until approximately 425 B.P. (200 cm depth) when Quercus increased by 10% of the AP Sum; following that, it decreased to its lowest levels of abundance, 21%. Concurrently, Pinus began to decrease in quantity, a trend which continued to the present. The lowest contribution of Pinus to the arboreal pollen spectrum was 17% at about 300 B.P. at the transition from the Mississippian to Historic cultural periods. Salix contributed to the spectrum during the Late Mississippian period, rising in abundance from a few percent to 54% of the AP Sum. Deciduous taxa such as Fraxinus, Liquidambar styraciflua, Castanea, Carya, and Ulmus comprised several

percent of the pollen. Nonarboreal pollen grains and spores present at various intervals of the Mississippian period included Sambucus, Rubus, Alnus rugosa type, Vitis, Cruciferae, Umbelliferae, Thalictrum, Cyperaceae, Gramineae, and Pteridium. Artemisia occurred for the first time in the upland pollen assemblage during the Mississippian period 600 years ago. Zea mays occurred for the first time in the palynological record at Black Pond at approximately 350 B.P. during the Late Mississippian period. Coincident with the dramatic Pinus decline, Ambrosia type pollen began to rise and culminated in a high of 61% of the Upland Sum at 300 B.P. (150 cm depth). Conversely, Osmunda regalis type and Osmunda cinnamomea dropped to only a few percent of the total Upland Sum.

Historic Period, ca. 300 B.P. to Present (150 to 0 cm)

Subsequent to the Late Mississippian period Quercus and Pinus decline; both increased several percent by 215 B.P. Pinus pollen, however, remained less abundant than Quercus. Castanea constituted 5 to 15% of the AP Sum but declined below 1% approximately 55 B.P. (circa A.D. 1925 in East Tennessee). Carya, Liquidambar styraciflua, Juglans, Cupressaceae, Carpinus/Ostrya type, Betula, and Ulmus each represented a few percent of the arboreal pollen with greatest quantities present in the late Historic period. Salix pollen diminished to about 10% and Fraxinus

fluctuated between 3% and 12% of the AP Sum. Nonarboreal shrubs and vines included trace amounts of *Rubus*, *Cephalanthus occidentalis*, *Hypericum*, *Vitis*, and *Lonicera*. *Ambrosia* type percentages were consistently high during the Historic period with a 58% spike in the Upland Sum at 80 B.P. (50 cm depth). *Ambrosia* type decreased slightly in recent times and was contrasted by a recent increase in Gramineae. Other upland taxa present included *Zea mays*, *Chenopodium* type, *Plantago lanceolata*, *Plantago major*, Solanaceae, *Diodia*, *Dodecatheon*, Onagraceae, *Rumex*, and *Trifolium*. *Osmunda regalis* type gradually diminished to 0% of the Upland Sum during the early Historic period. The relatively high value of 9% of pollen of the aquatic plant, pondweed (*Eupotamogeton*), and a slight increase in *Typha latifolia* indicate that a shallow, marshy environment surrounded Black Pond during historic times.

Icehouse Bottom

A 9,380±215 B.P. (Chapman 1977:165) radiocarbon age was obtained from Terrace 1 culturally sterile, organic gley from the Icehouse Bottom (40MR23) site (Figure 1, page 6). The sample was from 7 m below ground surface. Detailed results of pollen analysis of these sediments analyzed by Hazel R. Delcourt (1982, unpublished) are included in Appendix F.

Pollen Spectrum

The arboreal pollen spectrum (Figure 12) was dominated by 41% Castanea and 22% Quercus with 8% Tsuga and 2% or less each of Tilia, Juglans, Fagus grandifolia, and Ericaceae. Bottomland-favored tree genera comprised 19% of the AP Sum with 8% of both Betula and Fraxinus. Pinus constituted only 3% of the AP Sum. Shrubs and nonaquatic herbs and ferns represented 10% of the Upland Pollen and Spore Sum which included 3% Alnus rugosa type and less than 1% Ambrosia type and Gramineae.

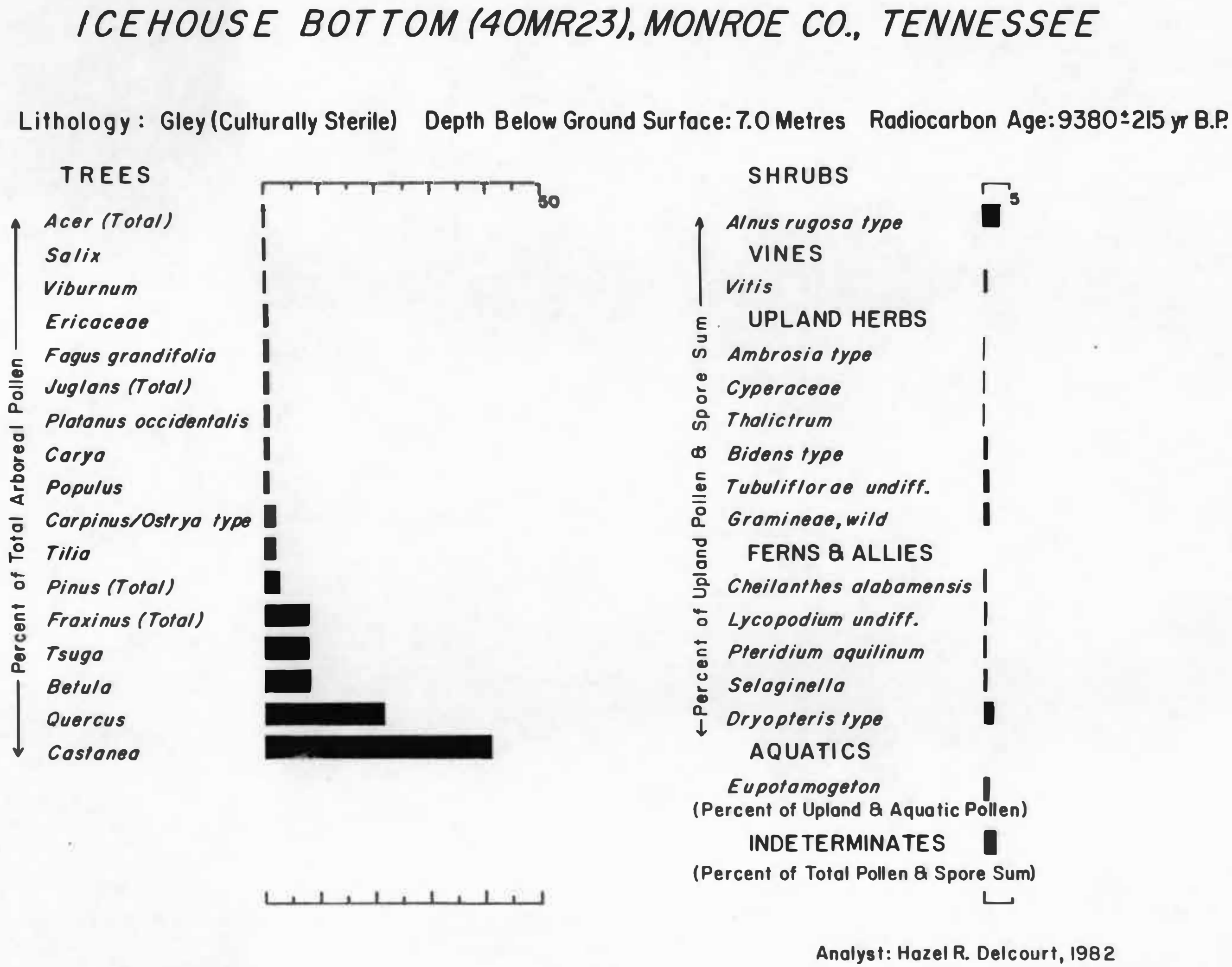

Figure 12. Summary diagram of pollen and spores of trees, shrubs, vines, upland herbs, ferns and allies, and aquatics, Icehouse Bottom site.

CHAPTER V

LATE-QUATERNARY FOREST COMPOSITION AND LANDSCAPE CHANGE IN THE LOWER VALLEY OF THE LITTLE TENNESSEE RIVER

Regional Paleoenvironment

The Pleistocene/Holocene boundary is time-transgressive, with postglacial climatic amelioration beginning first at 12,500 B.P. in the southeastern United States (Delcourt 1979; Delcourt and Delcourt 1981). It shifted later northward by 10,000 B.P. in the Great Lakes region (Bowan 1978: 106). In eastern North America, the Holocene is characterized by relatively minor climatic fluctuations that vary with intensity regionally (Wright 1968). Palynological evidence from the midwestern United States indicates a warm, dry Hypsithermal Interval from 8,500 B.P. to 4,000 B.P. with maximum warmth and dryness at 7,000 B.P. Palynological analyses of sediments from Anderson Pond, Middle Tennessee, identify a Hypsithermal Interval between 8,500 B.P. and 4,500 B.P. during which time the upland forests became more xeric (Delcourt 1979). Since these climatic fluctuations serve as forcing functions that resulted in changes in vegetation patterns (Delcourt and Delcourt 1981; 1983), postglacial environmental changes

were potentially important influences on prehistoric people's adaptations to the environment (cf. McMillan and Klippel 1981).

Based on late-Quaternary pollen diagrams, paleoenvironmental reconstructions document dramatic and discrete changes in the regional distribution of forest types in the southeastern United States (i.e., paleovegetation maps of Delcourt and Delcourt 1981). A jack pine-spruce (Northern Diploxylon *Pinus-Picea*) forest is mapped across East Tennessee at 14,000 B.P. Following the onset of the Holocene warming trend, East Tennessee was dominated by a mixed hardwood forest at approximately 10,000 B.P. By at least 5,000 B.P. and probably as early as 9,500 B.P., the areal extent of mixed hardwood forests within the Ridge and Valley Physiographic Province was progressively reduced as oak-chestnut (*Quercus-Castanea*) forests expanded along crests within the Ridge and Valley and in the adjacent Blue Ridge Physiographic Province. At approximately 200 B.P., forests established within the Southern Appalachian Mountains were dominated by oaks and chestnut. Remnants of mixed mesic hardwood forests were restricted to favorable, moist habitats such as coves within the nearby Great Smoky Mountains, mesic sites on low terraces in the Ridge and Valley, and ravines and gorges dissecting the Cumberland Plateau farther to the west (Delcourt 1979). Boreal forests of spruce and fir (*Abies*), initially widespread during

glacial times, were restricted to mountain crests above 1,524 m (Whittaker 1956). Both Braun (1950) and Shelford (1964) mapped the early historic forests as oak-chestnut with mixed mesophytic forests situated in the Appalachian Plateaus Physiographic Province to the west of the lower Little Tennessee River Valley.

Within 10 km east of the lower Little Tennessee River Valley, local vegetation and climatic changes have been determined for 6,600 B.P. to present at Lake in the Woods (Davidson 1983). This pond is located in Cades Cove in the western Great Smoky Mountains. Oak-dominated uplands and moist climatic conditions persisted from 6,600 B.P. to 6,300 B.P. From 6,300 B.P. to 1,900 B.P., drier climatic conditions were marked by continued oak dominance and increased chestnut and pine. Pine and oak were upland forest dominants after 1,900 B.P. to present.

Local Paleovegetation

Fine-scale, local paleoenvironmental reconstructions may be derived from palynological analyses of sediments from Icehouse Bottom, Black Pond, and Tuskegee Pond. The relatively high percentage of hemlock (Tsuga) at 9,500 B.P. from Icehouse Bottom is considered evidence that the local climate was slightly cooler and more moist during the early-Holocene than in the late-Holocene. The nearby Lake in the

Woods data reflects a warm and moist mid-Holocene (Davidson 1983). Using this as an analogue, it is assumed similar effects of the Hypsithermal Interval were also reflected in the vegetation of the lower Little Tennessee River Valley. At Black and Tuskegee ponds, for the past 3,000 years, oak, hickory, pine, and chestnut have dominated the arboreal pollen spectra. Of the variety of additional bottomland-favored taxa, ash, willow, elm, and birch were consistently represented throughout pond history. The Icehouse Bottom, Black Pond, and Tuskegee Pond data sets demonstrate that forests in the local study area were dominated by oak and chestnut with a mosaic of mixed mesic trees from approximately 9,500 B.P. to recent times. For the past 3,000 years, comprising the Late Archaic through Historic cultural periods, the forest represented a mosaic of oak-chestnut, cove hardwoods, and successional pine occupying undisturbed and disturbed upland sites.

Paleoecologic and Human Plant-Exploitation Patterns

Paleoethnobotanical remains represent plants exploited by prehistoric populations, but they also are an indication of plant species availability. Pollen assemblages from lacustrine sediments, on the other hand, are independent of human selection biases, but not human influence. Due to depositional and post-depositional variables of

paleoethnobotanical remains, short-term fluctuations of specific species representation are viewed with caution. Cumulative, long-term trends of both carbonized plant remains and fossil pollen are potentially more reliable indices of landscape and vegetation change. If prehistoric people significantly altered the vegetation in the lower Little Tennessee River Valley, then an increase in frequency of disturbance-favored, early-successional arboreal and nonarboreal species in paleoethnobotanical and palynological assemblages should correspond with cultural change. Increases in frequency and variety of herbaceous and cultigen species in the pollen and paleoethnobotanical diagrams should also occur at times of cultural change.

Interpretation of paleoethnobotanical and pollen data for each cultural period should facilitate evaluation of progressive landscape vegetation change and human plant-exploitation patterns in the lower Little Tennessee River Valley. Explication of this plant data is enhanced by a summary diagram of the relative percentages of species represented by the wood charcoal assigned to bottomland, upland, and disturbed upland habitats plotted against time (Figure 13). Percentage comparison of domesticated plants to nondomesticated plant seed and fruit remains by gram weight is plotted against time in Figure 13.

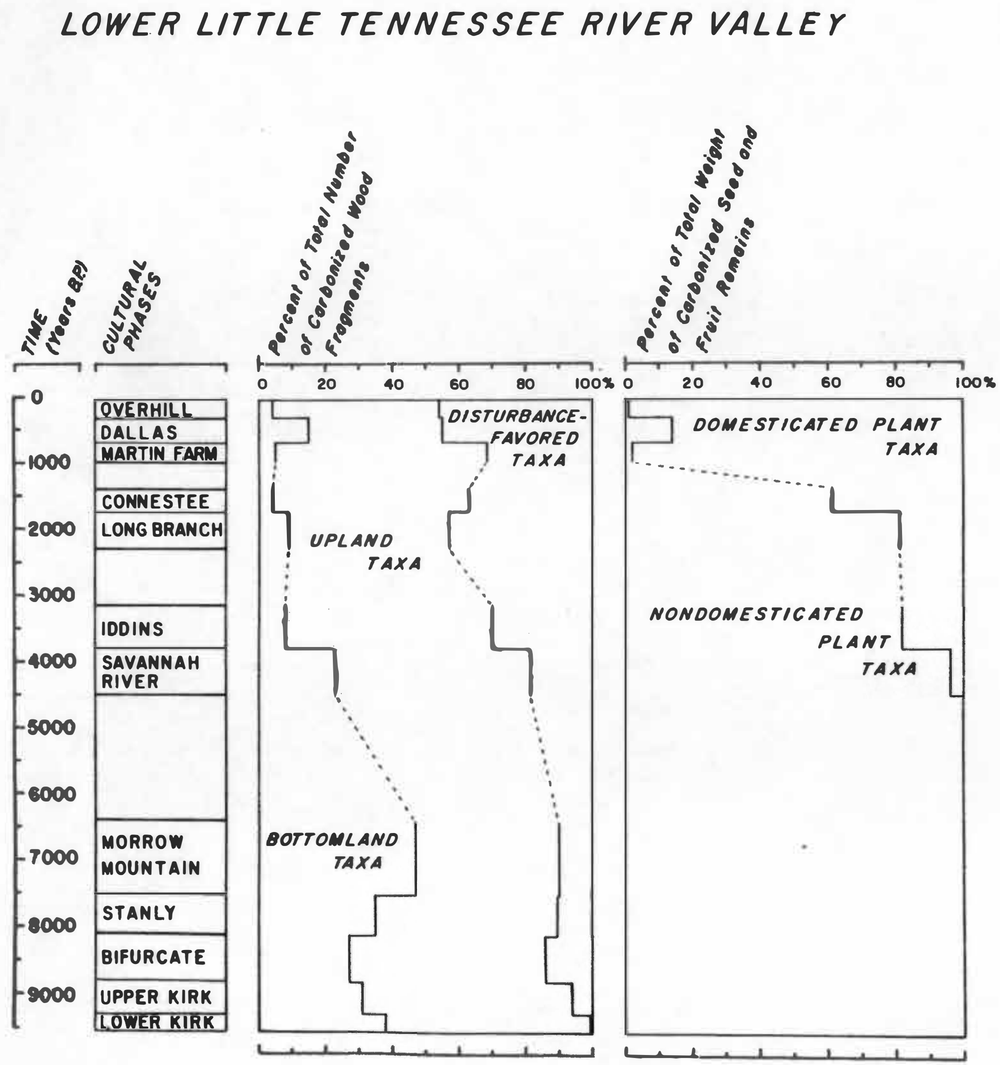

Figure 13. Summary diagrams of charred wood categorized by habitat and charred seeds and fruits categorized by domestication/nondomestication, lower Little Tennessee River Valley. (After Chapman et al. 1982)

Early Archaic Period

The pollen assemblage in gley sediments from Icehouse Bottom (circa 9,400 B.P.) indicates that the local vegetation was late-successional closed forest predominantly comprised of deciduous species such as chestnut, oak, basswood, hickory, beech, ash, birch, maple, cottonwood, and hophornbeam. Hemlock may have existed in local stands on mesic sites. The low values of pollen of Pinus and herbs such as grass and composites indicate a low frequency of disturbance with only limited openings in the forested landscape.

Arboreal species present in the paleoethnobotanical spectrum confirm the palynological interpretations of a local deciduous upland forest of oak, hickory, beech, and chestnut. Bottomland taxa such as maple and honey locust would have been and were available for exploitation. In comparison with other trees used for firewood in Early Archaic times, pine charcoal was only fifth in frequency of occurrence within hearths and features examined from this time period. Pine, moreover, did not occur in appreciable amounts until the latter portion (Bifurcate phase) of the Early Archaic period. This low concentration of pine-wood charcoal together with the low percentage of Pinus pollen, indicates that pine was not abundant in the lower Little Tennessee River Valley approximately 9,500 B.P. to 8,000 B.P. Herbaceous species recovered from

archaeological deposits include grape, bedstraw (*Galium*), and pokeweed (*Phytolacca americana*) which commonly grow at the edge of bottomland forests such as would have occurred along the active floodplain.

Habitats represented by spectra of wood charcoal (Figure 13), nutshells and seeds and fruits indicate that different source areas were deliberately exploited by Indian populations depending upon the type of plant product utilized. The greatest percentage of wood charcoal was derived from species growing in mesic and xeric uplands, followed by bottomland species. The smallest percentage (8%) was of disturbed upland species. Hickory was the most common arboreal taxon exploited for the food content of nutmeats. Hickory species may occur in bottomlands but, in this region, are most commonly found in upland habitats (Harrar and Harrar 1962). Prehistoric occupation sites from which the paleoethnobotanical remains were recovered were situated on an active floodplain. It may be hypothesized that wood procurement during the Early Archaic period was influenced both by factors of spatial accessibility and preference of wood from particular tree species.

Middle Archaic Period

No palynological data are available for the Middle Archaic period in the lower Little Tennessee River Valley. Carbonized plant material from Middle Archaic period

archaeological contexts is comprised of numerous bottomland and upland deciduous tree species including honey locust, maple, catalpa, elm, hackberry, oak, hickory, and flowering dogwood. If frequency may be interpreted as a first approximation of the availability of specific taxa on the local landscape, pine and walnut were more abundant than during the Early Archaic time span. In addition to pine, disturbance-favored tulip poplar, cane, pokeweed, bearsfoot (*Polymnia uvedalia*), and composites imply that forest openings were locally more frequent than previously.

Trends in plant procurement by humans indicate that approximately 43% of the wood was obtained from trees growing in bottomland habitats; honey locust and ash were either most preferred for utilization or most numerous in bottomland plant communities. Although intensity of habitat exploitation for wood had changed in comparison to the Early Archaic period (Figure 13), upland species were heavily utilized with 20% oak, the preferred taxon. The habitats exploited for nuts remained similar to the previous cultural period; the greatest change was in the increased utilization of walnuts from 0.2% to 13% of the total.

