A Palynological Study of Swamp Sediments at the Poverty Point Archaeological Site, Northeastern Louisiana

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A PALYNOLOGICAL STUDY OF SWAMP SEDIMENTS AT THE POVERTY POINT ARCHAEOLOGICAL SITE, NORTHEASTERN LOUISIANA

A Thesis
Submitted to the Graduate Faculty of the Louisiana State University and Agricultural and Mechanical College in partial fulfillment of the requirements for the degree of Masters of Arts in The Department of Geography and Anthropology

by
Karen Laurie Thomas
B.A., West Chester University, 1993
May 1996
MANUSCRIPT THESSES

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To my parents: for making the sacrifice to give me what I need and not necessarily what I want.

To Mom-Mom for being a second mom and dad whenever I needed one.
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Abstract

The Poverty Point site, characterized by elaborate earthworks, was occupied from about 1500 B.C. to 500 B.C. (Webb 1982). The site was the central node for a large manufacturing network at the end of the late Archaic Period. Questions of subsistence and the demise of the culture remain unanswered. This thesis employs a palynological study of a swamp in the Poverty Point archaeological site (16WC5), northeastern Louisiana. Eight cores were taken from a swamp immediately adjacent to the mounds at the site. Loss-on-ignition was done for four cores. Two cores, cores PP5 and PP7 were used for pollen analysis; core PP7 was used for Lead-210 dating and charcoal analysis.

The source of fill for most of the mounds is a mystery. The prevailing hypothesis is that the swamp was a "borrow pit" dug up by the Poverty Point inhabitants, and the earth used to build the mounds. The primary objective of this thesis is to test the hypothesis that the swamp was a "borrow pit" from which the Poverty Point inhabitants removed dirt to build the mound complex. No conclusive answer could be found on whether the swamp is the fabled borrow pit or not. It was either a depression or an active stream channel at the time of occupation.

The pollen data document the change in forest cover around Poverty Point. The forest cover around the site was
a pine-oak bottomland hardwood forest until the development of farming in the early to mid-19th century. The farm was abandoned before the turn of the century and forest recovery can be seen. A pecan grove may have been planted in the area around 1935. The current swamp conditions have only developed since 1950s.
Introduction

Palynology involves the use of pollen grains preserved in sediments to make inferences about past environmental conditions and vegetation types. Pollen grains are a useful proxy for paleoenvironmental reconstruction because their outer coat or exine is mainly sporopollenin, one of the most resistant substances known. Both the form and structure of the exine vary among taxonomic groups, thus allowing the mother plant to be identified to different taxonomic levels. Palynology can be used to reconstruct paleoenvironments since the time that the first terrestrial plants appeared.

This thesis involves a palynological study of a swamp in the Poverty Point archaeological site (16WC5), northeastern Louisiana. The Poverty Point site was occupied during the Late Archaic to Early Woodland Period approximately 3500-2500 years ago (Webb 1982). Figure 1 is a map depicting the location of the Poverty Point site. The location of the swamp in relation to the earthworks is in figure 2. The source of fill for the mounds is unknown. The prevailing hypothesis is that the swamp adjacent to mound A was a "borrow pit" dug up by the Poverty Point inhabitants and that the earth was used to build the mounds (Gibson 1993). The amount of labor needed to construct the earthworks has prompted discussion of the subsistence base of the people. Three hypotheses have been postulated to
Figure 1: Location of Poverty Point SCA.
Figure 2: Sketch of the Poverty Point Archaeological Site. (Adapted from: Gibson 1993)
explain the subsistence practices of the Poverty Point inhabitants. They are the "forest-edge efficiency" hypothesis (Gibson 1974), the seed horticulture hypothesis (Newman 1984; Byrd and Newman 1978), and the agriculture hypothesis (Webb 1968). A sedimentary and fossil pollen record recovered from the swamp at Poverty Point holds the potential to test these hypotheses.