Late Archaic Period

The Black Pond sediment core contains plant fossils representative of the terminal portion of the Late Archaic period. Upland arboreal vegetation interpreted from the

arboreal pollen spectra (Figure 10, page 78) was an oak-chestnut forest interspersed by stands of pine. A minor increase in charcoal influx corresponds with a gradual expansion in populations of pine. Either natural or Indian-set fires would have favored the establishment of the pine populations. Willow, elm, ash, birch, sycamore, and sweetgum persisted near the pond and on surrounding slopes and ravines. Willow was briefly important after the formation of the pond. During the Late Archaic period, Black Pond was a shallow pool surrounded by swampy areas, and moist, rich woods which supported these species as well as sedges and royal and cinnamon ferns.

More extensive exploitation of pine than in previous times is indicated by the wood charcoal spectrum for this cultural period. An increase in procurement of disturbance-favored arboreal taxa reflects a more open landscape than that during the Early and Middle Archaic periods. This is contrasted by a pronounced decline in procurement of the wood of bottomland-favored trees. Exploitation of trees most commonly growing in upland habitats continued as the dominant pattern (Figure 13). The slight increase in utilization of nuts of walnut noted during the Middle Archaic period was marked by a dramatic rise (by 63%) during the Late Archaic period. Extensive exploitation of walnut material may be attributed to both a rise in viable walnut availability induced by a more open forest canopy

or landscape and human preference. The enriched suite of probable domesticated plants and domesticated plants recovered from Late Archaic period hearths and features may indicate a more disturbed or open local landscape. Probable domesticated species, goosefoot, maygrass, and knotweed, were accompanied by domesticated squash and gourd. Calculated by gram weight, the percentage of domesticated plants, as opposed to all other nondomesticated plant remains, rose during the Late Archaic period Iddins phase (Figure 13).

Early Woodland Period

The pollen spectra from Black Pond demonstrate that oak and pine persisted as co-dominants of the vegetation into the Early Woodland period. Subdominant tree species included chestnut, hickory, sweetgum, birch, ash, elm, willow, hophornbeam, walnut, and cedar. Sweetgum, birch, ash, willow, elm, and hophornbeam probably grew near the pond margins. *Tilia, Liriodendron tulipifera, Fagus, Acer, Cornus, Catalpa speciosa, Rhamnus, Populus, Viburnum,* and *Tsuga* pollen occur in trace amounts. A gradual but continuous rise in percentage of *Pinus* pollen is accompanied by pollen of *Liriodendron tulipifera, Carpinus/Ostrya* type, and Cupressaceae; this indicates the landscape was progressively becoming more open. Herbaceous vegetation, characterized by grasses, plantain, goosefoot, and royal fern

occupied moist openings in woods and swampy areas near Black Pond.

Carbonized plant material recovered from three Early Woodland sites approximately 5 km from Black Pond reflect an arboreal assemblage similar to that inferred from the pollen record. Wood was collected by prehistoric populations primarily from mesic upland habitats and secondarily from nearby disturbed habitats (Figure 13, page 91). The trend for diminished procurement of bottomland-favored tree species evident during the Late Archaic period was more marked during the Early Woodland period. Nut procurement returned to the patterns of principal use of hickory nuts so typical of the Early and Middle Archaic periods. Representation of large percentages of probable domesticated and domesticated plants, species that thrive in distrubed and nonforested, open habitats, is evidence for an increase in patchy-open areas in the local landscape.

Middle Woodland Period

The pollen record from Black Pond provides a comparison of upland forests 3 km from the Little Tennessee River versus the Tuskegee Pond record of forests on a mid-level terrace approximately 1.5 km from Indian occupation sites and activities. The local forest at the Tuskegee Pond location, like Black Pond, was a mosaic of deciduous hardwoods and pine. Oak, pine, and chestnut gradually

increased through the Middle Woodland period. Additional trees growing on the hillslopes and ridge tops were sweetgum, beech, catalpa, prickly-ash, black gum, hickory, flowering dogwood, buckthorn, and hemlock. Elm, birch, willow and ash were abundant at the edge of the ponds. The abundance of elm growing in moist habitats reflects a locally dense elm population as the Tuskegee Pond basin initially filled with water. High percentages of *Pinus* pollen are indicative of considerable landscape disturbance, an interpretation strengthened by abundant representation of upland herbs, including ragweed (*Ambrosia* type) and grasses. Disturbance indicators such as goosefoot, sump-weed, and plantain may have grown in garden plots with maize (*Zea mays*) planted on the third terrace surface near this pond. *Zea mays* pollen is large (70 to 114 µm in diameter). Although *Zea mays* pollen is wind dispersed, experimental data show that concentrations of *Zea mays* pollen at 60 m from their source of dispersion average less than 1% of concentrations found at 1 m distance (Raynor et al. 1970, 1972). Thus, 1% to 2% maize representation at Tuskegee Pond may be interpreted as evidence that Middle Woodland period garden plots were situated on the third terrace in the immediate vicinity of Tuskegee Pond. *Pinus*, *Ambrosia* type, and *Zea mays* pollen concentrations indicate disturbed areas on the lower river terraces resulting from Indian cultivation activities.

The grains of fossil *Zea mays* pollen are complemented by the occurrence of carbonized maize kernel, cupule, and glume fragments from Middle Woodland period contexts at the Icehouse Bottom site, 1.7 km northeast of Tuskegee Pond. A substantial increase in domesticated plants during this period is indicated by gram weight comparisons (Figure 13, page 91). Carbonized maize fragments accompanied by remains of probable domesticated plants such as goosefoot, maygrass, pigweed, and knotweed provide further evidence of open, disturbed areas caused by Indian cultivation activities. Arboreal species characteristic of upland habitats were exploited extensively during the Middle Woodland period, as indicated by the percentages of charred wood and nutshell. The trend for diminished procurement of the wood of bottomland trees accompanied by increased use of disturbance-favored species continued during the Middle Woodland period.

Late Woodland through Early Mississippian Periods

During the Late Woodland period, the upland forest assemblage at Black Pond remained dominated by oak, chestnut, and pine. At about 1,000 B.P., the Woodland/Mississippian period interface, percentages of *Quercus* pollen declined and *Pinus* increased. A simultaneous minor increase in percentages of Gramineae, *Chenopodium* type, and *Iva* pollen provide evidence for a reduction in the upland forest canopy of that time.

At Tuskegee Pond, oak and pine pollen percentages both increased from 850 B.P. to 750 B.P. The abundance of hickory remained constant. Birch, ash, and elm decreased as bottomland habitats were progressively cleared of vegetation for cultivation and habitation plots. At the interface of the Woodland/Mississippian period, oak and chestnut began to decrease slightly while hickory and pine increased until 900 B.P. Throughout the Late Woodland and Early Mississippian periods, walnut, sweetgum, beech, hemlock, catalpa, buckthorn, prickly-ash, black gum, and black locust persisted on hillslopes and hill tops. Willow and hophornbeam grew in the bottomlands. Substantive growth of shrubs and herbs, with a ragweed rise which peaked at about 1,000 B.P., reflected increasing landscape disturbance resulting in reduced hardwood forests. Maize became more abundant during the Late Woodland through Early Mississippian periods when Zea mays pollen fluctuated between 1% and 2% of the total upland pollen sum.

Charred wood recovered from Early Mississippian sites consists of 72% of upland taxa. The trend established during earlier cultural periods for decreased procurement of wood of bottomland-favored species continued. Unlike previous trends, species commonly associated with disturbed habitats represent only 23% of the wood charcoal. Carbonized seed and fruit remains were derived primarily from herbaceous weeds, probable domesticated plants, and

domesticated plants which grew in fallow or cultivated soil. Maize cultivation increased significantly; the combined weight of sunflower, cucurbits, and maize remains accounts for greater than 95% of the seed and fruit material. Despite the demise in wood charcoal of disturbance-favored species, the pollen data document high abundances of early-successional trees and herbaceous plants. Thus, evidence for continued landscape clearance during the Early Mississippian period is appreciable.

Late Mississippian Period

Until 350 B.P., the upland forest dominants were pine and oak with subdominants of chestnut and hickory in uplands near Black Pond. An increase in charcoal influx accompanied the *Pinus* rise from 700 B.P. to 600 B.P. Sweet-gum, birch, ash, and elm were fairly well-represented and probably grew in moist habitats near the perimeter of Black Pond. Sedges, grasses, and ferns grew in patches in disturbed areas and moist woods in close proximity to the pond. By 400 B.P., a dramatic change occurred in local plant communities at Black Pond when percentages of *Quercus* and *Pinus* pollen dropped and *Salix* pulsed. *Castanea* and *Carya* were also less prominent than during earlier periods. Herbaceous vegetation is represented in the pollen diagram by extensive quantities of *Ambrosia* type and small amounts of *Zea mays,* suggesting that the landscape surrounding Black

Pond was partially placed in cultivation. Ferns continued to grow adjacent to the pond. This Late Mississippian period reduction in oak, pine, and fern pollen and spores together with increases in willow, ragweed, and maize indicates that oak and pine populations were being depleted locally. Moreover, an increase in sedimentation rate indicates the pond was filling in more rapidly due to increased soil erosion from the nearby uplands. This environment would have been condusive to willow, a successional taxon adapted to grow rapidly in disturbed, infertile soil. These landscape changes were precipitated by Indian populations through land clearance. Increasing charcoal influx reflects increased incidence of fire, possibly Indian-set, which was an important factor in these vegetational changes. Two Mississippian period occupation sites, Pate Mound (40MR16) and Tellico Blockhouse (40MR50) (Polhemus 1978), are situated in the uplands approximately 2.5 km south of Black Pond. The presence of prehistoric Zea mays pollen at Black Pond, coupled with the archaeological evidence, provide important settlement data. Increasing population pressure and/or depleted soil on the lower river terraces resulted in encroachment by Indian populations upon upland sites.

At Tuskegee Pond, forest dominants and subdominants remained the same as in earlier times, but a decrease in pine commenced approximately 800 B.P. and continued

throughout the remainder of the Mississippian period. Oak and chestnut became much more prevalent during this time than previously. Numerous tree species, represented by pollen, included walnut, sweetgum, maple, tulip poplar, black gum, cedar, catalpa, prickly-ash, cottonwood, holly, birch, ash, willow, and elm. Maize was cultivated as long as 1,000 years ago, and ragweed was abundant in disturbed, cultivated areas. From 580 B.P. to 470 B.P. Ambrosia type peaked; a 300 B.P. spike coincides with the major rise in pollen of Ambrosia type at Black Pond. Continued and extensive landscape clearance for agriculture is indicated by the pollen of these and other herbaceous species such as Chenopodium type, Plantago spp., and Xanthium.

Carbonized wood representative of a variety of species commonly growing in bottomland, upland, and disturbed upland habitats was recovered from Dallas phase contexts. Figure 13, page 91, illustrates increased Indian procurement of wood of bottomland and disturbance-favored trees in comparison to Early Mississippian period patterns. Exploitation of disturbance-favored species, especially pine, intensified during this period. This is interpreted as evidence that an open landscape with early-successional arboreal taxa was well-established by this period. A variety of habitats was exploited for the procurement of seeds and fruits. The greatest percentage of material, by

gram weight, is of domesticated plants, primarily consisting of maize. This evidence indicates extensive, open fields under cultivation on the lower terraces near the Indian settlements.

Archaeological evidence supports and explains this pattern of progressively open landscape and depleted forest area. Estimates have not been made for Dallas phase Indian populations. Schroedl (1979), however, has estimated that between 6,000 and 18,000 Dallas phase burials were at Toqua (40MR6), one of the two large Dallas sites situated in the lower Little Tennessee River Valley. Activities of a large population, centered at a large village and mound complex 4.5 km southeast of Tuskegee Pond, are presumed to have resulted in considerable impact on the landscape within several kilometres radii of Toqua. Subsistence, based on maize agriculture and hunting of native animal species resulted in deforestation of the landscape in order to clear fields for agriculture. Further destruction of the local upland forests resulted from the utilization of trees for the construction of palisades and structures in the Indian towns.

At Toqua, a palisaded Dallas phase town, 380 m of palisade lines were recorded during archaeological excavations (Polhemus 1983). At least three individual palisades, erected at three distinct times by Dallas phase occupants, were constructed with vertically-set posts

ranging from 14 cm to 30.5 cm in diameter. The posts were set at intervals ranging from 15 cm to 31 cm (Polhemus 1983) with a median of 23 cm. Polhemus (1983) has conservatively estimated total length of a single palisade extended 1,524 m. These data and estimates may be used to calculate minimum number of posts utilized in the three construction events. If total palisade (n=3) length was 4,572 m with posts set every 23 cm, 19,878 posts were used to construct the palisades. Assuming each post represented a single tree, approximately 20,000 trees were removed from surrounding forests. This is an extremely conservative estimate since additional trees were cut for relocation and replacement of posts as well as for construction of bastions during a single palisade event. Additional trees were cut for the construction of structures enclosed within the palisade walls. A total of 10,127 postmolds can be firmly associated with 133 roofed structures excavated at Toqua (Polhemus 1983). Numerous additional postmolds which did not describe a structural pattern were recorded during excavations. These data, therefore, are interpreted as demonstration that the removal of at least 30,000 trees, used for construction alone, had a dramatic impact in contributing to the depletion of upland forests in the vicinity of Toqua.

Historic Period: Overhill Cherokee

During the early portion of the Historic period (circa 300 B.P.), the plant communities established during the Late Mississippian period persisted at Black Pond. Pine, oak, hickory, and chestnut populations were depleted locally while populations of willow expanded. A dramatic rise of *Ambrosia* type in the pollen spectra, accompanied by *Zea mays* and Gramineae, indicates continued land clearance and Indian agricultural activities initiated in the Mississippian period. By approximately 200 B.P., the forest dominants oak, pine, and chestnut began to be replenished and willow diminished. Abundant *Ambrosia* type pollen and smaller amounts of pollen of Cyperaceae, Gramineae, *Chenopodium* type, and *Plantago* spp. indicate an open, disturbed landscape even though *Zea mays* was not represented for a short time (approximately 50 years) interval.

At Tuskegee Pond, forest dominants oak and pine continued a slight decline begun during the Late Mississippian period with increased representation of chestnut, walnut, sweetgum, cedar, catalpa, birch, and willow. Oak populations expanded briefly at 250 B.P. and then dropped to minimal levels by 200 B.P. After the marked depletion of pine at approximately 225 B.P., a peak in *Pinus* pollen occurred at 200 B.P. Pine remained well-represented thereafter. An *Ambrosia* type rise

occurred at 300 B.P. and again at 220 B.P. These increases in pollen of *Pinus* and *Ambrosia* type accompanied by *Zea mays, Plantago* spp., and *Iva* occur along with an increased sedimentation rate; this reflects continued and intensified landscape erosion and clearance for agriculture.

Intensification of landscape disturbance and clearance of Overhill Cherokee territory for settlement and subsistence based in maize-bean-squash cultivation is confirmed by paleoethnobotanical material recovered from lower Little Tennessee River Valley Overhill Cherokee sites. Minor Indian utilization of bottomland arboreal species suggests depletion of trees growing in that habitat had occurred. Wood of upland and disturbance-favored species, principally pine, oak, cane, and hickory, was heavily used (Figure 13, page 91). Nuts of hickory and walnut from an upland habitat comprised greater than 99% of the nut food. Herbaceous plants which typically grow in fallow soil were more prevalent than probable domesticated plants. Calculated by gram weight, greater than 98% of the seed and fruit remains were domesticated maize, beans, squash, sunflower, and peaches. Complemented by pollen of upland species indicative of cultivation, this signifies the importance of agriculture during this cultural period.

The open landscape construed from interpretations of paleoethnobotanial material and pollen spectra at Black and Tuskegee ponds are corroborated by historically

documented events. An impact of consequence was apparently made on the local landscape by Overhill Cherokee towns. In A.D. 1762 Timberlake (Williams 1927) mapped nine Overhill Cherokee towns, seven of which were located in the lower Little Tennessee River Valley study area. One of these towns, Tuskegee (40MR64), was also shown on DeBrahm's A.D. 1755 plot map of Fort Loudoun (DeVorsey 1971:98). Tuskegee, located less than 1 km north of Tuskegee Pond, had a population of 55 warriors (Williams 1927) in A.D. 1762 and is presumed, therefore, to have had a population density which would have impacted the surrounding environment for several kilometres. No firm data for population censuses are available for the Overhill Cherokee of the lower Little Tennessee River Valley. Timberlake (Williams 1927), however, estimated an additional combined total of 597 warriors from the nearby towns of Mialoquo (40MR3), Tomotley (40MR5), Toqua (40MR6), Tanasee (40MR62), Chota (40MR2), and Citico (40MR7). The population fluctuated as towns were established or were abandoned. In addition, population density fluctuated as a result of perpetual warfare and disease such a smallpox epidemics. Despite these factors, the area was apparently densely populated by Indians until the late A.D. 1700s when Euro-American encroachment, Cherokee and Euro-American warfare, and Cherokee removal (Corkran 1962; McDowell 1970; Brown 1971; Satz 1979) virtually decimated the Cherokee population and culture.

The disturbed vegetation is reflected in lower terrace and upland pollen diagrams. Towns, hamlets, and agricultural fields were established on the open landscape. The forests, which yielded trees for the construction and rebuilding of townhouses, residential structures, and storage facilities, were also further depleted during this time.

A network of Indian trails in the study area had an apparent but undefined degree of impact on the surrounding landscape. The Great Indian Warpath, Trail 31, was a war and trade route which extended along the south side of the Little Tennessee River near towns such as Toqua and Tuskegee (Myer 1928:750). It continued to the northwest in the vicinity of Pate Mound (40MR16) and Black Pond.

The local landscape vegetation was also affected by British occupation activities. From A.D. 1756 until A.D. 1760 garrisons of from approximately 200 to 500 men (Kunkel 1960:4; McDowell 1970) were living at Fort Loudoun, 1.6 km from Tuskegee Pond. Neither historic documents nor archaeological data (Carl Kutruff, personal communication 1983) provide any information regarding specific tree taxa used by the British soldiers for the construction of Fort Loudoun. Initially, the fort was composed of an outer and inner palisade line as well as internal structures. The outer palisade line was a minimum of 488 m and the inner, 365 m (DeVorsey 1971:104). These palisades were constructed

in A.D. 1756 and removed in A.D. 1757 (Kunkel 1960:6). A single palisade line, probably the outer palisade, was then erected. The number, spacing, and diameter of the vertically-set posts is undocumented for each construction. The second time the palisade was constructed, the logs were 4.6 m in length (McDowell 1970:326) and were expected to last six years (McDowell 1970:347). A large quantity of trees were obviously cut from the uplands for these palisades. A conservative but hypothetical estimate of 4,470 trees used for all palisade lines (1341 m) may be suggested if the posts were set at 30 cm intervals. The timbering apparently was some distance from the fort since two pairs of horse-drawn trucks were required for the operation and, according to the officer in charge of the fort, Raymond Demere,"...it will take a long Time before our Pallisadoe Work is finished" (McDowell 1970:326). A marked decline in the pollen of *Quercus, Pinus, Carya,* and *Castanea* which began by approximately 225 B.P, at Tuskegee Pond coincides with the British occupation and may reflect timbering of the upland forests.

The British also planted greater than 16 ha of maize near the fort as early as 1757 (McDowell 1970:366, 375). It is assumed they used European agricultural methods and a suite of metal implements. Thus, British impact, coupled with the Overhill Cherokee occupation of the lower Little

Tennessee River Valley, is presumed to be reflected in the *Ambrosia* type rise at Tuskegee Pond approximately 220 B.P.

Historic Period: Euro-American

The United States government enforced the removal of the Overhill Cherokee from the lower Little Tennessee River Valley in A.D. 1819 and A.D. 1836. Subsequently, pollen spectra reflect substantial growth of *Quercus, Castanea,* and *Pinus* at Tuskegee and Black ponds. An open canopy of walnut, sweetgum, and prickly-ash grew on hill-slopes and in ravines. Communities of willow, ash, and elm grew in moist habitats near the ponds. At Tuskegee Pond numerous willows and elm reflect modern pond sedimentation caused by increased erosion. At both ponds, the demise of *Castanea* pollen reflects the decimation of the chestnut by the A.D. 1920s. Pollen of herbaceous plants, which document substantial disturbance of the landscape as well as the advent of European and American settlement, included *Ambrosia* type, Cyperaceae, Gramineae, *Chenopodium* type, *Plantago, Rumex,* and *Trifolium.* Increased percentages of pollen of Gramineae and Rubus from the Tuskegee Pond diagram indicate much of the recent open landscape has been in pasture and many fields were not cultivated but, rather, allowed to lie fallow.

Anthropogenic-Indicator Plants

Trends of progressive landscape disturbance are further illustrated by one specific plant category. Specific early-successional or domesticated herbaceous plant species which commonly would have grown in cultivated field, fallow field, or pasture/wet meadow habitats in the lower Little Tennessee River Valley (Radford et al. 1968; Reed 1971) are anthropogenic-indicator plants (Table 9, following Behre 1981). These plant macro- and microfossils in paleoethnobotanical and palynological contexts from the study area Early Archaic through Historic Overhill Cherokee periods are summarized in Table 9. Occurrence of these plant species indicates prehistoric agricultural activities and, in general, landscape disturbance since these genera are encouraged by or dependent upon humans for their propagation.

Conclusions

Paleoethnobotanical data document the species richness of arboreal and herbaceous plants growing in the lower Little Tennessee River Valley since 9,500 B.P. Patterns of progressive vegetation change on lower terraces and uplands have been established for the past 3,000 years by pollen data. Paleoethnobotanical remains indicate that the quantity of species exploited by Indians varied from

Table 9. Habitat and cultural context of anthropogenic-indicator plant species represented by paleoethnobotanical and palynological plant remains from the lower Little Tennessee River Valley.

Taxon	Cultivated Fields	Fallow Fields	Wet Meadows/ Pastures	Cultural Context of Plant Remains[a]: Paleoethnobotanical	Palynological
Amaranthus	+	+		EA, LA, EW, MW, HC	-
Ambrosia type	+	+		LA, EM, LM, HC	EA, LA, EW, MW, LW, EM, LM, HC
Artemisia		+		-	MW, LM, HC
Chenopodium	+	+		EA, LA, EW, MW, EM, LM, HC	LA, EW, MW, EM, LM, HC
Compositae	+	+		EA, MA, LA, EW, MW, EM, LM, HC	LA, EW, MW, LW, EM, LM, HC
Cruciferae		+	+	-	LA, EW, MW, EM, LM, HC
Cyperaceae	+	+	+	LA, EW, HC	LA, EW, MW, LW, EM, LM, HC
Gramineae, wild		+	+	MA, LA, EW, MW, LM, HC	EA, LA, EW, MW, LW, EM, LM, HC
Ipomea	+	+		MA, EW, EM, LM, HC	-
Iva/ *Iva annua*	+	+		EW, MW, EM, LM, HC	EW, MW, LW, EM, LM, HC

Table 9. (continued)

Taxon	Cultivated Fields	Fallow Fields	Wet Meadows/ Pastures	Cultural Context of Plant Remains[a]: Paleoethnobotanical	Palynological
Phalaris caroliniana	+			LA, EW, MW, EM	-
Phytolacca americana	+	+	+	EA, MA, LA, EW, MW, EM, LM, HC	-
Plantago		+	+	-	LA, EW, MW, LW, EM, LM, HC
Polygonum	+	+		EA, LA, EW, MW, EM, LM, HC	-
Portulaca oleracea	+	+		EA, LA, EW	-
Rumex			+	-	HC
Umbelliferae	+			-	LA, EW, MW, EM, LM, HC
Urtica		+	+	-	LA, EW, MW, LW, LM, HC
Cucurbitaceae Cucurbita pepo	+			LA, EW, EM, LM, HC	-
Helianthus annuus	+			LA, MW, EM, LM, HC	-
Lagenaria siceraria	+			LA, EW, HC	-

Table 9. (continued)

Taxon	Cultivated Fields	Fallow Fields	Wet Meadows/ Pastures	Cultural Context of Plant Remains[a]: Paleoethnobotanical	Palynological
Phaseolus vulgaris	+			LM, HC	-
Zea mays	+			MW, EM, LM, HC	MW, LW, EM, LM, HC

a
EA= Early Archaic Period
MA= Middle Archaic Period
LA= Late Archaic Period
EW= Early Woodland Period
MW= Middle Woodland Period
LW= Late Woodland Period
EM= Early Mississippian Period
LM= Late Mississippian Period
HC= Historic Cherokee Period

cultural phase to phase. In general, the same suite of plants was consistently exploited through time. Cumulative, long-term trends provide indices of cultural process and landscape change.

Carbonized wood remains represent 39 individual plant taxa. Differences in species of wood, preserved portion of the woody plant, and degree of wood dryness when burned result in different degrees of incineration. Despite such variables, properties of wood are more comparable from species to species than are the carbonized remains of nutshell (hickory to acorn), seeds, and fruits (maygrass to maize). Consequently, in this study wood charcoal is regarded as a more reliable index of exploited species than other paleoethnobotanical material. Plotted against time, relative percentages of wood species assigned to bottomland, upland, and disturbed-upland habitats demonstrate a consistent Indian exploitation of upland taxa through time. Bottomland taxa display a trend of heavy (up to 47%) exploitation during the Early and Middle Archaic periods with a gradual decline to a low of less than 5% during the Historic Cherokee period. This is contrasted by the progressive increase in procurement of disturbance-favored taxa which rose from a low of less than 1% to a high of 46% by the Historic Cherokee period.

Carbonized nutshell remains indicate that nutmeats were significant dietary components even when domesticated

plants increased in importance. Nuts of trees which grow in upland habitats were most extensively exploited by prehistoric human populations. Nuts of high caloric value, especially hickory, comprised approximately 70% to 90% of the total nuts utilized during the Early Archaic, Middle Archaic, Woodland, and Mississippian periods. During the Late Archaic Savannah River phase, hickory constituted 50% and walnut 47% of the total; walnut increased to 89% and hickory decreased to 10% of the total during the Iddins phase. Historic Cherokee period walnut represented 38% and hickory, 60% of the total utilized nuts. From the Early Archaic through Historic Cherokee periods, acorn was used to a lesser extent. Beech, hazelnut, and chestnut are present in paleoethnobotanical samples sporatically and in trace amounts, a paucity due to processing, incineration, or misidentification factors (cf. Kline and Crites 1979:90).

Increases in herbaceous plants, and especially probable domesticated plants such as sumpweed, goosefoot, and maygrass, accompanied the introduction and proliferation of domesticated plants from the Late Archaic through Historic Cherokee periods. Percentage comparison of domesticated species to nondomesticated remains by gram weight are illustrative of an increase in importance of domesticated plants. These remains progressively increased with the introduction of cucurbits during the Late Archaic period,

maize during the Middle Woodland period, beans during the Late Mississippian period, and peaches during the Historic Cherokee period. Squash, gourds, sunflower, beans, maize, and peaches were recovered from Overhill Cherokee contexts, but ethnohistoric accounts also document Overhill Cherokee cultivation of apples (*Malus* spp.), watermelon (*Citrullus vulgaris*), peas (*Pisum sativum* and *Vigna sinensis*), cabbage (*Brassica* spp.), and tobacco (*Nicotina* spp.) (Mooney 1900; Williams 1927, 1928; Goodwin 1977; Commager 1977). Most importantly, the increase in Late Archaic through Historic Cherokee period domesticated plants, accompanied by herbaceous plants which grew on fallow and cultivated land, coincides with progressive landscape clearance for the propagation of these plants.

As established by pollen spectra from Tuskegee and Black ponds, lower terrace and upland forest dominants were consistently oak, pine, hickory, and chestnut from 3,000 B.P. to recent times. Subdominants, similar at both locales, included sweetgum, walnut, maple, black gum, catalpa, cedar, birch, ash, willow, and elm. Additional species at Tuskegee Pond were prickly-ash, hemlock, hop-hornbeam, and buckthorn.

At Black Pond, pregressive increases in percentages of *Pinus* pollen until the latter years of the Late Mississippian period establish evidence of gradual landscape clearance and forest replacement by this early-successional taxon.

Then, reduction in percentages of pollen of Pinus, Quercus, Carya, and Castanea with corresponding increases in Salix, Ambrosia type, and persistence of Zea mays occurred until approximately 200 B.P. This illustrates intensive clearance of the local upland landscape for agriculture; forest depletion may also have been caused by procurement of trees for construction of Fort Loudoun (A.D. 1756-A.D. 1760). A ragweed rise at approximately 300 B.P. was triggered by an expansion in Overhill Cherokee agricultural and settlement activities.

At Tuskegee Pond, Pinus pollen gradually increased from the Woodland period until the termination of the Early Mississippian period when it progressively declined until 200 B.P. Diminished percentages of Pinus pollen would be expected with increased exploitation of pine wood. Reduction in forest dominants from circa 300 B.P. to 200 B.P. is presumed to have been caused by Overhill Cherokee agricultural and settlement activities as well as procurement of trees for construction of Fort Loudoun by the British.

Herbaceous plant pollen data from Tuskegee Pond are highly significant. Evidence for maize agriculture on higher terraces as early as the Middle Woodland period is the first documentation that prehistoric maize agriculture was not strictly confined to bottomland habitats in the southeastern United States. The pollen data also negate the common precept of a single late-Holocene Ambrosia rise

occurring solely in conjunction with Euro-American settlement in North America. The Tuskegee Pond evidence clearly indicates four major Ambrosia type rises which mark intensive landscape clearance during the Woodland, Mississippian, Historic Overhill Cherokee, and Historic Euro-American periods.

Historic Overhill Cherokee and Euro-American Ambrosia type rises are also documented by herbaceous plant pollen data at Black Pond. However, these data from Black and Tuskegee ponds are especially significant in that they document progressive changes in prehistoric settlement patterns. A variety of factors, possibly including population pressure and soil depletion, triggered areally expanded landscape use and clearance. This progressed from bottomlands to lower terraces, and finally to uplands such as near the Black Pond site.

These paleoecologic data have shown that time-transgressive changes in the local landscape vegetation were induced principally as a consequence of progressive land-use/disturbance by humans. The pollen data have demonstrated independently that paleoethnobotanical remains can be used as a predictive model of landscape vegetation. Paleoethnobotanical data provide a first approximation of long-term landscape vegetation change. Therefore, the paleoethnobotanical and palynological data from the lower Little Tennessee River Valley document fragmentation of

forest taxa, progressive landscape clearance for subsistence and settlement activities, and dynamic vegetation responses to Indian and Euro-American settlement activity.

CHAPTER VI

FIRE HISTORY AND LANDSCAPE CHANGE

The Precolumbian human use of fire in altering the North American landscape is a persistent and controversial issue. Colonial period propaganda by Harriot (Quinn and Quinn 1982) and popular literature have perpetuated idealistic perceptions of the land and the "noble savage" who neither affect nor was affected by nature (Day 1953; Martin 1973; Pyne 1982). Descriptions which characterize eastern North America as an American Canaan (DeVorsey 1971: 105) where "The soil is the most plentifulll, sweete, fruitfull, and wholsome in all the world..." (Quinn and Quinn 1982:7) perpetuated this concept. In addition, colorful descriptions by early naturalists, such as Bartram (Van Doren 1928), of stately trees and magnificent forests fueled the myth of an unbroken virgin forest first impacted by white settlers (Maxwell 1910; Day 1953).

Not until the literature of the early A.D. 1900s (Maxwell 1910) was Indian-set fire identified as the cause of extensive savannahs and open forests that existed at the time the first European colonists arrived in the New World. Principal evidence of a precolonial open landscape maintained by intentional burning was derived from surveys of ethnohistoric documents (Maxwell 1910; Day 1953; Martin

1973; Guffey 1977; Pyne 1982). Comprehensive surveys (Guffey 1977; Russell 1983) of early documents pertinent to eastern North America establish evidence of Indian use of fire and of the open landscape. For example, in the mid-A.D. 1600s Morton stated, "...the Salvages are accustomed to set fire to the Country in all places where they come; and to burne it, twize a yeare vixe at the Spring and the fall of the leafe" (Force 1838:37). Other observers noted open plains of 200 ha or more and treeless areas of at least 11.7 km (up to eight leagues) (Strachey 1625).

The actual meaning and implications of these accounts are, however, open to debate when subjected to modern scrutiny. The interpretative trend is one of significant anthropogenic influence on the landscape (Maxwell 1910; Day 1953; Martin 1973; Pyne 1982). However, Russell (1983) reevaluated sixteenth and seventeenth century ethnohistoric references to fire and vegetation; she concluded that Indian-set fires were highly localized and unintentional. Russell (1983:86) considers that principal determinants of precolonial/colonial forest composition were climate and soil. Thus, evaluations (Maxwell 1910; Russell 1983) of anthropogenic influence upon the vegetation of presettlement eastern North America, as based upon eye-witness accounts of early settlers, have proved inconclusive.

The nature and extent of forest reduction prior to white settlement can be re-examined by augmenting

ethnohistoric documents with historic land-survey records, tree censuses, records of historic fire (Myers and Peroni 1983), and fossil charcoal and pollen data.

The Lower Little Tennessee River Valley

Ethnohistoric documents pertaining to East Tennessee are sparse and relatively late in the Colonial period. The cautious assumption can be made that at least some of the accounts of Indian-set fire from the Colonial period are applicable to practices of Indians living west of the Appalachian Mountains. These records (Arber 1910; Williams 1928; Van Doren 1928; Quinn and Quinn 1982) document use of fire for the following purposes: as a hunting technique in fire drives or circular hunts; land-management by clearing underbrush; and land clearance to establish habitation sites or agricultural sites. Archaeological evidence establishes the use of fire for cooking, processing (i.e., ceramics), campfires, ceremonial/sacred hearth fires, and light sources by Indians living in the lower Little Tennessee River Valley. Ample evidence, particularly for the Mississippian and Historic Cherokee periods, indicates both intentional and unintentional structural fires (Schroedl 1982b; Polhemus 1983).

Ethnohistoric accounts of the lower Little Tennessee River Valley and the Overhill Cherokee culture date from

about A.D. 1750 to A.D. 1800. This was a period of increasing encroachment of white people upon Cherokee land and culture (Corkran 1962). Moreover, the Cherokee towns and population were disrupted by military conflicts, political strife, and disease. Most ethnohistoric references to Overhill Cherokee fire-use pertain to cooking, campfires, ceremonial fire, and house fires. Only two accounts of what might be described as broadcast fire are in the literature. In October 1776, Col. William Christian burned five Overhill Cherokee towns (Williams 1928). The American goal was to punish and control the Cherokee by destroying their towns, agricultural fields, and food supplies. Identification of all the burned towns is uncertain. The peace town, Chota, was saved; apparently other towns along the Little Tennessee River from Fort Loudoun to Chota were destroyed. Intensity and extent of this military action is also unknown; Martin Schneider noted in 1784 that at the burned town of Tomotley, apple and peach trees were growing wild (Williams 1928:256).

A second, more significant account of fire, is provided by Abraham Steiner and Federick C. de Schweinitz. In November 1799, near the Tellico River and the town of Great Tellico, they observed meadows, cleared woods, and traces of forest fire. As they reached the outskirts of Great Tellico:

> Toward evening we passed women and children,

> who were setting fire to the grass in the woods; and soon after that we emerged in the great Tellico Plain, through which we rode some distance in the midst of high grass, seeing several houses to the right that belong already to Big Tellico.... Before us and to the side the Beautiful plain, entirely clear of woods, and in the same the town of Big Tellico, eighteen miles from Tellico Blockhouse (Williams 1928:478).

This example of Indian-set fire corresponds well with Adriaen Van der Donck's 1655 description and explanation of burning in the New Netherlands.

> the Indians have a yearly custom...of burning the woods, plains and meadows in the fall of the year, when the leaves have fallen, and when the grass and vegetable substances are dry. Those places which are then passed over are fired in the spring in April (O'Donnell 1968:20).

Fire was used to remove underbrush which hindered hunting, to enclose game and facilitate tracking, and to clear dead underbrush and grass in order to enhance the next season's growth (O'Donnell 1968:20-21). Presumably this also increased browse-area and attracted game such as white-tailed deer.

From A.D. 1761 to A.D. 1799 travelers in the lower Little Tennessee River Valley observed large, open expanses of meadows, grasslands, savannahs, and old fields. Their descriptions provide evidence of the extent of cleared land. Timberlake (Williams 1927) described an open landscape around Chota and the necessary procurement of firewood from forest remnants nearly 3 km away. In A.D.1784

Schneider (Williams 1928:256) noted that from the confluence of the Little Tennessee River and the Tellico River upstream to Citico (40MR7), "they reckon 8 miles, the half of which is cleared at least a Mile broad, as far as the even land goes, so that there is but little wood between and above mentioned Towns." The "even land" corresponds to the broad flats of the low- and mid-level river terraces. Steiner and Schweinitz (Williams 1928) and Louis Philippe (Commager 1977) in the late A.D. 1790s described the area as a treeless, grassy plain where "One can see entire treeless plains that could be mowed just as they are" (Commager 1977:84).

In addition to the ethnohistoric evidence of deforestation, palynological data establishes evidence of open forests. During the Woodland through Historic Cherokee periods, the local landscape was disturbed by cultivation or by fire with extensive open forests remaining within the river valley.

Charcoal Particles: Indicators of Fire History

Charcoal particles are preserved in sediments processed for pollen analysis. Several studies of pollen and charcoal analyses have correlated charcoal peaks with historically documented fires, local climatic change, and fire frequency (Davis 1967; Waddington 1969; Swain 1973, 1978). Tsukada and Deevey (1967) correlated charcoal peaks and agricultural

pollen indicators with occurrences of prehistoric Mayan slash and burn agriculture in Guatemala and El Salvador.

Charcoal peaks record local fire frequency, and perhaps intensity, but the cause of fire cannot be determined unless peaks can be correlated with strong indicators of natural and anthropogenic events or with known historic events. Charcoal influx is affected by a variety of variables, including fire intensity and sedimentation patterns (Swain 1978), which complicate interpretation of individual fire events. Identification of fire frequency can best be determined using annually-laminated sediments analyzed at short time intervals (Swain 1973, 1978). However, strong charcoal peaks evident in any palynological diagram are positive evidence of natural or human-induced fire.

Tuskegee and Black Ponds Charcoal Evidence

Pollen and charcoal particle counts for Tuskegee and Black ponds are presented in Figures 14 and 15. These are expressed as influx values (pollen grains or charcoal particles $\cdot$ $cm^{-2} \cdot yr^{-1}$). Vegetation changes subsequent to fire are more easily interpreted by influx data than percentage values. The most prominent charcoal peaks are considered to be indications of local fires.

The ratio of charcoal to pollen influx is plotted in Figures 14 and 15 to confirm and augment influx values.

BLACK POND, LOUDON CO., TENNESSEE

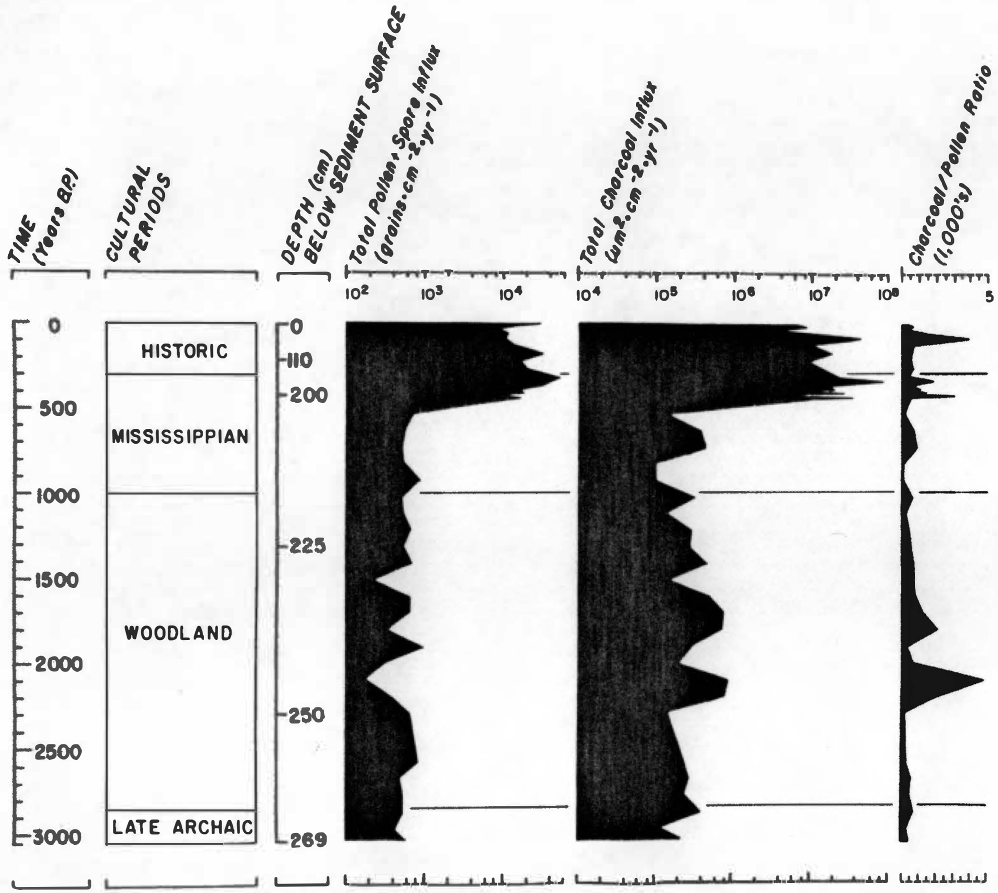

Figure 14. Pollen and spore influx, charcoal particle influx, and charcoal-pollen ratio for Black Pond, Loudon County, Tennessee.