A fossil record may give clues to the sudden end of the culture. The role of environmental change in the demise of the Poverty Point culture - either naturally or culturally induced - has not been seriously examined due to lack of evidence (Altschul 1978). A pollen study of the swamp at Poverty Point may provide more information on the geomorphic history of the region and additional paleoclimatic data. Little or no paleoclimatic data are available from the Poverty Point site or the tri-state region of Louisiana-Arkansas-Mississippi (Saucier 1995). This lack of information presents a challenge to researchers attempting to reconstruct the pattern and chronology of regional climatic changes and their possible influences on the Poverty Point culture (Delcourt and Delcourt 1985). Local geomorphic changes in the region and their effects are also poorly known. The work of Saucier (1995) on the lower Mississippi Valley is the basis of most of our current knowledge.
On a much shorter time scale, a pollen and sedimentary study of the swamp may also provide a record of the environmental impacts of European settlement in the area. Although the European impacts on the landscape and vegetation have been well documented palynologically elsewhere in North America (McAndrews 1988) very few pollen records exist in the Lower Mississippi region and especially in the Louisiana-Arkansas-Mississippi area that cover the post-settlement period (Delcourt and Delcourt 1985). The results of this thesis describe the post-settlement period of the Poverty Point site which lies within this understudied region. The environmental change during the prehistoric period is briefly covered.

The hypothesis of this thesis is that the swamp originated from a "borrow pit" from which the Poverty Point people removed earth to build the mound complex. If the swamp did originate from a borrow pit, a sediment core taken from the swamp should yield basal ages of around 3000 yr. B.P. and contain a record of swamp sediments deposited since that time. The "borrow pit" hypothesis is unlikely to be true if the age of the swamp is much younger than the time of occupation at Poverty Point.

The research methodology of this thesis involves pollen and microscopic charcoal analysis along with loss-on-ignition analysis. Soil erosion, deforestation, or any human disturbance to the landscape may be reflected in the
pollen and sediment stratigraphic records. Forest fires, either natural or anthropogenic, can be detected in the charcoal record. The existence of any cultivated plants or agricultural crops at the site may be recorded in the pollen record. Lead-210 dating was used to provide chronological control. The research methodology used in this thesis has the advantage of providing a continuous record of sedimentation and vegetation change since the formation of the swamp.
Archaeological Palynology

Archaeological Palynology uses pollen analysis to detect anthropogenically caused environmental change. Native Americans affected their environment in three ways: they increased the magnitude and frequency of fires; forests were managed to facilitate the growth of weedy or ruderal species; the use of certain plants changed both the forest composition and the distributional limits of plant species over a longer time scale (Delcourt and Delcourt 1987).

There are four main types of archaeological problems for which pollen analysis can provide information: the cultural uses of plant resources, the cultivation of crops or agriculture, the human impacts on vegetation, and the paleoenvironmental changes surrounding archaeological sites. Pollen analysis has the potential to provide information on these problems which could not be obtained in such great detail through other means. Kelso (1993:90) states that palynological data, when combined with other data, can prove archaeologists with "socio-cultural and ideological interpretations beyond the capability of any single archaeological sub-discipline."

Bryant and Hall (1993) describe the many benefits of incorporating pollen analysis in archaeological studies. The fossilized pollen concentration in samples can give information on the rate of sediment deposition. Abnormally
high concentrations of one taxon often indicates use of that particular plant by the inhabitants. Baker et al. (1993) add that in pollen diagrams, slight decreases of forest taxa and slight increases of crop species suggest the use of agriculture. Increases in ruderal species can be interpreted as occurring on newly cleared areas, abandoned fields or gardens.

Archaeological palynology commonly uses fine-resolution sampling or intervals of 5 cm or less. One common fine-resolution sampling technique is contiguous sampling which uses intervals of 1 cm or less (Dimbleby 1985; Edwards and MacDonald 1991). Edwards and MacDonald (1991) point out that the uncertainty attached to pollen accumulation rates and stratigraphic integrity cast doubts on the usefulness of contiguous pollen sampling. Also, a reliable chronology is difficult to obtain from a core which has been contiguously sampled mainly due to the time involved. No analytical technique is without its shortcomings, but the additional information that pollen analysis gives, especially when combined with sedimentological, charcoal, or isotope analysis far outweighs its shortcomings.