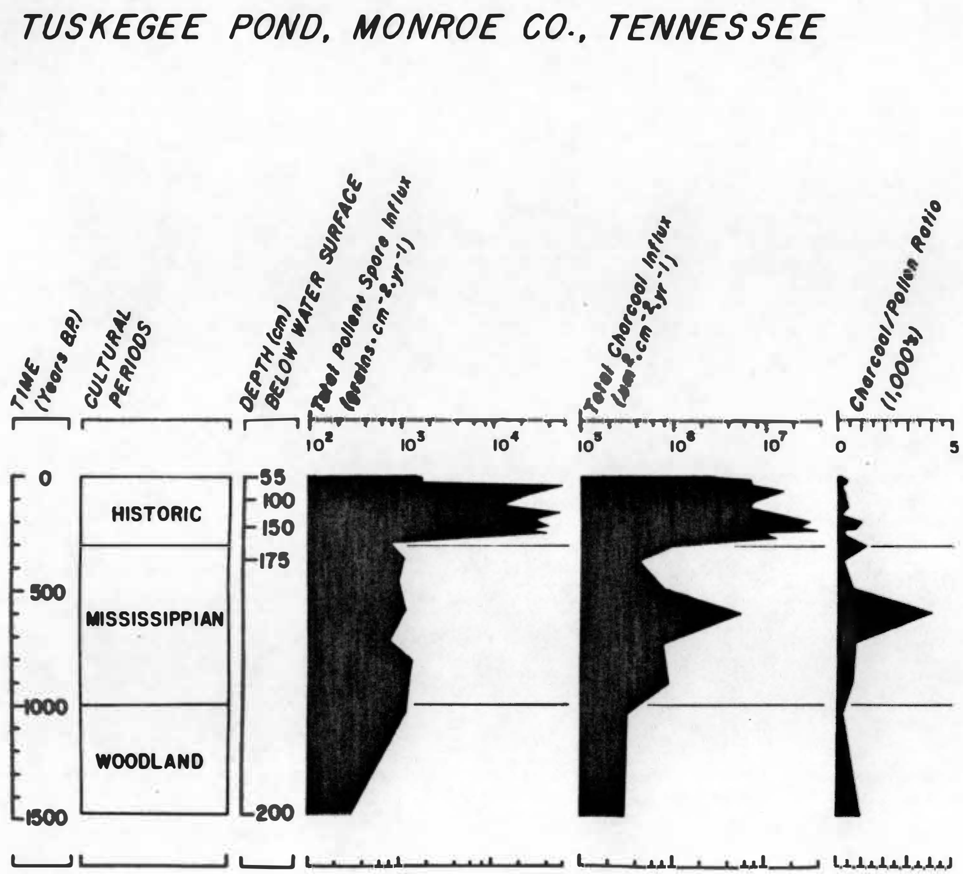

Figure 15. Pollen and spore influx, charcoal particle influx, and charcoal-pollen ratio for Tuskegee Pond, Monroe County, Tennessee.

Influx may produce accentuated peaks. For example, immediately following a fire, the amount of airborne charcoal is greater than pollen; charcoal deposition should also be greater and will be reflected accurately by ratios. Neither quantification method will reflect all charcoal peaks. Variables such as wind, erosion and redeposition, and intensity of each event determine the amount and particle size of deposited charcoal (Swain 1978:63). Only distinct fires near the pollen site are represented by the charcoal-pollen ratio.

Results

At Black Pond (Figure 14), the correlation of peaks in charcoal influx and charcoal-pollen ratio indicates that approximate dates of local fire were 2,800 B.P. (Late/Terminal Archaic period), 2,200 B.P. to 2,100 B.P. (Early Woodland period), 1,800 B.P. (Middle Woodland period), 1,000 B.P. (Early Mississippian period), 700 B.P. to 600 B.P. and 425 B.P. to 400 B.P. (Late Mississippian period), and 300 B.P. (Historic Cherokee period). A series of fires is indicated for the late nineteenth century. One peak reflected in the charcoal particle influx diagram at about 1,300 B.P. is not present in the charcoal-pollen ratio. The magnitude of each peak varies, as demonstrated by the charcoal-pollen ratios at 2,200 B.P. to 2,100 B.P., 1,800 B.P., 425 B.P., and 80 B.P.

Significance of peak height is undetermined although it may reflect a quantitative measure of the intensity/magnitude of fire.

Based on charcoal influx and charcoal-pollen ratio peaks, approximate dates of fire at Tuskegee Pond were 900 B.P. (Early Mississippian period), 600 B.P. (Late Mississippian period), and a series of fires from 220 B.P. to 190 B.P. (Historic Cherokee period). Peaks masked by the charcoal influx diagram but reflected in the charcoal-pollen profile were at 1,500 B.P. (Middle Woodland period) and 300 B.P. (Mississippian/Historic Cherokee interface). An influx peak at 250 B.P. (Historic Cherokee period) is not reflected in the charcoal-pollen ratio (Figure 15).

It was anticipated that changes in pollen assemblages, especially *Pinus,* Gramineae, and other herbs, would be displayed in the pollen diagrams at dates following each major fire. Pollen percentages, however, were not significantly altered by small or low intensity fires such as surface litter burns. Short-term fluctuations in fire frequency were also obscured by sampled intervals which span approximately 20 to 100 years.

In at least one test, Swain (1973:391) found that charcoal particle size seemed to correspond with distance of fire to deposition source. At Black Pond, large particles at intervals of high and low charcoal influx are not appreciably represented. The determining factor for fire

peak is quantity of small particles. At Tuskegee Pond, the determining factor for charcoal peaks is, also, number of particles rather than size of particles. In comparison to Black Pond particles, a greater number of large-sized particles are represented in all intervals regardless of peak height. If particle size is related to proximity of fire to deposition site, all major fires at Tuskegee Pond were local events.

The Black Pond and Tuskegee Pond charcoal peaks do demonstrate the occurrence of major upland and lower terrace fires during the Woodland, Mississippian, and Historic Cherokee cultural periods. At Black Pond, a series of major fires occurred during the early portion of the Middle Woodland period. Upland occupation sites were established near Black Pond during the Mississippian period. Pate Mound (40MR16) is situated approximately 2 km from Black Pond. A Mississippian structure identifed at Tellico Blockhouse (40MR50) is, moreover, about 2.5 km southeast of the pond. Internal changes within Indian cultures, population pressure, shifting settlement patterns, and probable increased land requirements for maize agriculture are factors which may have caused settlement expansion beyond the lower river terraces and into the uplands. In addition, many Indians lived in hamlets outside the prehistoric villages and towns. A series of charcoal peaks at Black Pond, beginning at 425 B.P., correlate with the

first pollen evidence of maize (*Zea mays*) and the ragweed (*Ambrosia* type) rise. Fires from approximately 425 B.P. to 200 B.P. are interpreted as Mississippian and Overhill Cherokee period Indian-set fires. Burning was conducted to facilitate maize agriculture.

While natural or anthropogenic cause of fire is indeterminable from the charcoal evidence alone, the dramatic charcoal particle peak in the Tuskegee Pond profile at approximately 580 B.P. correlates with a period of concentrated cultural activity. The Late Mississippian period was one of intensive occupation and agriculture as demonstrated by the Toqua (40MR6) site (Polhemus 1983). Charcoal peaks and the relatively high influx rates during the Mississippian period are considered indications of amplified and altered land use which accompanied an agriculturally-dominated economy. The polythetic factors of intensive agriculture, large Indian populations within permanent settlements and large villages contributed to high rates of charcoal influx at the nearby Tuskegee Pond site. Decreased influx from 470 B.P. to 360 B.P. may be an indication of short-term population/settlement decline immediately prior to the Overhill Cherokee phase. The rise in charcoal influx after 300 B.P. is referable to the occupation of the lower Little Tennessee River Valley by large Cherokee populations engaged in extensive land-use associated with agricultural activities and settlement of

towns. The accelerated influx rates of the recent Historic period, as compared with prehistoric rates, are attributable to increased sedimentation within the pond caused by activities of white settlers; these included, most significantly, steel plow agriculture.

Both the pollen and ethnohistoric records document the presettlement mosaic of forested and disturbed/open landscape of the lower terraces along the lower Little Tennessee River Valley. The charcoal particle analyses confirm that fire was a factor influencing the vegetation during at least the past 3,000 years. There is no pollen evidence for climatic changes which would have created prairie-like vegetation in East Tennessee during the late-Holocene. Consequently, it is postulated that the progressively disturbed landscape along the lower Little Tennessee River Valley was caused and maintained by prehistoric Indians who utilized fire as a major land-management tool.

CHAPTER VII

NATURAL AND ANTHROPOGENIC PALEOENVIRONMENTAL INFLUENCES

Historic Analogues

Tree census, land survey, and ethnohistoric accounts supplement and elucidate plant fossil data. Landscape vegetation, vegetation exploitation, land-use practices, and other cultural practices by Native Americans immediately prior to Euro-American dominance of the landscape may function as analogues for the past.

Land Use

Plant and animal dietary constituents of the Overhill Cherokee have been surveyed in detail (Hamel and Chiltoskey 1975; Goodwin 1977). Earliest (A.D. 1673) to most recent (A.D. 1799) ethnohistoric accounts (Williams 1927, 1928) of Cherokee foodstuffs include maize, potatoes, pumpkin, beans, peas, cabbage, melons, peaches, apples, strawberries, grapes, honey locust, acorns, hickory nuts, chestnuts, fish, venison, bear, buffalo, and small game. Plant macro- and microfossils recovered from the lower Little Tennessee River Valley have established the growth of and Indian exploitation of numerous food-bearing plants. Ethnohistoric accounts provide additional information regarding

cultivation practices by the Indians and serve as analogues of prehistoric Indian agricultural practices.

Size of fields cultivated by Indians apparently varied, but the fields could be rather large. Bartram (Van Doren 1928:284) observed Middle Settlement Cherokee garden patches of corn and beans situated near houses as well as large fields, almost 3 km in length, of "Indian plantations of Corn, which was well cultivated, kept clean of weeds" (Van Doren 1928:287). According to Schneider (Williams 1928:261) in A.D. 1784, the Cherokee did not fence their fields; however, Steiner and Schweinitz (Williams 1928:473) noted fields of maize enclosed by low fences at the lower Little Tennessee River Valley Toqua (40MR6) settlement in A.D. 1799. Various travelers in Overhill Cherokee territory, including Schneider (A.D. 1784), Hawkins (A.D. 1797), Louis Philippe (A.D. 1797), and Steiner and Schweinitz (A.D. 1799) (Williams 1928; Georgia Historical Society 1938; Commager 1977), observed numerous cultivated fields, old fields, and peach and apple orchards.

During his visit to the lower Little Tennessee River Valley in A.D. 1799, Louis Philippe (Commager 1977:88) described Overhill Cherokee cultivation techniques. A small spot of ground was cleared, holes were dug, seeds planted, and only the weeds surrounding each plant were removed. This is quite similar to cultivation practices of coastal

Carolina Indians which were observed by Thomas Harriot in 1588 (Quinn and Quinn 1982).

> A few dayes before they sowe or set, the men with woodden instruments, made almost in forme of mattocks or hoes with long handles: the women with short peckers or parers, because they use them sitting, of a foot long and about five inches in bredth, doe onely breake the upper part of the ground to rayse up the weeds, grasse, and olde stubbes of corne stalkes with theyr roots. The which after a day or twoes drying in the Sunne, being scrapt up into may small heaps, to save them the labour of carrying them away, they burne into ashes.... And this is all the husbanding of theyr ground that they use.
>
> Then theyr setting or sowing is after this manner. First for theyr corne, beginning in one corner of the plot, with a pecker they made a hole, wherein they put foure graines...and so throughout the whole plot, making such holes, and using them after such maner.... By this means there is a yard spare ground betweene every hole: where according to discretion heere and there, they set as many beans and peaze ....(Quinn and Quinn 1928:56-57).

The Overhill Cherokee apparently continued to use their traditional digging implements until the late A.D. 1700s. They may have acquired metal agricultural implements by the early A.D. 1700s (Goodwin 1977:138). Metal broad hoes have been recovered from archaeological contexts at the Citico (40MR7) (T. Ford 1979:44) and Chota (40MR2) (Schroedl 1982b) sites. Widespread use of implements such as the plow and harrow, which required draft animals, did not occur until the late A.D. 1700s. A provision of the Treaty of Holston (A.D. 1791) required that the Cherokee be supplied with agricultural implements although the Cherokee did not adapt Euro-American agricultrual

practices until after A.D. 1800 (Mooney 1900:214; Satz 1979:78-80). They had earlier rejected the plow as an implement which would adversely impact their culture by displacing too many individual field laborers (Bartram 1789:47-50; Goodwin 1977:139). The cultural importance of communal participation in agricultural activities by a town's populace may be indicated by Schneider's observations of the Overhill Cherokee in A.D. 1784. When the town chief called the people together, they came

> with their Indian-Corn Hoes, & go together; in proper Order to Work. And tho' every Family has its own Field, yet they begin fellowshiply on one End, & continue so one after the other till they have finished all. As every one must come & hoe (he may have planted or not) it seems they prevent thereby that not easily a Family can come to Want by Carelessness (Williams 1928:261).

Thus, at least until the early A.D. 1800s, the introduction of metal agricultural implements and European cultivation methods to the Overhill Cherokee had minimal impact on the local paleovegetation and landscape. Patterns of forest depletion and progressive landscape clearance during the Historic Overhill Cherokee period were presumably the result of expanded forest removal expedited by the Cherokee using traditional methods of cultivation and timbering. The Ambrosia type rise at Tuskegee Pond approximately 220 B.P. was triggered by a combination of anthropogenic influences;

these were primarily Cherokee and British subsistence and settlement activities.

It has been proposed that open, grassy meadows and fragmented forests dominating the late eighteenth century landscape of the lower Little Tennessee River Valley were maintained by Indian-set fire. The pollen and paleoethnobotanical data indicate that these expansive meadows and depleted forest had been in existence long before Euro-Americans arrived to describe them. Ethnohistoric accounts by Timberlake, Schneider, Hawkins, Louis Philippe, and Steiner and Schweinitz (Williams 1927, 1928; Georgia Historical Society 1938; Commager 1977) can be compiled to provide the following summary description of the landscape on the south side of the Little Tennessee River. Bottomlands and lower river terraces were comprised of river islands covered with peach orchards; and meadows and grasslands on which grew large reed/cane thickets, stands of tall grasses, and strawberries so plentiful that "When the strawberries are ripe the region is said to appear as though covered with a red cloth" (Williams 1928:471). Interspersed were Indian towns, where peach and apple trees grew near each house, and old and cultivated fields. Wild onions and other herbaceous plants grew in old fields while crops which grew in cultivation included maize, pumpkins, beans, potatoes, cabbage, and tobacco. Trees growing in undisturbed areas and on the uplands included ash, birch,

plum, honey locust, persimmon, oaks, pine, poplar, red cedar, hickory, flowering dogwood, maple, walnut, mulberry, sumac, and sourwood.

As one progressed further away from the Overhill towns, wooded areas and forests gradually increased. On a journey from Tellico Blockhouse to Great Tellico, Steiner and Schweinitz (Williams 1928) described the environment as they progressed south to their destination. On high, basically level land, scattered tree species were pine, hickory, post oak, minor numbers of black oak, and other oaks with little understory other than scrub hickory and sourwood; tulip poplar grew near small tributaries.

Anthropogenic Influences

Several factors contributed to this open landscape which extended along the Little Tennessee River for at least 13 km and then 3 km inland from the south bank of the river. These included:

1. timbering and deforestation in conjunction with Indian settlement activities;

2. land clearance for the establishment of villages and towns;

3. procurement of wood for structures and fuel;

4. land clearance for the development of agricultural plots and fields.

Euro-Americans also contributed to the demise of forests in

the vicinity of the river. Construction of the small, unoccupied Virginia Fort (40MR71) across the river from Chota (40MR2) in A.D. 1756 probably had little impact on the forest. Construction of Fort Loudoun, beginning in A.D. 1756, with its associated palisades and internal structures had an appreciable impact on the forest in the Tuskegee Pond vicinity. The effects of these anthropogenic influences are, in fact, recorded in pollen diagrams for Tuskegee and Black ponds. As previously indicated, Woodland, Mississippian, Historic Cherokee, and Euro-American period *Ambrosia* type rises and fluctuations in percentages of pollen of *Quercus, Pinus,* and *Zea mays* at Tuskegee Pond reflect the impact of human activities on the local landscape vegetation. Progressive increases in the pollen of *Pinus* and the dramatic rise in *Ambrosia* type pollen accompanied by *Zea mays* pollen at Black Pond demonstrate anthropogenic influences on the landscape during the Late Mississippian and Historic Overhill Cherokee periods.

Contributions of Paleoecologic Data

Palynological and paleoethnobotanical data from the lower Little Tennessee River Valley make significant contributions to archaeological interpretations of human interaction with the local environment. The paired set of paleovegetational and archaeological data provide the

basis for a fine-scale interpretation of cultural behavior. The pollen cores uniquely supply independent paleoecological data from two diverse but geographically close habitats.

These data establish that progressive landscape and vegetation change within the study area have been anthropogenically induced since at least 4,000 B.P. when the local climate and geology had stabilized. Throughout the 10,000 years of human occupation of the lower Little Tennessee River Valley, patterns of landscape vegetation change have been progressive and largely anthropogenically generated. Early and Middle Archaic populations probably had limited impact on the environment. By the Late Archaic period, and continuing to Historic times, increasing abundance of successional arboreal and herbaceous species in the paleoetnnobotanical and pollen spectra was evident. These species, including pine as well as herbaceous probable domesticated and domesticated plants, are indicators of landscape disturbance that was human-induced. The occurrence of maize (*Zea mays*) during the Middle Woodland period at Tuskegee Pond is incontrovertible evidence of clearance and cultivation activities on upland terraces. It is, moreover, an indication of changing settlement patterns. The implication is of increasing population pressure which resulted in human encroachment on the upland forests further and further away from major first terrace occupation sites. This territorial expansion and landscape

change reached its zenith during the Mississippian and Historic Cherokee periods. Open forests and vast expanses of nearly treeless, cleared land were described ethnohistorically for the Historic Overhill Cherokee phase. Changing ratios of AP/NAP represented at Tuskegee Pond indicate that this was a continuation of landscape vegetation/land-use patterns established during the Mississippian period. Charcoal influx curves from Tuskegee and Black Ponds coincide with known periods of expansion in Indian populations and intensive Historic period land-use. Evidence of Historic period Indian-set fire to control understory vegetation (Williams 1928) serves as an analogy for land-management beginning at least as early as the Mississippian period.

The most persuasive evidence for progressive anthropogenically-induced vegetation change in the lower Little Tennessee River Valley are the four ragweed (*Ambrosia* type) rises which occurred during the Late Woodland, Mississippian, Historic Cherokee, and Euro-American periods. *Ambrosia* rises previously recorded in the eastern United States have been limited to Historic times, resulting from activities associated with Euro-American settlement. Pollen data from the lower Little Tennessee River Valley documents that Native Americans had considerable impact upon the local ecosystems throughout their prehistoric and historic occupation of the area.

This research is one of the first cases in which pollen cores were obtained from within close proximity to documented archaeological sites in the southeastern United States. It is expected that local anthropogenic influences, such as those established by prehistoric *Ambrosia* type rises at Tuskegee and Black ponds, can be detected in sediment cores from other archaeological districts in the Southeast. This research has demonstrated that palynological data recovered from sources a few kilometres from archaeological sites can effectively supplement paleoethnobotanical data. The paired data strongly enhance our understanding of prehistoric humans' lifeways and impact upon local environments in eastern North America.

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APPENDIXES

APPENDIX A

PROVENIENCE AND REFERENCE FOR PALEOETHNOBOTANICAL MATERIAL USED IN STUDY

Historic Overhill Cherokee

Phase: Overhill
Site: Chota (40MR2)
Reference: Schroedl 1982

Features: 11, 13, 18, 52, 53, 60, 80, 82, 83, 87, 128, 141, 142, 195A, 214, 227, 266, 294, 345, 379, 405, 485, 489, 492, 493, 495, 500, 502, 505, 507, 512, 518, 520, 525, 555, 566, 573, 583, 596, 615, 616, 618, 633, 643, 646, 647, 650, 654, 661, 669, 673, 678, 694, 713, 736, 753, 756, 758, 760, 768, 773, 775, 782

Phase: Overhill
Site: Tanasee (40MR62)
Reference: Schroedl 1982

Features: 7, 51, 74, 95, 112, 152, 185

Phase: Overhill
Site: Mialoquo (40MR3)
Reference: Russ and Chapman 1983

Features: 1, 2, 3, 4, 5, 6, 7, 8, 11, 12, 14A, 14B, 18, 19, 20, 24, 26, 27, 28, 30, 31, 32, 33, 34, 37, 39, 40, 41, 46, 49, 51, 52, 55, 57, 58, 60, 62, 81, 586, 589, 592, 593, 596, 597, 598, 600, 601, 610, 8/04, 8/09

Phase: Overhill
Site: Tomotley (40MR5)
Reference: Baden 1983

Features: 279, 280, 281, 283, 284, 285, 286, 287, 288, 289, 291, 292, 295, 296, 297, 298, 302, 303, 304, 305, 306, 308, 310, 313, 321, 322, 323, 324, 326, 328, 332, 333, 334, 341, 342, 343, 345, 346, 347, 349, 350, 352, 353, 358, 366, 368, 374, 376, 383, 385, 387, 389, 390, 403, 405, 406, 407, 411, 414, 415, 416, 417, 418, 419, 421, 423

Burials: 82, 83, 84, 86, 87, 88, 89, 90, 96, 98, 99

Phase: Overhill
Site: Toqua (40MR6)
Reference: Site files, Frank H. McClung Museum, University of Tennessee, Knoxville

Features: 3, 10, 75, 77, 78, 634, 635, 636, 793

Late Mississippian

Phase: Dallas
Site: Toqua (40MR6)
Reference: Site files, Frank H. McClung Museum, University of Tennessee, Knoxville

Features: 12A, 12B, 13A, 13B, 21A, 21B, 21C, 21D, 21E, 21F, 21G, 22A, 22B, 23, 24A, 24B, 26A, 26B, 26C, 26D, 26E, 26F, 26G, 27A, 27B, 27C, 30, 33, 34, 35A, 35B, 36, 42, 43A, 54, 55, 79, 81, 86, 87A, 87B, 87C, 100, 106, 117, 122, 125, 126, 128, 129, 130, 131, 132, 135, 137A, 137B, 137C, 137D, 138A, 138B, 138C, 139A, 139B, 139C, 139D, 139E, 140A, 140B, 140C, 140D, 159, 177, 192, 193, 199, 207A, 207B, 208, 221, 250, 251, 253, 254, 271, 286, 287, 295, 379, 393, 411A, 411B, 421, 493, 495, 787
Section 42; Structure 32

Early Mississippian

Phase: Martin Farm
Site: Martin Farm (40MR20)
Reference: Schroedl et al. 1982

Features: 7A, 7B, 7C, 32, 33A, 34, 39A, 39B, 40A, 40B, 41, 42, 43A, 43B, 44, 45, 46A, 46B, 47, 50, 51A, 51B, 53, 55, 56A, 56B, 57A, 57B, 57C, 60, 61, 62, 63, 64A, 64B, 64C, 66A, 66B, 66C, 67A, 67B, 68A, 68B, 69A, 69B, 70, 71, 72, 73, 74, 75
Structures: 3, 7, 8, 12
Block 1: Levels: 1, 2, 3, 4, 5, 6, 7, 8, 9
Block 2: Levels: 2, 3, 4
10-20L10-30: Levels: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11

Phase: Hiwassee Island
Site: Tomotley (40MR5)
Reference: Baden 1983

Feature: 325

Middle Woodland

Phase: Connestee/Candy Creek
Site: Icehouse Bottom (40MR23)
Reference: Cridlebaugh 1981

Features: 588, 589, 590, 594, 595, 596, 597, 598A, 598B, 598C, 603, 605, 606, 607, 608, 609, 610, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633
Postmolds: 460, 461, 462, 473, 506, 514
Excavation Unit:
85R215 Levels: 2, 3, 4, 5, 6, 7, 8
85R270 Levels: 2, 3, 4, 5, 6, 7
110R115 Levels: 2, 3, 4, 5, 6, 7, 8
110R120 Levels: 2, 3, 4, 5, 6, 7, 8
110R125 Levels: 2, 3, 4, 5, 6, 7, 8
110R130 Levels: 2, 3, 4, 5, 7, 8
115R115 Levels: 2, 3
115R120 Levels: 2, 3, 4, 5, 6, 7, 8
115R125 Levels: 2
115R130 Levels: 2, 3, 4, 5, 6, 7, 8
115R140 Levels: 2, 3, 4, 5, 6, 7, 8
105R140 Levels: 3, 4, 5, 6, 7, 8
105R145 Levels: 3, 4, 5, 6, 7, 8
105R150 Levels: 3, 4, 5, 6, 7
115R135 Levels: 3, 5, 6, 7, 8
115R145 Levels: 3, 5, 6, 7, 8
115R155 Levels: 3, 4, 5
115R150 Levels: 4, 5, 6, 7
110R135 Levels: 6
85R135 Levels: 4

Early Woodland

Phase: Long Branch
Site:Rose Island (40MR44)
Reference: Chapman 1975, 1979

Features: 3, 4A, 4B, 4C, 7, 11, 16A, 16B, 17, 19, 21, 54

Phase: Long Branch
Site: Patrick (40MR40)
Reference: Schroedl 1978

Features: 2, 3, 4, 5, 6, 7, 17, 20, 21, 24, 25, 30, 32, 41, 43, 46, 52, 55, 57, 66, 75, 83, 84, 85, 86A, 86B, 86C, 87, 89, 92, 95, 101, 102, 103, 113, 120, 136, 140, 145, 147, 153, 154, 155, 157, 158

Phase: Long Branch
Site: Calloway Island (40MR41)
Reference: Chapman 1979

Features: 13, 22A, 22B, 27A, 27B, 27C, 96, 97A, 97B, 118, 130A, 130B, 130C, 145, 170, 171A, 171B, 171C, 171D, 186, 187, 188, 189

Late Archaic

Phase: Iddins
Site: Iddins (40LD38)
Reference: Chapman 1981

Features: 1, 2, 4, 5, 6, 7, 13, 14, 16, 17, 18, 19, 20, 23A, 23B, 29, 32, 36, 39, 40A, 40B, 46, 56, 57, 59, 60, 63, 66, 67, 73, 76, 77, 80, 82, 83, 84, 85, 86, 87, 88, 90, 92, 93, 96, 104, 106, 107, 108

Excavation Unit:	Stratum:	Unit	Stratum:
110R505	III	120R555	III
115R505	IIIA, IIIB	125R560	III
115R110	IIIA, IIIB	125R565	III
115R565	III	130R540	III
120R510	IIIA, IIIB	130R545	III
120R530	III	130R575	III
120R535	III	140R575	III
120R540	III	145R575	III
120R545	III		
120R550	III		
115/120R570	III		

Phase: Savannah River
Site: Bacon Bend (40MR25)
Reference: Chapman 1981

Features: 10, 11, 13, 14, 15, 16A, 16B, 17, 18, 19, 20, 21, 22, 23, 24, 26, 28, 29, 30, 31, 32, 33, 34

Excavation Unit:	Level:	Unit:	Level:
100R505	3	120R520	3
105R505	3	100R525	3A, 3B
110R505	3	105R525	3
115R505	3	110R525	3
120R505	3	115R525	3
100R510	3	120R525	3
105R510	3	105R530	1C, 3
120R510	3A, 3B	110R530	2, 3
100R515	3A, 3B	115R530	3
105R515	3	120R530	3
110R515	3	110R535	3
115R515	3	115R535	3
120R515	3	120R535	3A, 3B
100R520	3	110R510	3
105R520	3		
110R520	3		

Middle Archaic

Phase: Morrow Mountain
Site: Howard (40MR66)
Reference: Chapman 1979

Features: 3, 7, 8, 13, 14, 15, 16, 28, 31, 33, 34, 35, 40, 43, 44, 45, 46, 48, 49A, 49B, 51, 55A, 55B, 55C, 66, 68, 69, 75, 77, 79, 81, 82

Excavation Unit:

110R470	Levels: 2, 3
100R480	Levels: 4
100R490	Levels: 2
100R500	Levels: 2, 3, 4
100R520	Levels: 4, 5
100R530	Levels: 5
100R540	Levels: 3, 4
110R540	Levels: 3

Phase: Morrow Mountain
Site: Icehouse Bottom (40MR23)
Reference: Chapman 1979; Site files, Frank H. McClung Museum, University of Tennessee, Knoxville

Features: 121, 124, 126, 543

Excavation Unit:

110R480 Level: 2

Phase: Stanly
Site: Howard (40MR66)
Reference: Chapman 1979

Features: 24, 27, 30, 50, 52, 53, 54, 56, 57, 58, 59, 65, 67, 72
Excavation Unit:

110R510	Levels: 9, 11
120R510	Levels: 6, 7, 8, 9
120R530	Levels: 2
120R540	Levels: 1
110R270	Levels: 4
120R270	Levels: 3
120R280	Levels: 2
130R280	Levels: 2, 3

Phase: Stanly
Site: Icehouse Bottom (40MR23)
Reference: Site files, Frank H. McClung Museum, University of Tennessee, Knoxville

Features: 144, 146, 147, 195, 220, 333, 359

Phase: Stanly
Site: Bacon Farm (40LD35)
Reference: Chapman 1978

Features: 113, 114
Test Pits: 6-L2, 8B-16, 8B-17, 8B-18, 8B-19

Early Archaic

Phase: Bifurcate
Site: Icehouse Bottom (40MR23)
Reference: Chapman 1979

Feature: 171, 197, 206, 211, 213, 229, 250, 262, 280, 289, 316, 368, 374, 375, 376, 377, 392, 393, 394, 395, 396, 404, 405, 406, 409, 412, 413, 415, 417, 419, 420, 421, 428, 434

Phase: Bifurcate
Site: Bacon Farm (40LD35)
Reference: Chapman 1978

Features: 37, 52
Excavation Unit: Stratum VI Level:3

Phase: Bifurcate
Site: Calloway Island (40MR41)
Reference: Chapman 1979

Features: 32, 46, 56, 60, 67, 72, 84, 85, 92, 95, 114, 123, 129, 133, 156, 159, 161, 173

Excavation Unit:

115R260	Levels: 8, 9, 10
115R270	Levels: 11
120R160	Levels: 5
120R170	Levels: 2
120R190	Levels: 5B, 6
125R260	Levels: 8, 9
125R270	Levels: 10
130R150	Levels: 4
130R160	Levels: 5
130R190	Levels: 3, 4, 5A, 5B, 6

Phase: Upper Kirk
Site: Icehouse Bottom (40MR23)
Reference: Chapman 1977

Features: 175, 249, 254, 290, 295, 297, 300, 443, 462, 468, 469, 476, 478, 480, 483, 490, 508, 519, 520, 522, 524, 525, 527, 528, 529, 530, 531, 537

Excavation Unit:

55L275	Level: 13

Phase: Upper Kirk
Site: Bacon Farm (40LD35)
Reference: Chapman 1978

Features: 10, 39A, 39B, 44, 46, 53, 54, 55, 58, 73

Phase: Lower Kirk
Site: Icehouse Bottom (40MR23)
Reference: Chapman 1977

Features: 156, 158, 329, 341, 342, 347, 354, 535, 538, 544, 547, 559, 563, 565, 568, 570, 580, 581

Excavation Unit:

55L275	Levels: 20A, 20B
80L305	Areas: A
80L315	Areas: C, D; Levels: 17A, 17B
125L325	Levels: 10

APPENDIX B

PALEOETHNOBOTANICAL REMAINS

Table 10. Numerical count or gram weight of charred wood, nut, and seed and fruit remains recovered from archaeological contexts, lower Little Tennessee River Valley.

SPECIES	Overhill Cherokee No.	Dallas No.	Martin Farm No.	Connestee No.	Long Branch No.
WOOD					
Acer	44	57	66	10	15
Betula	2	5	1	0	1
Catalpa	2	2	0	0	13
Celtis	0	0	0	2	1
Cercis canadensis	10	1	7	0	0
Diospyros virginiana	3	14	6	0	5
Fraxinus	202	397	31	7	16
Gleditsia triacanthos	35	42	64	42	96
Gymnocladus dioicus	7	1	7	8	29
Platanus occidentalis	28	8	27	13	21
Populus	12	0	0	0	0
Salix	32	2	9	6	17
Ulmus	28	3	36	0	12
Vitis	0	0	0	0	21
Aesculus	0	0	0	0	0
Carya	1460	321	1544	434	347
Castanea	97	179	10	0	10
Cornus florida	13	15	6	5	12
Fagus	15	16	17	0	0
Ilex	0	0	0	0	0
Juglans	57	60	13	42	124

Table 10. (continued)

SPECIES	Overhill Cherokee No.	Dallas No.	Martin Farm No.	Connestee No.	Long Branch No.
Liquidambar styraciflua	18	5	14	0	1
Morus rubra	3	3	24	5	6
Nyssa sylvatica	0	0	0	4	0
Oxydendrum arboreum	4	2	2	0	4
Prunus undiff.	237	12	32	2	46
Prunus persica	26	0	0	0	0
Quercus (Red Group)	1137	308	1063	463	95
Quercus (White Group)	1506	377	807	227	442
Quercus undiff.	197	26	7	49	191
Rhamnus caroliniana	37	0	0	0	0
Robinia pseudoacacia	37	118	175	4	11
Sassafras albidum	5	0	18	1	1
Tilia	0	0	0	0	0
Tsuga canadensis	44	7	2	14	0
Arundinaria	1655	406	247	151	423
Carpinus caroliniana	1	1	0	0	0
Juniperus virginiana	46	187	128	4	8
Liriodendron tulipifera	92	3	22	9	10
Ostrya virginiana	6	0	9	0	0
Pinus	2674	955	786	628	749
SEEDS & FRUITS					
Ampelopsis	0	0	0	0	0
Crataegus	0	1	0	0	0
Diospyros virginiana	7	71	11	1	15
Euonymus	0	1	0	0	0

Table 10. (continued)

SPECIES	Overhill Cherokee No.	Dallas No.	Martin Farm No.	Connestee No.	Long Branch No.
Gleditsia triancanthos	4	9	90	10	34
Malus	0	9	0	0	0
Prunus sp.	19	14	7	4	0
Vitis	124	63	48	49	117
Carex	1	0	0	0	0
Equisetum	0	0	0	0	0
Galium	17	8	20	85	7
Scirpus	3	0	0	0	1
Acalpha	0	0	0	0	0
Ambrosia	14	11	9	0	0
Compositae	496	60	428	3	18
Gramineae	4	2	12	27	6
Ipomea	12	7	77	0	3
Leguminosae	3	4	35	11	2
Panicum	1	0	0	0	0
Passiflora incarnata	175	65	35	6	1
Phytolacca americana	4	4	2	9	11
Polymnia	144	5	6	17	4
Rosaceae	0	0	0	4	0
Rhus	0	4	0	1	10
Rubus	1	0	5	1	26
Vaccinum	0	0	0	0	1
Xanthium	30	0	0	0	0
Amaranthus	1	0	0	9	1
Chenopodium	3	1	179	60	1442
Helianthus	23	2	6	0	18
Iva annua	2	445	19	1	26
Phalaris caroliniana	0	0	9	131	429
Polygonum	7	11	479	10	6
Portulaca oleracea	0	0	0	0	3
Zizania aquatica	16	0	0	0	0

Table 10. (continued)

SPECIES	Overhill Cherokee G	Dallas G	Martin Farm G	Connestee G	Long Branch G
DOMESTICATED PLANTS					
Cucurbitaceae	2.28	0	.12	0	0
Cucurbita pepo	1.05	.07	0	0	.40
Lagenaria siceraria	.12	0	0	0	.03
Phaseolus vulgaris	89.27	1.25	0	0	0 0
Prunus persica	620.70	0	0	0	0 0
Zea mays	1169.35	69.61	122.41	1.18	0 0
NUTSHELL					
Carya	275.15	112.03	743.52	224.20	1366.51
Castanea dentata	0	0	.45	0	0
Fagus grandifolia	0	0	0	0	0
Juglans	172.09	15.45	34.29	55.99	91.71
Quercus	1.48	4.04	36.87	8.78	191.55
Corylus	.04	0	.03	.01	0

Table 10. (continued)

SPECIES	Iddins No.	Savannah River No.	Morrow Mountain No.	Stanly No.	Bifurcate No.	Upper Kirk No.	Lower Kirk No.
WOOD							
Acer	54	17	30	17	180	0	0
Betula	0	0	5	0	0	3	1
Catalpa	0	101	74	0	0	0	0
Celtis	5	3	9	16	2	0	3
Cercis canadensis	0	2	0	0	0	0	2
Diospyros virginiana	2	1	5	0	2	0	0
Fraxinus	10	51	241	68	7	11	5
Gleditsia triacanthos	42	150	377	125	75	121	225
Gymnocladus dioicus	5	6	2	16	47	2	0
Platanus occidentalis	0	2	13	1	10	1	11
Populus	1	1	1	0	0	0	0
Salix	16	0	9	4	0	7	3
Ulmus	2	15	48	19	4	1	8
Vitis	10	4	12	2	0	1	0
Aesculus	0	0	0	1	4	0	0
Carya	97	391	133	73	286	48	6
Castanea	0	2	0	0	1	6	0
Cornus florida	5	38	38	5	17	19	11
Fagus	0	1	14	2	44	14	47
Ilex	0	0	0	0	0	3	0
Juglans	107	107	90	43	16	24	0

Table 10. (continued)

SPECIES	Iddins No.	Savannah River No.	Morrow Mountain No.	Stanly No.	Bifurcate No.	Upper Kirk No.	Lower Kirk No.
Liquidambar styraciflua	1	0	19	4	4	6	1
Morus rubra	26	26	80	45	1	4	10
Nyssa sylvatica	0	0	0	0	0	0	1
Oxydendrum arboreum	0	1	1	0	0	11	1
Prunus undiff.	0	0	1	1	2	1	0
Prunus persica	0	0	0	0	0	0	0
Quercus (Red Group)	477	118	73	48	98	49	169
Quercus (White Group)	209	167	160	76	32	13	89
Quercus undiff.	187	37	80	74	212	99	98
Rhamnus caroliniana	0	0	0	0	0	0	0
Robinia pseudoacacia	2	22	60	39	7	5	9
Sassafras albidum	0	0	2	3	0	0	0
Tilia	1	0	2	0	0	0	2
Tsuga canadensis	0	0	0	0	0	0	0
Arundinaria	165	82	11	17	0	0	0
Carpinus caroliniana	0	0	0	0	6	1	0
Juniperus virginiana	1	0	0	0	0	0	0
Liriodendron tulipifera	0	0	8	6	3	0	2
Ostrya virginiana	0	0	0	0	0	0	0
Pinus	363	207	157	58	164	25	0
SEEDS & FRUITS							
Ampelopsis	0	0	0	0	0	0	1
Crataegus	0	0	0	0	0	0	0
Diospyros virginiana	0	3	0	1	0	0	0
Euonymus	0	0	0	0	0	0	0

Table 10. (continued)

SPECIES	Iddins No.	Savannah River No.	Morrow Mountain No.	Stanly No.	Bifurcate No.	Upper Kirk No.	Lower Kirk No.
Gleditsia triancanthos	0	0	2	1	0	0	0
Malus	0	0	0	0	0	0	0
Prunus sp.	0	0	0	0	0	0	0
Vitis	509	13	106	1	6	6	0
Carex	0	0	0	0	0	0	0
Equisetum	0	0	1	0	0	0	0
Galium	18	10	0	0	28	0	0
Scirpus	1	0	0	0	0	0	0
Acalpha	0	0	0	0	0	1	0
Ambrosia	1	0	0	0	0	0	0
Compositae	99	1	7	1	7	2	0
Gramineae	0	94	2	0	0	0	0
Ipomea	0	0	0	1	0	0	0
Leguminosae	1	0	2	0	0	3	0
Panicum	0	0	0	0	0	0	0
Passiflora incarnata	0	0	0	1	0	0	0
Phytolacca americana	3	7	13	16	26	2	0
Polymnia	1	0	15	0	0	0	0
Rosaceae	0	0	0	0	0	0	0
Rhus	0	1	1	0	2	0	2
Rubus	3	0	0	0	0	0	0
Vaccinum	0	0	0	0	0	0	0
Xanthium	0	0	0	0	0	0	0
Amaranthus	1	0	0	0	0	1	0
Chenopodium	47	1	0	0	15	0	3
Helianthus	0	0	0	0	0	0	0
Iva annua	0	0	0	0	0	0	0
Phalaris caroliniana	1	130	0	0	0	0	0
Polygonum	4	0	0	0	1	0	0
Portulaca oleracea	11	0	0	0	0	3	0
Zizania aquatica	1	3	0	0	0	0	0

Table 10. (continued)

SPECIES	Iddins G	Savannah River G	Morrow Mountain G	Stanly G	Bifurcate G	Upper Kirk G	Lower Kirk G
DOMESTICATED PLANTS							
Cucurbitaceae	0	0	0	0	0	0	0
Cucurbita pepo	.40	.02	0	0	0	0	0
Lagenaria siceraria	.04	0	0	0	0	0	0
Phaseolus vulgaris	0	0	0	0	0	0	0
Prunus persica	0	0	0	0	0	0	0
Zea mays	0	0	0	0	0	0	0
NUTSHELL							
Carya	85.26	189.21	278.06	44.85	524.88	59.68	25.72
Castanea dentata	.69	0	.22	0	3.60	.18	0
Fagus grandifolia	0	0	0	0	.02	0	0
Juglans	747.83	176.58	46.25	4.98	.76	.36	.01
Quercus	10.77	20.22	11.32	.85	47.41	21.54	4.16
Corylus	.06	0	.02	0	0	0	0

APPENDIX C

LOSS-ON-IGNITION DATA

Table 11. Loss-on-ignition data for Tuskegee Pond, Monroe County, Tennessee.