The Pollen Grain

Before pollen analysis can be fully understood, some information on pollen is necessary. Pollen grains are almost always less than 200 microns in diameter with most
ranging from 10 to 50 microns. This fact makes pollen grains well adapted to wind dispersal. They are produced in mass quantities by the mother plant and contain an outer wall composed of sporopollenin. Sporopollenin is a chemically stable substance consisting of oxidative co-polymers of carotenoid and carotenoid esters. Only excessive heat and oxidation can destroy the exine or outer wall of the pollen grain. The composition of the pollen grain makes it highly resistant to degradation through time.

Pollen grains are morphologically complex structures. As a result, the mother plant which produces the grains can be identified to various taxonomic levels (either family, genus, or species). The abundance of the plant populations can be quantitatively inferred from the pollen grains.

The pollen grain is subject to several dispersal processes which must be accounted for when reconstructing past environments. How pollen grains from different species are transported is important. Some are transported by wind, others by insects or water over various distances. Depositional processes possibly affecting the grain include degradation, bioturbation, and resuspension. These processes affect which grains are preserved or fossilized, if any, and if they are reworked in the sediment. These factors are accounted for through site selection and quantitative analyses performed. Through an understanding
of the pollen grain, its transportation and depositional processes which may affect its preservation, palynologists can use the pollen grains preserved in sediment to help solve archaeological problems.

History of Archaeological Palynology

The application of pollen analysis to problems in archaeology has a history almost as long as Quaternary palynology. Hollaway and Bryant (1986) provide a brief chronology of archaeological palynology which was the basis for this section. Paul A. Sears was one of the first palynologists to apply pollen analysis to archaeological problems in America. In his 1932 paper, Sears used pollen analysis to reconstruct the late Holocene paleoenvironment of the eastern United States. He suggested that the change in climate favored the northward and eastward expansion of Hopewellian agriculture approximately 3000 years ago. This work came at a time when the field of palynology was still new.

In later works, Sears applied this technique to the American Southwest and explained how pollen analysis could be used as a tool in archaeological interpretations of culture. While Sears provided a climatic sequence for the Southwest, archaeological palynology was not systematically applied to the Southwest until Paul S. Martin 's studies in the late 1950s to early 1960s.
Although Sears was the first to practice archaeological palynology, it was Johs. Iversen (1941) who established pollen analysis as a viable tool for archaeological problems. Iversen is one of the founders of palynology and co-authored one of the first textbooks in palynology (Faegri and Iversen 1975). This book included detailed drawings of the pollen grain which are admired to this day. Iversen successfully dated the beginning of the Neolithic period in the European archaeological chronology using the *Ulmus* (elm) declines in Denmark. An expansion of herbaceous and weedy vegetation was interpreted by Iversen to suggest human disturbance, specifically deforestation for agriculture.

Iverson's work combined with Knut Faegri's (a contemporary to Iversen in pioneering the field of palynology) precisely dated the arrival of agriculture to Europe. They also provided evidence that cereal grains originating in the Middle East were planted and that various cultures had used slash-and-burn techniques to alter forest composition.

With this basis, archaeological palynology was soon applied to solve problems throughout the world. J. Trols-Smith, the German architect of the most widely used sediment classification systems, used pollen analysis to reconstruct the paleoenvironment in West Zealand, Denmark and provided evidence that overgrazing of domestic animals
caused changes in the forest composition. George Dimbleby (1985), a leading scientist today in archaeological palynology, used pollen analysis to demonstrate how the shift from a hunting and gathering society to an agricultural society was accompanied by changes in the forest composition.