Depth (cm)	Sample Weight (g/cm^3)	Organic Matter (g/cm^3)	Percent Organic Matter
55	0.60905	0.05313	8.0
60	0.62422	0.05737	8.4
70	0.75043	0.05876	7.8
80	0.69524	0.06341	9.1
90	0.87301	0.06048	6.9
100	0.86662	0.05747	6.6
110	1.09234	0.06348	5.8
120	1.10294	0.07395	6.7
130	1.06757	0.06410	6.0
140	1.20070	0.07154	6.0
150	1.14508	0.07381	6.4
160	1.11159	0.06327	5.7
170	1.01613	0.08578	8.4
180	1.19620	0.07564	6.3
190	1.23215	0.07236	5.9
200	1.27223	0.06022	4.7

APPENDIX D

POLLEN DATA, TUSKEGEE POND

Table 12. Pollen and spore data, Tuskegee Pond, 55 to 150 cm depth.

	Depth (cm)										
	55	60	70	80	90	100	110	120	130	140	150
TREES											
Acer undiff.	1	3	0	0	2	1	0	1	0	0	2
Acer negundo	3	1	1	2	0	3	1	2	2	1	3
Acer rubrum	0	0	0	0	0	0	1	1	0	0	0
Acer saccharum	3	2	0	0	0	0	0	1	1	0	0
Betula	5	1	6	8	0	2	7	11	4	4	4
Carpinus/ Ostrya type	6	1	0	0	2	2	0	0	0	0	2
Carya	20	16	4	23	11	10	7	4	15	18	6
Castanea	0	2	1	2	2	0	3	4	3	2	28
Catalpa speciosa	2	1	1	0	0	2	0	0	0	0	2
Celtis/ Maclura type	7	11	22	6	4	12	16	5	9	7	2
Cornus florida	0	1	0	1	0	0	0	2	0	0	1
Cupressaceae	0	1	0	0	1	0	0	1	0	0	3
Ericaceae	0	0	0	0	0	0	0	0	0	0	0
Fagus	0	0	0	0	1	0	0	0	0	0	1
Fraxinus undiff.	2	10	7	3	4	6	3	2	0	5	5
Fraxinus nigra-quadrangulata type (Cperi)	2	5	3	2	0	1	3	4	4	0	2

Table 12. (continued)

	Depth (cm)										
	55	60	70	80	90	100	110	120	130	140	150
Fraxinus pennsylvanica-americana type (C4-6stp)	6	7	4	2	0	1	0	9	4	0	1
Gleditsia	0	0	1	1	0	2	0	0	1	0	0
Ilex	0	0	2	0	0	0	0	1	0	0	2
Juglans undiff.	1	1	1	1	1	3	3	2	1	0	1
Juglans cinerea (P2-8)	0	0	0	0	0	0	0	0	0	0	0
Juglans nigra (P9-15)	0	1	0	0	0	0	1	0	1	1	1
Liquidambar styraciflua	3	0	2	4	5	2	1	6	4	0	3
Liriodendron tulipifera	0	0	0	0	0	0	0	0	0	0	0
Morus	0	0	0	3	2	2	0	0	0	0	1
Myrica type	0	1	2	1	1	0	0	1	0	0	0
Nyssa	0	1	0	1	0	2	0	0	1	0	2
Pinus undiff.	74	56	67	52	71	60	84	78	91	103	55
Pinus Diploxylon	29	23	29	23	49	31	39	45	37	51	34
Platanus	0	0	0	0	0	3	3	1	0	0	0
Populus	0	1	0	0	3	1	0	0	0	0	3
Prunus	1	1	0	0	1	0	0	0	0	0	0
Quercus	141	130	104	129	98	114	89	93	112	95	135
Rhamnus	0	0	0	0	0	0	0	0	0	0	1
Robinia	0	0	1	2	0	1	2	1	1	0	0
Salix	4	12	10	14	13	21	10	21	13	9	9
Tilia	1	0	0	0	0	0	0	0	0	0	0
Tsuga	0	0	0	0	0	0	0	0	0	0	0
Ulmus	17	16	34	72	44	37	28	23	22	12	8

Table 12. (continued)

	Depth (cm)										
	55	60	70	80	90	100	110	120	130	140	150
Xanthoxylum americanum	0	2	0	2	0	2	3	1	1	2	0
Total Arboreal Pollen	329	307	302	354	315	322	304	320	327	310	317
SHRUBS											
Alnus rugosa type	1	0	1	2	5	3	3	3	4	0	0
Cephalanthus occidentalis	0	0	0	0	0	1	0	0	1	1	0
Corylus	2	0	0	0	3	2	0	0	1	0	2
Potentilla	0	0	0	0	0	0	0	0	0	0	0
Rubus	3	3	4	28	17	20	20	27	5	1	5
Sambucus	1	1	2	0	1	4	3	2	4	0	0
VINES											
Celastraceae	0	0	8	8	0	2	5	0	0	0	0
Lonicera	0	3	0	0	0	0	0	1	0	0	0
Parthenocissus	0	0	0	0	0	0	0	0	0	0	0
Rhus radicans	0	0	0	0	0	0	0	0	2	0	6
Smilax	0	0	0	0	0	0	0	0	0	0	1
Vitis	2	3	1	4	1	4	3	2	2	1	2
NONAQUATIC HERBS											
Caryophyllaceae	2	1	2	2	3	4	3	8	2	5	4
Chenopodium type	8	6	5	8	8	21	10	38	16	20	11
Tubuliflorae undiff.	8	8	3	6	1	3	1	15	2	4	1
Ambrosia	195	194	169	212	175	373	261	614	324	270	622
Artemisia	4	2	0	2	1	3	1	3	0	2	0
Bidens type	4	5	12	7	2	12	15	4	16	16	11

Table 12. (continued)

	Depth (cm)										
	55	60	70	80	90	100	110	120	130	140	150
Iva	2	1	2	1	5	4	2	3	3	1	2
Xanthium	3	3	2	2	10	8	4	11	7	4	5
Liguliflorae	1	1	1	1	0	0	0	0	0	1	0
Cruciferae	0	3	3	0	1	1	0	00	0	0	0
Cyperaceae	0	3	3	0	1	1	0	0	0	0	0
Gramineae, wild	128	113	252	1486	659	558	461	1078	380	209	124
Zea mays	0	1	2	2	4	4	4	2	4	3	2
Phlox	0	0	0	0	0	0	0	1	0	0	0
Plantago, undiff.	6	2	1	5	0	2	5	2	5	0	0
Plantago lanceolata	0	0	0	3	3	0	0	0	0	0	0
Plantago major	0	5	0	0	0	0	0	0	0	0	0
cf. Portulacaceae	0	0	0	0	0	0	0	0	1	0	0
Rumex	0	1	0	0	0	2	0	0	0	0	0
Thalictrum	0	1	1	0	0	1	1	9	1	0	2
Umbelliferae	0	0	1	4	2	0	3	4	2	1	0
Urtica	0	1	1	2	0	0	1	1	0	4	0
Labiatae	0	2	0	0	0	0	0	0	0	0	0
Sida	0	0	0	0	0	1	0	0	0	0	0
Diodia	0	0	0	0	0	0	0	0	0	1	0
Euphorbia type	0	0	0	0	0	0	2	0	0	0	0
Eupatorium	0	0	0	0	0	0	0	1	0	0	2
Galium	0	0	0	0	0	0	0	0	0	0	0
Oxalis	0	0	1	0	0	0	0	0	0	0	0
Ranunculaceae	0	0	2	0	0	0	0	0	2	0	1
Solanaceae	0	1	0	0	0	0	0	0	1	0	0

Table 12. (continued)

	Depth (cm)										
	55	60	70	80	90	100	110	120	130	140	150
Trifolium	0	0	0	11	0	3	0	0	0	0	0
NONAQUATIC FERNS											
Botrychium	0	0	0	0	0	0	0	0	0	0	1
Dryopteris type	0	0	0	0	0	0	0	1	0	0	2
Osmunda cinnamomea	0	2	1	0	1	0	3	2	0	0	0
CLUB MOSSES											
Equisetum	0	1	0	0	0	0	0	0	0	1	0
Lycopodium undiff.	1	2	3	0	1	0	0	1	0	0	4
Selaginella	0	0	0	0	0	1	0	0	0	0	1
UNKNOWN	0	0	0	0	0	0	0	0	0	0	0
Total Upland Pollen and Spores	715	696	808	2184	1226	1397	1132	2215	1149	877	1172
OBLIGATE AQUATICS											
Myriophyllum undiff.	0	0	0	0	0	0	0	0	0	0	0
Nuphar	0	1	0	0	0	0	0	0	0	1	0
Nymphaea	0	0	0	0	0	0	0	0	0	1	1
Polygonum hydropiper type	0	0	1	1	0	3	0	0	3	1	3
Eupotamogeton	0	6	2	2	7	2	1	4	2	0	0
Proserpinaca	0	0	0	0	0	0	3	0	0	0	0
Sparganium type	2	2	2	2	0	1	2	5	3	4	2
Typha latifolia	0	2	0	1	0	0	0	0	2	0	0
Total Obligate Aquatics	2	11	5	6	7	6	6	9	10	7	6

Table 12. (continued)

	Depth (cm)										
	55	60	70	80	90	100	110	120	130	140	150
INDETERMINABLE POLLEN											
Corroded & Degraded	3	4	2	4	0	2	1	2	2	2	0
Corroded & Concealed	0	1	2	0	0	1	0	0	2	4	3
Corr., Degraded & Concealed	2	2	0	8	9	2	2	1	1	6	0
Degraded & Concealed	2	0	1	0	0	9	1	3	4	0	2
Degraded, Mech., Conc. Det.	0	0	2	4	5	3	4	4	0	3	0
Mechanical & Concealed	1	1	0	0	0	0	0	0	0	0	3
Concealed by Detritus	1	1	0	10	2	2	1	0	0	00	0
Total Indeterminable Pollen	9	9	8	16	24	10	10	14	9	15	8
Total Pollen & Spores	717	707	813	2190	1233	1403	1138	2224	1159	884	1178
Number of *Eucalyptus* pollen grains counted	310	281	266	215	266	420	476	225	220	325	374
Number of *Eucalyptus* tablets/cm^3	1	1	1	1	1	1	1	1	1	1	1

Table 13. Pollen and spore data, Tuskegee Pond, 160 to 200 cm depth.

	Depth (cm)										
	160	170	172.5	175	178	180	182.5	185	187.3	190	200
TREES											
Acer undiff.	0	0	1	0	0	0	0	1	0	0	2
Acer negundo	0	0	1	2	1	0	0	0	0	0	0
Acer rubrum	0	0	0	0	0	0	0	0	0	0	0
Acer saccharum	1	1	0	1	0	2	0	0	0	0	1
Betula	2	2	7	3	7	3	4	7	4	5	14
Carpinus/ Ostrya type	0	2	1	0	0	0	1	0	0	2	1
Carya	10	18	9	12	11	9	14	12	34	11	9
Castanea	11	6	13	12	19	18	5	10	2	17	2
Catalpa speciosa	0	0	8	0	0	0	2	1	1	0	3
Celtis/ Maclura type	0	1	0	0	0	0	0	0	0	0	5
Cornus florida	0	0	0	0	0	0	0	0	0	0	1
Cupressaceae	1	0	10	0	1	0	1	0	0	0	1
Ericaceae	1	1	0	0	0	1	0	0	0	3	7
Fagus	0	0	0	0	0	0	1	0	1	0	1
Fraxinus undiff.	2	2	1	2	0	1	1	0	2	2	5
Fraxinus nigra-quadrangulata type (Cperi)	2	2	0	3	3	2	3	5	1	3	3

Table 13. (continued)

	Depth (cm)										
	160	170	172.5	175	178	180	182.5	185	187.5	190	200
Fraxinus pennsylvanica-americana type (C4-6stp)	0	0	0	1	0	1	3	1	0	1	7
Gleditsia	1	0	0	0	0	0	0	0	0	0	1
Ilex	1	1	1	0	0	0	0	0	0	0	0
Juglans undiff.	3	2	3	4	1	1	0	2	0	1	0
Juglans cinerea (P2-8)	0	0	0	0	0	0	0	1	1	0	0
Juglans nigra (P9-15)	1	0	1	0	1	0	0	1	0	0	0
Liquidambar styraciflua	2	0	2	0	1	1	0	4	0	1	2
Liriodendron tulipifera	0	0	0	1	0	0	1	0	0	0	0
Morus	0	0	0	0	0	0	0	0	0	0	0
Myrica type	0	0	1	0	0	0	0	0	0	0	0
Nyssa	0	0	1	0	0	0	1	1	0	0	1
Pinus undiff.	46	53	68	69	62	58	74	69	97	78	77
Pinus Diploxylon	24	31	16	31	12	23	31	36	36	38	7
Platanus	0	0	0	0	0	0	0	0	0	0	0
Populus	0	0	1	0	0	0	2	0	0	0	0
Prunus	0	0	0	0	0	0	0	0	0	0	0
Quercus	184	139	160	163	181	184	151	141	123	146	99
Rhamnus	0	0	1	0	0	0	1	0	1	0	0
Robinia	0	0	0	0	0	0	0	0	1	0	2
Salix	13	6	7	5	3	3	0	5	0	7	9
Tilia	0	0	0	0	0	0	0	0	0	0	0
Tsuga	0	0	1	0	0	0	2	0	1	0	0
Ulmus	5	6	3	2	5	6	5	8	3	2	39

Table 13. (continued)

	Depth (cm)										
	160	170	172.5	175	178	180	182.5	185	187.5	190	200
Xanthoxylum americanum	0	36	1	1	0	0	0	3	0	1	1
Total Arboreal Pollen	310	309	318	312	307	313	303	307	308	318	300
SHRUBS											
Alnus rugosa type	1	0	1	5	1	0	2	7	0	1	3
Cephalanthus occidentalis	0	0	0	1	1	0	0	0	0	0	2
Corylus	0	0	0	0	3	0	0	0	0	0	0
Potentilla	0	0	0	0	0	1	0	0	0	0	0
Rubus	0	1	4	3	3	2	0	1	3	1	5
Sambucus	2	0	1	0	0	0	0	0	1	1	4
VINES											
Celastraceae	0	0	0	0	0	0	0	0	0	0	0
Lonicera	0	0	0	0	0	0	0	0	0	0	0
Parthenocissus	1	0	0	0	0	0	0	0	0	0	2
Rhus radicans	0	0	0	0	0	0	0	0	0	0	0
Smilax	0	1	0	0	0	0	0	0	0	0	0
Vitis	2	1	0	0	0	1	1	1	0	1	2
NONAQUATIC HERBS											
Caryophyllaceae	2	1	4	1	2	2	2	1	2	3	2
Chenopodium type	2	2	6	3	3	6	3	0	2	6	16
Tubuliflorae undiff.	6	13	14	3	15	12	5	5	7	4	12
Ambrosia	459	236	512	322	438	409	306	352	136	325	197
Artemisia	0	1	0	0	2	0	0	0	0	0	1
Bidens type	7	4	12	12	14	9	3	14	2	7	9

Table 13. (continued)

	Depth (cm)										
	160	170	172.5	175	178	180	182.5	185	187.5	190	200
Iva	0	8	4	2	5	3	0	3	0	5	2
Xanthium	8	4	11	4	12	13	0	8	0	0	7
Liguliflorae	0	0	0	0	1	1	0	0	0	0	0
Cruciferae	0	1	0	0	1	0	0	0	2	0	0
Cyperaceae	30	15	34	20	30	24	22	33	13	8	18
Gramineae, wild	76	51	99	70	62	59	74	191	34	105	483
Zea mays	1	4	5	8	3	6	12	4	9	5	3
Phlox	0	0	0	0	0	0	0	0	0	0	0
Plantago, undiff.	1	1	0	0	0	0	1	3	2	4	0
Plantago lanceolata	0	0	0	1	0	0	0	0	0	0	0
Plantago major	0	0	0	1	0	0	0	0	0	0	0
cf. Portulacaceae	0	0	0	0	0	1	0	0	1	0	0
Rumex	0	0	0	0	0	0	0	0	0	0	0
Thalictrum	0	1	1	1	0	1	0	0	0	0	1
Umbelliferae	0	1	0	0	0	0	0	0	3	0	0
Urtica	3	0	0	0	0	0	0	0	0	0	1
Labiatae	0	0	0	0	0	0	0	0	0	0	1
Sida	0	0	0	0	1	0	1	1	0	1	1
Diodia	1	0	0	0	0	0	1	0	0	1	0
Euphorbia type	0	0	0	0	1	0	0	0	0	0	0
Eupatorium	0	0	0	1	0	0	0	0	0	0	0
Galium	0	0	1	0	0	0	0	0	0	0	0
Oxalis	0	0	0	0	0	0	0	0	0	0	0
Ranunculaceae	0	0	0	0	0	0	0	0	0	0	0
Solanaceae	0	0	0	0	0	0	0	0	0	0	0

Table 13. (continued)

	Depth (cm)										
	160	170	172.5	175	178	180	182.5	185	187.5	190	200
Trifolium	0	0	0	0	0	0	0	0	0	0	0
NONAQUATIC FERNS											
Botrychium	0	0	0	0	0	0	0	1	0	0	0
Dryopteris type	0	0	0	0	0	0	0	0	1	0	0
Osmunda cinnamomea	1	1	1	1	1	11	0	1	0	0	0
CLUB MOSSES											
Equisetum	0	0	1	0	0	0	0	1	0	0	0
Lycopodium undiff.	2	1	2	1	4	0	0	2	1	6	0
Selaginella	0	1	0	0	0	0	0	0	0	0	0
UNKNOWN	0	0	1	0	0	0	0	0	0	0	0
Total Upland Pollen and Spores	916	658	1034	773	910	873	736	936	527	802	1072
OBLIGATE AQUATICS											
Myriophyllum undiff.	2	0	0	0	0	0	0	0	0	0	1
Nuphar	0	0	0	2	0	0	0	0	0	0	0
Nymphaea	1	1	0	0	3	0	3	2	0	2	21
Polygonum hydropiper type	0	1	1	1	0	3	0	2	3	5	2
Eupotamogeton	1	1	0	1	2	3	1	1	0	1	0
Proserpinaca	0	0	0	1	0	0	0	0	0	0	0
Sparganium type	6	4	7	4	4	0	2	0	0	2	7
Typha latifolia	0	0	1	0	0	0	0	3	0	1	3
Total Obligate Aquatics	10	7	9	8	10	6	6	8	3	11	34

Table 13. (continued)

	Depth (cm)										
	160	170	172.5	175	178	180	182.5	185	187.5	190	200
INDETERMINABLE POLLEN											
Corroded & Degraded	1	3	4	2	3	0	2	1	0	2	0
Corroded & Concealed	3	1	1	0	1	1	1	0	0	0	0
Corr., Degraded & Concealed	0	2	3	3	3	0	0	0	0	0	0
Degraded & Concealed	0	0	0	0	0	0	5	0	5	2	0
Degraded, Mech., Conc. Det.	2	0	0	1	1	3	0	5	0	3	0
Mechanical & Concealed	4	2	0	0	0	0	0	3	0	2	0
Concealed by Detritus	0	2	1	2	0	0	0	2	74	3	39
Total Indeterminable Pollen	10	10	9	8	8	4	8	11	79	13	39
Total Pollen & Spores	926	665	1043	781	920	879	742	944	530	813	1106
Number of *Eucalyptus* pollen grains counted	475	214	457	257	326	258	318	244	169	237	4009
Number of *Eucalyptus* tablets/cm^3	1	1	1	1	1	1	1	1	1	1	3

APPENDIX E

POLLEN DATA, BLACK POND

Table 14. Pollen and spore data, Black Pond, 10 to 160 cm depth.