Holloway and Bryant (1986) state that more archaeological data need to be correlated with paleoecological data in order to better interpret past cultures. Also, too little time is devoted to botanical analysis and interpretation in archaeological research despite federal and state regulations which call for paleoenvironmental testing. Lack of time is often the leading cause of the lack of vegetational and environmental data at sites. Holloway and Bryant (1986) point to Thorne and Curry's 1983 paper as a successful incorporation of palynology into archaeological work.

Holloway and Bryant (1986), along with Edwards (1983), criticize palynologists as well for lacking a rigorous scientific approach. They call for explicitly stated hypotheses which are testable using pollen analysis. Archaeologists will not fully utilize the value of palynology until they use palynological data for model building and theory testing.

Archaeological palynology can be applied to any period when human activity has occurred. Because the impacts of
Europeans in the Americas have been substantial, this short review of archaeological palynology is divided into studies assessing prehistoric and European impacts. Evidence for prehistoric impacts includes agriculture and diet and the use of fire.

Prehistoric Agriculture

Human modification of the landscape for agricultural purposes in Mexico is documented in the Lake Patzcuaro core by 3700 yr B.P. (Watts and Bradbury 1982). *Zea mays* (corn) appeared at this level in conjunction with increases in ruderal plants such as *Chenopodium*-type and Tubuliflorae/Cyperaceae. Upland forest vegetation remained the same, but a decline in *Alnus* (alder) was seen. Cutting by farmers in conjunction with less precipitation was cited as one possible reason for the change.

*Zea mays* appeared in the Lake Ayauch\(^1\), Ecuador, core indicating cultivation at 5300 yr B.P. This was approximately 2000 years earlier than any previously reported date for the Amazon basin (Bush et al. 1989). In Lake Kumpak\(^2\), Ecuador, the pollen stratigraphy also showed an agricultural phase between 1500 and 2200 yr B.P. (Figure 3) This zone was marked by the presence of *Zea mays* grains along with an expansion of Gramineae pollen (Liu and Colinvaux 1988).

*Zea mays* grains were found by Whitehead (1965) in

Dismal Swamp, Virginia dating to 200 B.C. Slight increases
Figure 3: Pollen Diagram for Lake Kumpak, Ecuador (Modified from Liu and Colinvaux 1988).
in Gramineae, Corylus, Myrica and Ilex pollen were also seen at levels containing Zea mays. This study was one of the first palynological studies to document agriculture in North America.

Closer to the study site, Whitehead and Sheehan (1985) reported Zea pollen from the B.L. Bigbee swamp, Mississippi (Figure 4). Maize-based agriculture was practiced by Native Americans in the area during 2400 yr. B.P. This practice occurred in a zone where pine replaced oak as the dominant forest component. Whitehead and Sheehan (1985) attributed this situation to changing land-use patterns.

Perhaps the most exciting recent discovery for corn in North America was the 3500-year-old Zea mays pollen from Lake Shelby, Alabama sediments (Fearn and Liu 1995). This fossil corn pollen predates any known evidence for corn in eastern North America by at least 1000 years. This date was supported by several other findings of corn pollen in time intervals much earlier than the first occurrence of corn in the macrofossil records. Examples include Whitehead and Sheehan's (1985) finding at 2400 yr B.P. in Tombigbee River Valley, Mississippi, Whitehead (1965) at 2200 yr B.P in Great Dismal Swamp, Virginia, and Delcourt et al. (1985) at 1600 yr B.P. in Little River Valley, Tennessee.

Collectively, these paleoecological studies provide compelling evidence for the presence of corn in North
Figure 4: Pollen diagram from B.L. Bigbee Swamp (Modified from Whitehead and Sheehan 1985)
America much earlier than the archaeological record. Fearnand Liu (1995) point out that when carefully collected and analyzed, microfossil evidence is as reliable as macrofossil evidence. This interpretation was confirmed by their scanning electron microscopy (SEM) identification and analysis of the Zea mays grain, which was performed in addition to routine laboratory analysis. Several other records for cultivars other than corn exist, but corn is chosen because of the importance of corn-based agriculture in cultural development. For more information about other palynological studies on prehistoric agriculture, see Dimbleby (1985).