	Depth (cm)										
	10	20	30	40	50	70	90	110	130	150	160
TREES											
Acer undiff.	1	1	1	0	0	0	1	0	0	0	0
Acer negundo	1	1	0	1	0	0	0	0	0	0	1
Acer rubrum	0	0	0	0	0	1	0	1	0	1	0
Acer saccharum	2	0	0	0	0	0	1	0	1	0	0
Betula	4	4	5	3	2	8	6	1	1	0	1
Carpinus/Ostrya type	5	7	2	4	1	3	0	0	1	0	0
Carya	13	17	10	9	1	1	7	8	4	5	8
Castanea	0	3	2	44	22	18	10	18	7	10	7
Catalpa speciosa	0	1	1	2	0	0	0	1	0	3	3
Celtis/Maclura type	4	2	0	0	0	0	0	1	0	0	0
Cornus florida	0	0	0	0	1	0	0	0	0	0	1
Cupressaceae	4	2	4	4	4	7	2	4	3	0	0
Ericaceae	1	0	0	1	0	0	0	0	1	0	1
Fagus	1	1	0	4	0	0	0	1	1	0	1
Fraxinus undiff.	3	6	2	0	6	5	1	1	3	2	1
Fraxinus nigra-quadrangulata type (Cperi)	20	17	19	7	10	8	3	8	4	3	5

Table 14. (continued)

	Depth (cm)										
	10	20	30	40	50	70	90	110	130	150	160
Fraxinus pennsylvanica-americana type (C4-6stp)	17	17	16	6	4	9	6	3	2	2	4
Ilex	1	0	0	1	0	0	0	0	0	0	1
Juglans undiff.	2	5	5	5	1	5	0	1	1	1	1
Juglans cinerea (P2-8)	0	0	0	0	0	0	0	0	0	1	0
Juglans nigra	4	5	4	9	1	4	2	0	0	0	0
Liquidambar styraciflua	6	7	1	1	1	2	1	2	2	2	4
Liriodendron tulipifera	0	0	0	1	0	0	0	0	0	0	1
Magnolia	0	0	0	0	0	1	0	0	0	0	0
Morus	0	0	0	0	0	2	0	0	0	0	0
Myrica type	0	2	1	0	0	1	0	0	0	0	0
Nyssa	0	1	2	1	0	1	0	0	0	0	0
Pinus undiff.	34	32	41	58	54	43	82	79	67	39	65
Pinus Diploxylon	29	30	27	36	26	29	31	25	37	22	25
Platanus	2	0	1	0	2	0	0	1	0	0	0
Populus	1	0	1	0	0	0	0	0	0	0	0
Prunus	0	1	0	0	0	0	0	0	0	0	1
Quercus	129	109	123	123	136	128	137	139	101	74	73
Rhamnus	0	1	0	0	0	0	0	0	0	0	1
Robinia	0	0	0	0	0	0	0	1	1	0	0
Salix	28	41	38	27	12	23	16	18	74	191	107
Tilia	0	0	0	0	0	0	0	0	0	0	0
Tsuga	0	0	1	0	0	0	0	0	0	0	1
Ulmus	15	10	1	4	4	1	4	1	2	2	3

Table 14. (continued)

	Depth (cm)										
	10	20	30	40	50	70	90	110	130	150	160
Viburnum	0	0	1	0	1	0	0	0	1	0	0
Xanthoxylum americanum	0	1	0	0	0	0	0	0	0	0	0
Total Arboreal Pollen	327	322	310	309	310	304	318	306	325	355	319
SHRUBS											
Alnus rugosa type	3	4	4	3	1	1	3	1	0	0	2
Cephalanthus occidentalis	0	10	4	7	3	6	0	4	2	1	0
Corylus	1	1	1	1	0	1	0	1	0	1	0
Hypericum	0	0	0	0	1	0	0	0	0	0	0
Rubus	3	2	1	1	14	3	5	2	2	0	1
Sambucus	2	3	3	1	0	2	1	0	0	2	1
VINES											
Celastraceae	0	0	0	0	0	0	0	0	0	0	0
Lonicera	0	1	0	0	0	0	0	0	0	0	0
Rhus radicans	0	0	0	0	0	0	0	0	0	0	0
Vitis	2	3	2	1	1	2	1	3	1	2	1
NONAQUATIC HERBS											
Caryophyllaceae	2	4	2	2	0	0	0	0	0	0	1
Chenopodium type	3	2	1	2	2	1	2	1	0	0	2
Tubulifloreae undiff.	4	8	3	18	16	8	45	36	21	41	15
Ambrosia	68	108	237	236	569	208	321	303	254	723	290
Artemisia	0	0	1	0	0	0	0	0	0	0	0
Bidens type	1	4	1	4	10	3	13	17	10	7	9
Iva	0	0	0	1	1	1	0	1	0	1	0

Table 14. (continued)

	Depth (cm)										
	10	20	30	40	50	70	90	110	130	150	160
Xanthium	0	3	0	4	10	0	6	2	1	4	2
Liguliflorae	0	0	0	0	0	0	0	1	0	1	0
Cruciferae	3	1	0	3	1	3	0	0	2	3	4
Cyperaceae	11	13	15	16	22	7	14	44	27	15	11
Gramineae, wild	75	27	17	32	20	26	19	27	13	21	18
Zea mays	0	0	1	2	1	0	2	0	0	3	1
Galium	0	0	0	0	0	0	0	0	0	0	0
Diodia	0	1	0	0	0	0	1	0	0	0	0
Dodecatheon	0	0	1	0	0	0	0	0	0	0	0
Hypoxis hirsuta	0	0	0	0	0	0	0	1	0	0	0
Labiatae	0	0	0	0	2	0	0	0	0	0	0
Malvaceae	0	0	0	0	0	0	0	0	0	0	0
Mitella	1	0	0	0	0	0	0	0	0	1	0
Onagraceae	0	0	0	0	1	0	0	0	0	0	0
Plantago undiff.	0	0	0	0	0	0	0	1	0	0	0
Plantago lanceolata	6	2	4	3	0	3	2	0	0	0	1
Plantago major	3	3	6	3	1	1	0	0	0	0	0
Rumex	0	1	0	3	0	2	0	0	0	0	0
Solanaceae	0	0	1	0	1	0	1	0	1	0	0
Thalictrum	2	0	0	0	0	0	0	1	0	0	0
Trifolium	0	0	0	1	0	0	0	0	0	0	0
Umbelliferae	2	0	1	0	0	0	1	0	0	0	1
Urtica	2	0	0	2	0	1	0	1	0	0	0
NONAQUATIC FERNS											
Athyrium	0	0	0	0	0	0	0	0	0	0	0

Table 14. (continued)

	Depth (cm)										
	10	20	30	40	50	70	90	110	130	150	160
Botrychium	0	0	0	0	0	0	0	0	0	0	2
Cheilanthes	0	0	0	0	0	0	0	0	0	0	0
Cystopteris	0	0	0	0	0	0	0	0	0	0	0
Dennstaedtia	0	0	0	0	0	0	0	0	0	0	0
Dryopteris	0	0	0	0	0	0	0	0	0	0	1
Osmunda cinnamomea	0	0	0	1	0	0	1	0	1	2	3
Osmunda regalis type	0	0	0	0	0	0	0	1	1	2	0
Polypodium	0	0	0	0	0	0	0	0	0	0	0
Pteridium	0	0	0	0	0	0	0	0	0	0	0
CLUB MOSSES											
Equisetum	0	2	0	0	0	0	0	0	0	0	0
Lycopodium undiff.	0	0	0	1	1	0	0	0	1	0	0
UNKNOWN	1	0	0	0	0	0	0	0	0	0	0
Total Upland Pollen and Spores	522	525	616	657	988	583	756	753	662	1184	704
OBLIGATE AQUATICS											
Myriophyllum undiff.	0	0	0	0	0	0	0	0	0	0	0
Nuphar	0	0	0	0	0	0	0	1	0	0	0
Nymphaea	0	0	0	0	0	1	0	2	0	0	1
Polygonum hydropiper type	0	0	0	0	0	0	1	1	0	0	1
Eupotamogeton	4	1	57	50	6	7	1	1	0	1	1
Sparganium type	0	0	0	0	0	0	1	1	0	0	1
Typha latifolia	2	1	1	4	7	11	0	0	0	0	0
Total Obligate Aquatics	6	2	58	54	13	19	3	6	0	1	4

Table 14. (continued)

	Depth (cm)										
	10	20	30	40	50	70	90	110	130	150	160
INDETERMINABLE POLLEN											
Corroded & Degraded	0	1	1	3	2	3	2	2	1	4	2
Corroded & Concealed	0	0	1	0	1	2	1	1	1	1	2
Corr., Degraded & Concealed	0	0	0	1	1	0	3	0	3	1	1
Degraded & Concealed	2	1	2	1	0	2	0	0	2	1	0
Degraded, Mech., Conc. Det.	0	0	0	1	0	0	0	3	0	1	1
Mechanical & Concealed	0	0	0	0	1	0	0	0	0	0	1
Concealed by Detritus	0	0	0	1	1	1	0	2	0	2	1
Total Indeterminable Pollen	2	2	4	7	6	8	6	8	7	10	8
Total Pollen & Spores	528	527	674	711	1001	602	759	759	662	1185	708
Number of *Eucalyptus* pollen grains counted	150	278	533	429	679	306	172	333	234	159	116
Number of *Eucalyptus* tablets/cm^3	1	1	1	1	1	1	1	1	1	1	1

Table 15. Pollen and spore data, Black Pond, 170 to 212.5 cm depth.

	Depth (cm)										
	170	180	185	190	195	200	202.5	205	207.5	210	212.5
TREES											
Acer undiff.	1	1	0	1	0	0	0	0	1	0	0
Acer negundo	0	0	0	0	0	0	0	0	0	0	0
Acer rubrum	0	0	1	0	0	0	0	0	0	0	1
Acer saccharum	0	0	0	0	0	1	0	0	0	0	0
Betula	1	2	1	7	2	4	4	6	1	2	1
Carpinus/Ostrya type	1	0	0	0	0	2	1	1	0	0	0
Carya	6	4	5	7	5	2	17	12	4	17	11
Castanea	7	15	22	13	17	21	12	18	13	19	9
Catalpa speciosa	2	0	0	1	0	0	0	0	1	0	0
Celtis/Maclura type	1	2	1	0	0	0	0	0	0	0	0
Cornus florida	0	0	1	1	0	0	0	0	1	0	1
Cupressaceae	3	3	2	7	3	3	1	1	0	0	1
Ericaceae	0	0	0	0	0	0	1	0	0	0	0
Fagus	4	1	2	2	1	5	0	0	0	1	0
Fraxinus undiff.	1	5	9	10	7	7	1	2	3	2	2
Fraxinus nigra-quadrangulata type (Cperi)	5	6	6	8	2	3	2	3	2	6	5

Table 15. (continued)

	Depth (cm)										
	170	180	185	190	195	200	202.5	205	207.5	210	212.5
Fraxinus pennsylvanica-americana type (C4-6stp)	12	16	19	11	3	5	1	3	8	9	5
Ilex	0	1	0	0	0	0	0	0	0	0	0
Juglans undiff.	0	0	0	0	0	0	0	2	0	0	1
Juglans cinerea (P2-8)	0	0	0	0	0	0	0	0	0	0	0
Juglans nigra	1	0	0	0	1	0	0	0	0	0	0
Liquidambar styraciflua	13	2	1	2	2	9	2	1	15	9	7
Liriodendron tulipifera	0	0	0	0	0	0	0	0	0	0	0
Magnolia	0	0	0	0	0	0	0	0	0	0	0
Morus	0	1	0	1	0	0	0	0	0	0	0
Myrica type	0	1	0	0	0	0	0	0	0	0	0
Nyssa	1	0	0	0	0	0	0	0	1	2	1
Pinus undiff.	40	49	96	73	131	102	152	128	123	112	110
Pinus Diploxylon	12	18	16	16	18	15	34	17	39	34	45
Platanus	1	0	0	0	0	2	0	0	0	0	1
Populus	0	1	0	0	0	0	0	0	0	0	0
Prunus	0	0	0	0	0	0	0	0	0	0	0
Quercus	53	71	111	84	108	113	84	102	92	93	99
Rhamnus	0	0	0	0	0	0	1	0	0	0	0
Robinia	0	0	0	0	0	0	0	0	0	0	0
Salix	129	99	7	58	3	6	0	4	2	2	0
Tilia	0	0	0	0	0	0	0	0	0	0	0
Tsuga	0	0	0	0	0	0	0	0	1	0	2
Ulmus	11	2	4	2	0	2	1	2	2	5	1

Table 15. (continued)

	Depth (cm)										
	170	180	185	190	195	200	202.5	205	207.5	210	212.5
Viburnum	1	1	0	0	0	1	0	0	0	0	0
Xanthoxylum americanum	0	0	0	0	0	1	0	0	0	0	0
Total Arboreal Pollen	306	300	305	305	303	304	314	302	309	313	303
SHRUBS											
Alnus rugosa type	1	1	1	3	0	0	1	0	0	0	0
Cephalanthus occidentalis	0	1	0	0	0	1	0	0	2	4	0
Corylus	1	0	0	1	1	0	0	0	0	0	0
Hypericum	0	0	0	0	0	0	0	0	0	0	0
Rubus	0	0	0	0	0	3	0	0	0	0	1
Sambucus	4	7	0	2	0	1	0	0	0	1	0
VINES											
Celastraceae	1	0	0	0	0	0	0	0	0	0	0
Lonicera	0	0	0	0	0	0	0	0	0	0	0
Rhus radicans	0	0	0	0	0	0	0	0	0	0	0
Vitis	1	1	0	0	1	0	0	0	0	0	0
NONAQUATIC HERBS											
Caryophyllaceae	1	0	1	0	0	0	0	0	1	0	0
Chenopodium type	0	1	0	1	1	0	0	0	0	1	0
Tubulifloreae undiff.	0	5	5	9	0	3	0	0	0	0	0
Ambrosia	112	61	23	144	7	30	0	4	3	4	4
Artemisia	0	0	0	0	0	1	3	1	0	0	0
Bidens type	1	0	1	3	0	0	1	2	0	1	2
Iva	0	0	0	1	0	1	0	0	0	0	0

Table 15. (continued)

	Depth (cm)										
	170	180	185	190	195	200	202.5	205	207.5	210	212.5
Xanthium	0	0	0	0	0	0	0	0	0	0	0
Liguliflorae	0	0	0	0	0	0	0	2	0	0	0
Cruciferae	0	0	0	0	0	4	0	1	1	0	2
Cyperaceae	17	20	25	23	33	15	21	24	23	24	21
Gramineae, wild	10	5	12	19	4	15	8	8	6	7	4
Zea mays	0	0	0	0	0	0	0	0	0	0	0
Galium	0	0	0	0	0	0	0	0	0	0	0
Diodia	0	0	0	0	0	0	0	0	0	0	0
Dodecatheon	0	0	0	0	0	0	0	0	0	0	0
Hypoxis hirsuta	0	0	0	0	0	0	0	0	0	1	0
Labiatae	0	0	0	0	0	0	0	0	0	0	0
Malvaceae	0	0	0	0	0	0	0	0	0	0	0
Mitella	0	0	0	0	0	0	0	0	0	0	0
Onagraceae	0	0	0	0	0	0	0	0	0	0	0
Plantago undiff.	0	0	0	0	1	0	1	0	2	1	2
Plantago lanceolata	0	0	0	2	0	0	0	0	0	0	0
Plantago major	0	0	0	0	0	0	0	0	0	0	0
Rumex	0	0	0	0	0	0	0	0	0	0	0
Solanaceae	0	0	0	0	0	0	0	0	0	0	0
Thalictrum	0	0	0	0	0	0	1	0	0	0	2
Trifolium	0	0	0	0	0	0	0	0	0	0	0
Umbelliferae	0	0	1	0	0	0	1	1	1	0	0
Urtica	0	0	0	2	0	0	0	0	0	0	0
NONAQUATIC FERNS											
Athyrium	0	0	0	0	0	0	0	0	0	0	0

Table 15. (continued)

	Depth (cm)										
	170	180	185	190	195	200	202.5	205	207.5	210	212.5
Botrychium	0	0	1	0	0	2	1	0	0	0	0
Cheilanthes	0	0	0	1	0	0	1	0	0	0	0
Cystopteris	0	0	0	0	0	0	0	0	0	0	0
Dennstaedtia	0	0	0	0	0	0	0	0	0	0	0
Dryopteris	0	2	0	0	0	0	3	1	0	0	4
Osmunda cinnamomea	0	4	7	2	1	10	11	3	10	10	12
Osmunda regalis type	5	33	67	27	59	67	75	60	47	56	57
Polypodium	0	0	1	0	0	2	0	0	1	1	0
Pteridium	0	0	0	0	0	0	0	1	0	0	0
CLUB MOSSES											
Equisetum	0	0	0	0	0	0	1	0	0	0	0
Lycopodium undiff.	0	0	0	1	0	0	1	1	0	0	0
UNKNOWN	0	0	0	0	0	0	0	0	0	0	0
Total Upland Pollen and Spores	460	441	450	546	411	459	444	412	406	427	413
OBLIGATE AQUATICS											
Myriophyllum undiff.	0	0	1	0	0	0	0	0	0	0	0
Nuphar	0	0	0	0	0	0	0	0	0	0	0
Nymphaea	0	0	0	1	0	0	0	0	0	0	0
Polygonum hydropiper type	0	0	0	0	0	0	0	0	0	0	0
Eupotamogeton	0	0	2	1	0	1	1	0	0	0	0
Sparganium type	0	1	1	3	0	3	0	0	0	0	2
Typha latifolia	0	1	0	1	0	2	0	0	0	0	0
Total Obligate Aquatics	0	2	4	6	0	6	1	0	0	0	2

Table 15. (continued)

	Depth (cm)										
	170	180	185	190	195	200	202.5	205	207.5	210	212.5
INDETERMINABLE POLLEN											
Corroded & Degraded	5	2	1	2	1	2	4	2	1	3	1
Corroded & Concealed	0	2	1	1	1	2	2	0	0	0	2
Corr., Degraded & Concealed	0	1	0	2	2	1	0	1	0	0	2
Degraded & Concealed	0	0	0	0	0	0	0	0	0	0	0
Degraded, Mech., Conc. Det.	0	0	0	0	0	1	0	1	0	0	1
Mechanical & Concealed	0	0	1	0	0	0	0	0	1	0	0
Concealed by Detritus	0	1	1	0	1	0	0	2	2	0	0
Total Indeterminable Pollen	5	6	4	5	5	6	6	6	4	3	6
Total Pollen & Spores	460	443	454	552	411	465	445	412	406	427	415
Number of *Eucalyptus* pollen grains counted	100	177	202	210	213	312	184	255	258	268	273
Number of *Eucalyptus* tablets/cm^3	1	1	1	1	1	1	1	1	1	1	1

Table 16. Pollen and spore data, Black Pond, 215 to 240 cm depth.