Aboriginal Use of Fire

Pollen analysis, when combined with charcoal analysis, can detect the burning of forests for agricultural purposes. The Lake George, Australia site is one of the best examples of how palynologists can detect aboriginal uses of fire (Singh and Geissler 1985). Pollen evidence from cores showed the expansion of Eucalyptus-dominated fire-tolerant sclerophyll communities at the expense of fire-sensitive communities. This can be correlated with the archaeological record to suggest aboriginal use of fire. The archaeological evidence indicated that fire would have been used for hunting, clearing for travel, or signalling. Fires started by lightning ignition, however, cannot be ruled out.
Scott (1987) attributed native use of fire to clear forests as the cause for a sharp decline in *Podocarpus* around Tate Vondo, South Africa around 1500 yr B.P. Pollen analysis from a core close to the Khok Phanom Di site in Thailand showed that the natives were burning vegetation and practicing agriculture by 4300 yr B.C. This was seen in an increase in both Gramineae pollen and microscopic charcoal. The pollen of plants associated with rice agriculture was found at this level as well (Maloney et al. 1989).

Charcoal analysis is often crucial in providing the information necessary for discovering the practice of swidden agriculture, or slash-and-burn agriculture in Central America. *Zea mays* pollen is often found associated with increases in microscopic charcoal levels in the presettlement landscape of Mesoamerica (McAndrews 1988; Vaughan et al. 1985; Bush and Colinvaux 1994).

One example of this can be seen in the Lake Quexil, Guatemala core (Figure 5) which showed increased levels of charcoal along with the presence of *Zea mays* at 6000 yr B.P., indicating slash-and-burn agriculture (Vaughan et al. 1985). Further analysis on this site revealed that the Maya clay layer was deposited as a result of swidden practices (Edwards and MacDonald 1991).

The Darian, Panama core contains one of the most well documented records of swidden agriculture. Bush and
Figure 5: Pollen Diagram from the Peten Lake District (Modified from Vaughan et al. 1985)
Colinvaux (1994) found evidence for slash-and-burn agriculture from 4000 to 350 yr B.P. *Zea mays* pollen and phytoliths were present along with increases in charcoal fragments around 350 yr B.P. This provided proof that human disturbance in this region helped to maintain the local biodiversity.

Charred macrofossils in addition to charcoal can be used to reconstruct forest burning for agriculture. In the Little Tennessee River valley, Delcourt et al. (1986) correlated charred plant remains from stratified archaeological sites scattered throughout the valley with pollen diagrams from two ponds. Their data showed that during the late Archaic period *Pinus* (pine) and *Arundinaria* (switch cane) (both disturbance indicators) increase sharply at the expense of bottomland taxa. At this time, charred seeds from the cultigens *Phalaris caroliniana* (a grass), *Helianthus annus* (sunflower), and *Iva anna* (sumpweed) appeared, along with *Curbita pepo* (squash) and *Lagenaria siceraria* (gourd). *Zea* appeared later in the core.

**European Settlement and Activities**

European settlement of the Americas can be detected on pollen diagrams by a rise in *Ambrosia*-type pollen grains. Mathewes and D'Auria (1982) defined a settlement horizon in pollen diagrams as the level where native plants decrease, exotics first appear, and weeds and cultivated species
increase along with secondary seral species. When a sharp rise in *Ambrosia*-type pollen is seen in a pollen diagram, this change is interpreted as the beginning of European settlement in the area. Examples of studies containing pollen diagrams depicting an *Ambrosia* rise include Brugam (1978), Whitehead and Sheehan (1985), Mathewes and D'Auria (1982) (see Figure 4).

McAndrews (1988) lists the following evidences for European disturbance of the environment: smoke particulates from forest fires, industrial sources, increased sedimentation from erosion, deposition of mine tailings, pollution from heavy metals, and lake eutrophication from nutrient run-off. All of these can be detected in pollen diagrams. In general, European impacts occurred more abruptly and at a greater magnitude than Native American impacts and can be seen more distinctively in pollen diagrams (Baker et al 1987).

Palynologists have detected land use changes from the pollen record. Their findings can be classified into the following categories: land clearing and deforestation, logging, the introduction of exotic species and crops, and grazing effects by animals.

One of the best examples of European deforestation for agriculture is Foster et al. (1992) (Figure 6). They studied the effects of European settlement by analyzing changes in a woodlot in New England. The presettlement
Figure 6: Pollen Diagram from Black Gum Swamp, MA (Modified from Foster et al. 1992)
forest contained many species which were common in the presettlement forest but rare afterwards. The modern forest appears mature and stable, but its composition is drastically different from its presettlement counterpart. Massive deforestation and agriculture caused declines in *Tsuga* (hemlock), *Pinus strobus* (white pine), and *Picea* (spruce) and increases in *Castanea* (chestnut) and *Acer rubrum* (red maple). After the chestnut blight, hardwoods grew rapidly to replace *Castanea* (chestnut) in the stand. The Chestnut blight can be used as a marker for cores from the Northeast, but is not noticeable in the south. A hurricane in 1938 along with selective thinning of hardwoods caused an increase in *Tsuga* (hemlock) in the lot. The most important conclusion of their study was how little of the presettlement forest is left. Without a paleoecological, especially palynological study, this would never have been noticed.

Land clearing for settlement and the effects of logging are clearly seen in the pollen record from Crawford Lake, Ontario (McAndrews and Boyko-Diakonow 1987). The lake contained varved deposits which allowed for excellent chronological control. Historical records dated settlement around the lake to between 1822 and 1864. Land clearing for road building was inferred from the appearance of *Rumex acetosella* (sorrel) in the 1820s. Gramineae pollen abundance rose during the 1830s and the *Ambrosia* (ragweed)
rise was seen in the 1840s. After settlement, the effects of logging during the 1870s can be seen in this core. At this time, Pinus (pine) and Tsuga (hemlock) decreased in abundance and are replaced by Thuja (cedar), Betula (birch), Juglans (walnut), Ulmus (elm), and Populus (poplar).

Closer to the study site, an example of deforestation can be seen in the Little Tennessee River Valley core (Delcourt et al. 1985) (Figures 7 and 8). Most of the study is concerned with the effects of Native Americans from the late Archaic to contact, but significant European impacts are documented. During the Historic period, the Cherokee cultivated beans and peaches which were introduced by the Spanish. An Ambrosia rise was seen along with the occurrence of introduced species. Animal grazing was introduced by the Europeans. It represented a new kind of disturbance that favored the spread of European weeds, which out-competed the native ruderal species. A decline in Quercus (oak) and Carya (hickory) occurred when Fort Loudoun was established.

Other than logging, European settlers introduced various exotic and crop species to North America. Their appearance in the pollen record is best depicted in Mathewes and D'Auria (1982) (Figure 9). Mathewes and D'Auria analyzed a core from Deer Lake, Vancouver, to document environmental changes associated with land
Figure 7: Arboreal component from Black Pond. (Modified from Delcourt et al. 1985)
Figure 8: Non-arboreal component from Black Pond. (Modified from Delcourt et al. 1985)
Figure 9: Pollen Diagram from Deer Lake. (Modified from Mathewes and D'Auria 1992)
clearance and urban development. The settlement horizon was found at 42.5 cm dating to 1892. Settlement was marked by an increase in crop and ornamental pollen including Zea mays (corn), Ulmus (elm), Fagus (beech), Impatiens glandulifera (policeman's helmet), and Nymphaea (water lily). Plantago lanceolata (ribwort) pollen was recorded from 42.5 cm to 33 cm. Rumex acetosella, an indicator of land clearance, occurred at depths of less than 42.5 cm. The selective removal of Juniperus (red cedar) trees during the 1910s appeared on the diagram as a decline in cedar pollen and an increase in Alnus (red alder). All of their findings are corroborated with historical records.