	Depth (cm)										
	215	217.5	220	222.5	225	227.5	230	232.5	235	237.5	240
TREES											
Acer undiff.	0	0	0	0	0	0	0	0	0	0	1
Acer negundo	0	0	0	0	0	0	0	0	0	0	0
Acer rubrum	0	0	0	0	0	0	1	0	1	1	0
Acer saccharum	0	0	0	0	0	0	0	0	0	0	0
Betula	2	2	4	4	3	4	3	4	1	1	3
Carpinus/Ostrya type	0	1	0	1	2	0	0	0	2	1	1
Carya	10	12	9	11	14	6	6	8	18	13	12
Castanea	13	13	13	31	26	36	27	15	19	17	20
Catalpa speciosa	1	0	0	0	1	0	1	0	0	2	0
Celtis/Maclura type	0	1	0	0	1	0	1	0	00	0	0
Cornus florida	0	0	0	0	0	0	0	0	0	1	0
Cupressaceae	0	0	1	1	1	1	0	2	0	0	2
Ericaceae	0	0	0	0	0	0	0	1	0	0	0
Fagus	0	0	2	0	1	0	2	0	0	0	1
Fraxinus undiff.	1	1	1	0	3	2	3	1	2	1	4
Fraxinus nigra-quadrangulata type (Cperi)	1	3	4	3	4	4	2	5	4	1	6

Table 16. (continued)

	Depth (cm)										
	215	217.5	220	222.5	225	227.5	230	232.5	235	237.5	240
Fraxinus pennsylvanica-americana type ($C_{4-6}stp$)	3	1	4	3	2	2	2	1	1	6	12
Ilex	0	0	0	0	0	0	0	0	0	0	2
Juglans undiff.	0	0	2	0	1	3	0	1	1	0	1
Juglans cinerea (P2-8)	0	0	0	0	0	1	0	0	0	0	2
Juglans nigra	0	0	0	0	0	0	0	0	1	0	0
Liquidambar styraciflua	11	10	5	11	31	5	3	8	8	6	11
Liriodendron tulipifera	0	0	0	0	1	0	0	0	0	0	0
Magnolia	0	0	0	0	0	0	0	0	0	0	0
Morus	0	0	0	0	0	0	0	0	0	0	0
Myrica type	0	0	0	0	0	0	0	0	0	0	1
Nyssa	0	0	0	2	0	0	0	0	0	0	0
Pinus undiff.	137	158	150	109	110	115	118	103	118	121	69
Pinus Diploxylon	38	48	20	31	15	35	12	34	26	26	11
Platanus	0	1	0	0	0	0	0	0	0	0	0
Populus	0	0	0	0	0	0	0	0	0	0	0
Prunus	0	0	0	0	0	0	0	0	0	0	0
Quercus	73	53	88	98	87	91	117	110	103	102	132
Rhamnus	0	0	0	0	0	0	0	0	0	0	0
Robinia	0	0	0	0	0	0	0	0	0	0	0
Salix	2	1	3	1	0	3	0	2	1	1	7
Tilia	0	0	0	0	0	0	00	0	0	0	0
Tsuga	2	0	0	0	1	0	0	0	0	0	0
Ulmus	7	1	4	8	0	6	4	10	1	5	3

Table 16. (continued)

	Depth (cm)										
	215	217.5	220	222.5	225	227.5	230	232.5	235	237.5	240
Viburnum	0	0	0	0	0	0	0	1	0	1	0
Xanthoxylum americanum	0	0	0	0	1	0	0	0	0	0	0
Total Arboreal Pollen	301	305	310	314	305	318	302	306	307	306	301
SHRUBS											
Alnus rugosa type	0	0	0	1	2	0	0	0	0	1	1
Cephalanthus occidentalis	0	0	0	0	0	0	0	0	1	0	0
Corylus	0	0	0	0	1	0	1	0	0	0	2
Hypericum	0	0	0	0	0	0	0	0	0	0	0
Rubus	1	0	0	2	3	4	2	2	1	2	0
Sambucus	0	0	0	0	0	0	1	0	0	0	0
VINES											
Celastraceae	0	0	0	0	0	0	0	0	0	0	0
Lonicera	0	0	0	0	0	0	0	0	0	0	0
Rhus radicans	0	0	0	0	0	0	0	0	0	0	1
Vitis	0	0	0	0	0	0	1	0	0	0	1
NONAQUATIC HERBS											
Caryophyllaceae	1	0	0	0	3	0	1	0	0	0	0
Chenopodium type	1	0	0	0	0	1	0	0	0	0	0
Tubulifloreae undiff.	1	0	0	0	0	0	1	0	0	0	0
Ambrosia	1	1	4	6	3	10	6	6	2	5	10
Artemisia	0	0	0	0	0	0	0	0	0	0	0
Bidens type	0	0	0	1	3	0	2	1	1	1	1
Iva	1	0	0	1	0	0	0	0	0	1	0

Table 16. (continued)

	Depth (cm)										
	215	217.5	220	222.5	225	227.5	230	232.5	235	237.5	240
Xanthium	0	0	0	0	0	0	0	0	0	0	0
Liguliflorae	1	0	0	0	0	0	0	0	0	0	0
Cruciferae	0	3	0	2	1	0	3	1	1	0	0
Cyperaceae	18	23	23	19	22	38	33	28	28	24	29
Gramineae, wild	5	0	7	1	7	7	18	5	1	3	15
Zea mays	0	0	0	0	0	0	0	0	0	0	0
Galium	0	0	0	0	0	0	0	0	0	0	1
Diodia	0	0	0	0	0	0	0	0	0	0	0
Dodecatheon	0	0	0	0	0	0	0	0	0	0	0
Hypoxis hirsuta	0	1	0	0	0	0	2	0	1	0	0
Labiatae	0	0	0	0	0	0	0	0	0	1	0
Malvaceae	0	0	0	0	0	0	0	0	0	0	0
Mitella	0	0	0	0	1	0	0	0	0	0	0
Onagraceae	0	0	0	0	0	0	0	0	0	0	0
Plantago undiff.	0	0	1	1	1	1	0	2	1	1	0
Plantago lanceolata	0	0	0	0	0	0	0	0	0	0	0
Plantago major	0	0	0	0	0	0	0	0	0	0	0
Rumex	0	0	0	0	0	0	0	0	0	0	0
Solanaceae	0	0	0	0	0	0	0	0	0	0	0
Thalictrum	0	0	0	0	0	1	0	1	1	1	0
Trifolium	0	0	0	0	0	0	0	0	0	0	0
Umbelliferae	0	0	0	0	0	2	1	0	0	0	3
Urtica	0	0	0	0	0	1	0	0	0	1	1
NONAQUATIC FERNS											
Athyrium	0	0	0	0	0	0	0	0	0	0	0

Table 16. (continued)

	Depth (cm)										
	215	217.5	220	222.5	225	227.5	230	232.5	235	237.5	240
Botrychium	0	0	0	0	1	0	1	0	0	0	4
Cheilanthes	0	0	0	0	0	0	0	0	0	0	0
Cystopteris	0	0	0	0	1	1	0	0	3	0	0
Dennstaedtia	0	0	0	0	0	0	0	0	0	0	0
Dryopteris	4	0	0	1	5	4	1	5	9	4	0
Osmunda cinnamomea	4	4	8	15	12	24	7	17	6	11	10
Osmunda regalis type	85	74	58	98	238	174	89	119	151	78	161
Polypodium	0	0	1	0	0	1	0	0	1	0	0
Pteridium	0	0	1	0	0	0	0	0	0	0	0
CLUB MOSSES											
Equisetum	0	0	1	0	1	1	0	0	1	1	0
Lycopodium undiff.	0	0	0	0	0	1	2	0	1	1	3
UNKNOWN	0	0	0	0	0	0	0	0	0	0	0
Total Upland Pollen and Spores	424	414	414	462	613	591	474	493	517	443	544
OBLIGATE AQUATICS											
Myriophyllum undiff.	0	0	0	0	0	0	0	0	0	0	0
Nuphar	1	0	0	0	0	0	1	0	0	0	2
Nymphaea	0	0	0	1	0	0	0	1	0	0	0
Polygonum hydropiper type	0	0	0	0	1	0	0	0	0	0	1
Eupotamogeton	0	1	1	1	1	0	3	1	2	1	1
Sparganium type	0	0	1	0	1	2	6	1	0	0	2
Typha latifolia	0	1	0	0	0	0	1	0	0	0	0
Total Obligate Aquatics	1	2	2	2	3	2	11	3	2	1	6

Table 16. (continued)

	Depth (cm)										
	215	217.5	220	222.5	225	227.5	230	232.5	235	237.5	240
INDETERMINABLE POLLEN											
Corroded & Degraded	0	3	5	2	3	1	2	1	2	2	6
Corroded & Concealed	0	3	0	1	0	0	1	1	0	0	0
Corr., Degraded & Concealed	1	0	1	0	2	0	0	0	3	0	0
Degraded & Concealed	0	0	0	1	0	0	2	1	0	1	0
Degraded, Mech., Conc. Det.	2	0	0	0	1	2	0	2	0	1	0
Mechanical & Concealed	1	0	0	0	0	1	0	0	1	0	0
Concealed by Detritus	1	0	0	1	1	1	0	0	1	0	0
Total Indeterminable Pollen	5	6	6	5	7	5	5	5	4	7	6
Total Pollen & Spores	425	416	416	464	616	593	485	496	519	444	550
Number of *Eucalyptus* pollen grains counted	174	339	327	293	439	366	1898	331	318	509	247
Number of *Eucalyptus* tablets/cm^3	1	1	1	1	1	1	2	1	1	1	1

Table 17. Pollen and spore data, Black Pond, 242.5 to 269 cm depth.

	Depth (cm)									
	242.5	245	247.5	250	257.5	260	262.5	265	267.5	269
TREES										
Acer undiff.	0	1	0	0	0	0	0	1	0	1
Acer negundo	0	0	0	0	0	0	0	0	0	0
Acer rubrum	0	0	0	0	0	0	1	0	0	3
Acer saccharum	1	0	1	0	0	0	0	1	3	0
Betula	3	7	8	6	52	7	8	5	2	2
Carpinus/Ostrya type	0	0	0	0	0	2	3	3	2	1
Carya	8	6	16	16	12	10	7	8	5	4
Castanea	13	13	15	20	14	21	21	29	16	20
Catalpa speciosa	2	0	1	1	1	0	0	0	0	1
Celtis/Maclura type	0	0	0	1	0	0	1	4	0	0
Cornus florida	3	0	1	3	1	0	0	0	0	0
Cupressaceae	1	1	1	3	1	3	3	1	2	0
Ericaceae	0	0	0	0	0	0	0	0	0	0
Fagus	0	0	1	1	2	2	1	4	4	2
Fraxinus undiff.	1	4	1	5	2	5	4	5	6	8
Fraxinus nigra-quadrangulata type (Cperi)	3	5	3	3	3	4	3	0	1	9

Table 17. (continued)

	Depth (cm)									
	242.5	245	247.5	250	257.5	260	262.5	265	267.5	269
Fraxinus pennsylvanica-americana type (C4-6stp)	0	4	2	4	3	2	3	4	7	7
Ilex	0	0	0	0	0	0	0	0	0	1
Juglans undiff.	0	1	2	1	1	2	1	1	0	0
Juglans cinerea (P2-8)	0	0	1	0	1	0	0	0	0	0
Juglans nigra	2	1	0	0	0	1	0	0	0	0
Liquidambar styraciflua	5	7	8	1	5	20	11	13	8	2
Liriodendron tulipifera	0	2	1	0	0	1	2	0	0	0
Magnolia	0	0	0	1	0	0	0	0	0	0
Morus	1	0	0	0	0	0	0	0	0	0
Myrica type	1	0	0	0	0	0	1	0	0	0
Nyssa	4	2	1	0	3	0	0	0	0	0
Pinus undiff.	97	112	128	94	77	70	77	69	72	85
Pinus Diploxylon	32	23	25	16	11	9	9	11	5	15
Platanus	0	0	0	0	0	0	0	0	4	0
Populus	0	0	0	0	2	0	2	0	0	1
Prunus	0	0	0	0	0	0	0	0	0	0
Quercus	127	108	89	126	98	125	123	123	122	124
Rhamnus	0	3	1	0	2	2	2	0	1	0
Robinia	0	0	0	0	0	0	0	0	0	0
Salix	0	0	2	0	4	3	1	2	36	14
Tilia	0	0	0	0	0	0	1	0	0	0
Tsuga	0	0	0	0	0	1	0	0	0	0
Ulmus	8	1	1	1	7	13	17	18	4	3

Table 17. (continued)

	Depth (cm)									
	242.5	245	247.5	250	257.5	260	262.5	265	267.5	269
Viburnum	0	0	0	0	0	1	0	0	0	0
Xanthoxylum americanum	0	0	0	0	0	0	0	0	0	0
Total Arboreal Pollen	312	301	309	303	302	304	302	302	300	303
SHRUBS										
Alnus rugosa type	0	0	1	0	2	0	0	1	0	2
Cephalanthus occidentalis	0	0	0	0	0	0	0	0	0	0
Corylus	1	3	0	0	2	2	1	1	0	1
Hypericum	0	0	0	0	0	0	0	0	0	0
Rubus	1	1	0	1	0	4	0	2	0	0
Sambucus	0	1	0	1	0	0	1	0	6	1
VINES										
Celastraceae	0	0	0	0	0	0	0	0	0	0
Lonicera	0	0	0	0	0	0	0	0	0	0
Rhus radicans	0	0	0	0	0	0	0	0	0	1
Vitis	0	0	0	0	0	0	0	1	0	0
NONAQUATIC HERBS										
Caryophyllaceae	0	0	0	0	0	0	1	0	0	0
Chenopodium type	1	0	1	1	1	1	1	1	0	0
Tubulifloreae undiff.	0	1	0	1	0	0	0	0	2	0
Ambrosia	4	2	7	5	5	3	2	2	8	5
Artemisia	0	0	0	0	0	0	0	0	0	0
Bidens type	2	0	1	1	0	1	2	1	2	0
Iva	0	0	0	0	0	1	0	0	0	0

Table 17. (continued)

	Depth (cm)									
	242.5	245	247.5	250	257.5	260	262.5	265	267.5	269
Xanthium	0	0	0	0	0	0	0	0	0	0
Liguliflorae	1	0	0	0	0	0	0	0	0	0
Cruciferae	0	0	1	2	1	2	1	3	4	1
Cyperaceae	14	19	32	40	36	45	44	24	18	22
Gramineae, wild	3	8	10	8	8	10	13	7	10	14
Zea mays	0	0	0	0	0	0	0	0	0	0
Galium	0	0	1	0	0	0	0	0	0	1
Diodia	0	0	0	0	0	0	0	0	0	0
Dodecatheon	0	0	0	0	0	0	0	0	0	0
Hypoxis hirsuta	0	0	0	0	0	0	0	0	0	0
Labiatae	0	0	0	0	0	0	0	0	0	0
Malvaceae	1	0	0	0	0	0	0	0	0	0
Mitella	0	0	0	0	0	0	0	0	0	0
Oragraceae	0	0	0	0	0	0	0	0	0	0
Plantago undiff.	0	2	0	0	2	2	6	1	0	0
Plantago lanceolata	0	0	0	0	0	0	0	0	0	0
Plantago major	0	0	0	0	0	0	0	0	0	0
Rumex	0	0	0	0	0	0	0	0	0	0
Solanaceae	0	0	0	0	0	0	0	0	0	0
Thalictrum	1	1	4	0	0	0	0	0	0	0
Trifolium	0	0	0	0	0	0	0	0	0	0
Umbelliferae	3	0	2	2	3	0	1	3	0	1
Urtica	0	3	0	1	1	1	4	2	0	0
NONAQUATIC FERNS										
Athyrium	0	0	0	0	0	0	1	0	0	0

Table 17. (continued)

	Depth (cm)									
	242.5	245	247.5	250	257.5	260	262.5	265	267.5	269
Botrychium	1	0	2	0	1	0	0	0	0	0
Cheilanthes	0	0	0	0	0	0	0	0	0	0
Cystopteris	0	0	0	0	0	0	0	0	1	0
Dennstaedtia	0	0	1	0	0	0	0	0	0	0
Dryopteris	2	3	1	1	0	0	0	0	0	0
Osmunda cinnamomea	6	5	10	5	5	2	3	4	2	3
Osmunda regalis type	70	62	122	102	93	53	55	38	12	29
Polypodium	0	0	0	0	0	2	0	0	0	0
Pteridium	2	1	1	1	2	0	1	1	5	0
CLUB MOSSES										
Equisetum	0	3	0	2	0	0	1	1	0	2
Lycopodium undiff.	0	0	2	0	0	0	1	0	1	0
UNKNOWN	0	0	0	0	0	0	0	0	0	0
Total Upland Pollen and Spores	427	412	510	476	464	434	441	395	371	386
OBLIGATE AQUATICS										
Myriophyllum undiff.	0	0	0	0	0	0	0	0	0	0
Nuphar	2	1	1	0	0	0	0	0	0	0
Nymphaea	0	2	1	0	0	0	0	0	0	0
Polygonum hydropiper type	0	0	0	1	0	0	0	0	0	0
Eupotamogeton	1	0	0	1	1	3	0	2	1	0
Sparganium type	2	2	1	3	1	1	3	3	5	5
Typha latifolia	0	1	0	1	0	0	0	0	0	0
Total Obligate Aquatics	5	6	3	6	2	4	3	5	6	5

Table 17. (continued)

	Depth (cm)									
	242.5	245	247.5	250	257.5	260	262.5	265	267.5	269
INDETERMINABLE POLLEN										
Corroded & Degraded	1	3	2	1	3	1	2	1	0	1
Corroded & Concealed	1	0	1	1	0	1	1	0	1	0
Corr., Degraded & Concealed	0	0	2	3	2	3	3	3	0	1
Degraded & Concealed	0	0	1	0	0	0	1	0	1	0
Degraded, Mech., Conc. Det.	2	0	0	3	0	0	2	0	2	0
Mechanical & Concealed	0	0	0	0	0	0	0	0	0	0
Concealed by Detritus	0	1	0	0	0	0	1	0	0	2
Total Indeterminable Pollen	4	4	6	8	5	5	9	4	4	4
Total Pollen & Spores	432	418	513	482	466	438	444	400	377	391
Number of *Eucalyptus* pollen grains counted	592	1011	527	949	734	1166	1077	954	1157	330
Number of *Eucalyptus* tablets/cm^3	1	1	1	3	3	3	3	3	3	1

APPENDIX F

POLLEN DATA FOR ICEHOUSE BOTTOM (9,380 B.P.)

Table 18. Plant species and number of pollen grains counted from Icehouse Bottom, Monroe County, Tennessee.

TREES	
Acer rubrum	1
Betula	25
Carpinus/Ostrya type	6
Carya	3
Castanea	124
Ericaceae	2
Fagus	2
Fraxinus undiff.	13
Fraxinus nigra-quadrangulata type (Cperi)	8
Fraxinus pennsylvanica-americana type (C_{4-6}stp)	1
Juglans cinerea	2
Pinus undiff.	6
Pinus Diploxylon	3
Platanus	2
Populus	3
Quercus	65
Salix	1
Tilia	6
Tsuga	24
Ulmus	1
Total Arboreal Pollen	300
SHRUBS	
Alnus rugosa type	11
LIANAS	
Vitis	2
NONAQUATIC HERBS	
Tubuliflorae undiff.	3
Ambrosia type	1
Bidens type	2
Cyperaceae	1
Gramineae, wild	3
Thalictrum	1
NONAQUATIC FERNS	
Dryopteris type	6
Pteridium aquilinum	1
Cheilanthes alabamensis	1
Lycopodium undiff.	1
Selaginella	1
Total Upland Pollen and Spores	332
OBLIGATE AQUATICS	
Eupotamogeton	3
Total Aquatic Pollen	3
INDETERMINABLE POLLEN	
Corroded	1
Degraded & Mechanical	3
Mechanical (Broken/Clump)	3
Total Indeterminable Pollen	7
Total Pollen and Spores	342
Eucalyptus pollen concentration grains/cm	20,000
Number *Eucalyptus* grains counted	69

APPENDIX G

CHARCOAL PARTICLE DATA

Table 19. Charcoal cross-sectional area for each depth interval, mid-point groups 7.13 to 142.5 μm, Tuskegee Pond.

Depth (cm)	Cross-Sectional Area (μm^2)	*Eucalyptus* Grains Counted
55	5982.64	12
60	5547.27	5
70	7940.92	7
80	7399.98	4
90	4697.63	3
100	11864.06	10
110	10123.37	9
120	6874.79	3
130	10227.32	2
140	9237.85	4
150	5096.63	2
160	6987.06	12
170	6605.18	7
172.5	13239.87	5
175	7775.29	7
178	6021.83	3
180	13964.96	1
182.5	3764.77	2
187.5	9936.72	4
190	7840.59	9
200	2563.06	9

Table 20. Charcoal cross-sectional area for each depth interval, mid-point groups 7.13 to 213.75 µm, Black Pond.

Depth (cm)	Cross-Sectional Area (μm^2)	*Eucalyptus* Grains Counted
10	2795.56	3
20	4981.02	4
30	6949.70	15
40	4721.68	2
50	5835.05	0
70	2688.69	2
90	7756.15	3
110	7862.51	6
130	10250.84	5
150	9790.88	3
160	12042.36	1
170	4798.36	2
180	2895.06	1
185	9932.35	6
190	3895.51	1
195	679.98	3
200	4702.06	0
202.5	1389.40	1
205	345.00	1
207.5	1090.46	0
210	1353.30	1
212.5	564.50	2
215	1977.11	7
217.5	2253.06	3
220	1685.44	5
222.5	3496.23	5
225	5168.72	7
227.5	8861.72	8
230	2382.57	13
232.5	3516.66	3
235	4022.25	2
237.5	1900.65	1
240	1405.53	2
242.5	3877.78	8
245	2007.10	1
247.5	2004.69	1
250	684.29	6
257.5	2014.66	11
260	1441.30	7

Table 20. (continued)

Depth (cm)	Cross-Sectional Area (μm^2)	*Eucalyptus* Grains Counted
262.5	1676.42	9
265	883.80	3
267.5	923.81	10
269	1475.76	3

VITA

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She received the Master of Arts degree in Anthropology from the University of Tennessee, Knoxville, in 1977. She received the Doctor of Philosophy degree in Anthropology from the University of Tennessee, Knoxville, in March 1984.

Dr. Cridlebaugh has extensive archaeological field experience in Winchester, England; Cholula, Mexico; the Piedmont North Carolina, South Carolina, and Georgia; and East and Middle Tennessee. Her most extended research, initiated in 1973, has been archaeological and palynological investigations in conjunction with the Tellico Archaeological Project. In addition, she has taught undergraduate and graduate courses in anthropology, Department of Anthropology, University of Tennessee, Knoxville.