Historical records were combined with sedimentological, pollen, macrofossil, and insect analyses by Baker et al. (1993) to assess the impact of European settlement in northeast Iowa. Historical records document that the Roberts Creek area was settled during 1840-1856. The pollen record revealed that the presettlement forest included Quercus (oak), Salix (willow), Gramineae, Compositae (but no Ambrosia), and Cyperaceae in high percentages. Upland areas contained oak savannas, and Salix (willow) grew in the floodplains with aquatic and wetland species. After settlement, increases in Ambrosia (ragweed) and Gramineae are seen while Quercus (oak) and other tree pollen decrease along with Compositae and Cyperaceae. Ruderal species were most abundant during
times of maximum flooding. When stream stabilization occurred and floods were less frequent, a decline in ruderal species were found. This was attributed to a wider meander belt and the use of herbicides in recent decades.

Kelso (1993) provides an example of what pollen analysis can contribute to the study of Historical Archaeology. He studied the pollen content of a historical archaeological soil profile at the Boot Mills site in Lowell, Massachusetts. His aim was to identify palynological site formation processes at archaeological sites. Abundance of *Ambrosia* (ragweed) and other weedy pollen types indicated agricultural fields or clearing for mansion construction. Above this level, Gramineae (grass) pollen abruptly replaced *Ambrosia* and other weedy pollen types. This replacement was interpreted as either pasture-land replacing weeds or a stabilizing soil as human activity decreased. Where a lawn was established, grass pollen sharply increased.

In another profile from the same site, *Ambrosia* pollen replaced Gramineae pollen which reflected a change from a formal lawn to urban backlot. An abrupt increase in Chenopodiaceae (chenopods) pollen was seen during the deposition of organically enriched, trash-loaded soil. Their abundance dropped as the land was converted to pastoral use, which was seen in the pollen diagram as an increase in Gramineae pollen. As trees matured around the
house, the pollen of *Castanea* (chestnut), *Ulmus* (elm), and *Vitaceae* (wild grape) increased.

Kelso (1993) also described a buried soil layer in an infilled privy in Massachusetts. He interpreted the data in terms of a soil disturbance event which caused a change in the type and amount of soil deposited (Figure 11). An abrupt decline in pollen concentrations from 16,000 to 6,000 grains/gm sediment was seen at the site corresponding to the early 20th century. This decline in pollen concentration was accompanied by an abrupt increase in the percentages of indeterminable pollen. This change is attributed to the period that the lot experienced pedestrian traffic. The increased traffic exposed the pollen in the soil to oxygen and other corrosive agents and compressed the soil. This resulted in the near total destruction of pollen and prevented the preservation of pollen past the 1900s. Kelso concluded that within a hundred years, if the soil used as a fill remains exposed, then all evidence of it having been a fill would have disappeared.

Pollen analysis has proven to be a valuable tool in studying archaeological problems. Examples from North America and Mesoamerica have shown that archaeological palynology can detect environmental changes which have gone otherwise unnoticed; it can also aided archaeologists in confirming their interpretations. A reconstruction
Figure 10: Pollen diagram from an infilled Privy. (Modified from Kelso 1993)
of the forest cover during the time of occupation and information on the use of plant species can be obtained by pollen analysis. Pollen analysis can depict the presence of agriculture and the timing of deforestation or the abandonment of fields. Fire frequency can be detected by charcoal analysis which, when combined with pollen analysis, can indicate land clearing for grazing or agriculture. The future of archaeological palynology is bright as palynologists and archaeologists discover the benefits of their collaborations.
The Physical Background To Poverty Point

The Poverty Point State Commemorative Area (or SCA), which contains the archaeological site and the study site, was established in the early 1970s (Figure 1). This site declaration took place in order to preserve the mound complex on the archaeological site (Figure 2). Although the Poverty Point site covers only 7 km² (1000 acres), the SCA itself covers only 2 km² (400 acres) and lies entirely within West Carroll Parish. To fully understand the study site, a description of the mound complex at the archaeological site as well as the geological setting, climate, hydrology, and present vegetation is provided in this chapter.

Description of the Mound Complex

The Poverty Point site (Figure 2) contains one large bird shaped mound (Mound A) that is 215 m (705 feet) wide along the base of its east-west axis and over 21 m (69 feet) tall (Haag 1986). Six concentric rings of ridges and swales lie to the east of Mound A. The ends of the outermost ridge are 1200 m (3937 feet) apart and the innermost ends are 600 m (1968.5 feet) apart (Gibson 1986). The dimensions for the ridges before erosion and destruction would have been 3.0 to 3.7 m (10-12 feet) tall (Gibson 1986; Ford and Webb 1956). Erosion and dessication of the archaeological site have reduced the height of the ridges to less than 1.8 m (6 feet) taller than the swales. 33
Spacing between the ridges is uniform and the enclosure approximates an ellipse (Gibson 1986). The arrangement of these mounds is presumed to be a bird effigy. Other mounds in the area include Lower Jackson Mound and Motley Mound.

Geographical and Geological Setting

The geographic center for the archaeological site is at 32°38'15"N, 91°24'30"W. The Poverty Point site is the largest of several related sites scattered on the Macon Ridge terrace in northeastern Louisiana (Figure 11). Saucier (1995) describes the geological characteristics of the Macon Ridge (Figure 12). The Macon Ridge terrace separates two watersheds: the Tensas basin within the Mississippi River Alluvial Valley in the east and the Boeuf basin within the Ouachita River Alluvial Valley in the west (Figure 12). The Macon Ridge is 217 km (135 miles) long and its maximum width is 40 km (25 miles).

The bluff along the eastern edge of the Macon Ridge (which contains the Poverty Point site) is an average of 6-9 m (20-30 feet) tall. The Macon Ridge was created in part from the deposits of an ancestral channel of the Arkansas river. Sediment underlying the Macon Ridge are Early Wisconsin-aged glacial outwash. The Macon Ridge is part of the Monroe Uplift which may currently be experiencing neotectonic movement which may warp some terraces.
Figure 11: Related Archaic Period Sites Surrounding Poverty Point. (Adapted from Webb 1982)
Figure 12: The Location of the Macon Ridge in the Mississippi River Alluvial Valley. (Adapted from Saucier 1995)
Mississippi River Influence

The Quaternary geology of the study area, including the formation of the Macon Ridge, the soils and hydrology, is controlled by the Mississippi River (Figure 12). Most of the current knowledge concerning geomorphology is based on Saucier (1974, 1995), with soil sections based on Allen and Touchet (1990), Allen (1986), and Weems et al. (1977).

The Mississippi River fluctuates between a filling stage and a cutting stage. When sea level falls and continental glaciers begin to advance, the cutting stage begins. This change is marked by deep trenches being cut into the Mississippi River valley. During the last cutting stage, two-thirds of the deposits were removed.

When continental glaciers begin to retreat, sea level begins to rise. This change marks the filling stage which last occurred 12,000 to 9,000 years ago. Large dust storms occurred each winter in the valley as large areas of bare soil was exposed to the winds. Some of this dust settled forming loess deposits.

The Mississippi River created the Macon Ridge bluff during the last cutting cycle as this was the eastern edge of abrasion by the river. The subsequent filling cycle deposited loess on the Macon Ridge, from which the present-day soils originated. Gibson (1990) postulates that Joes Bayou may have been an active channel of the Mississippi River at the time of occupation at Poverty Point. If this
is true, then the Mississippi River had an even greater influence on the lives of the occupants at Poverty Point.

**Hydrological Setting**

Poverty Point related sites are located within the Mississippi Alluvial Plain section of the East Gulf Coastal Plain physiographic province (Poole 1961). The Poverty Point site overlooks Bayou Macon (Figure 13). Bayou Macon is a tributary of the Tensas River and separates East and West Carroll Parishes. Bayou Macon is approximately one kilometer from the swamp and 30 m (100 feet) lower in elevation than the swamp. Harlan Bayou is a local stream that is found on the site itself. Alligator Bayou is the only other stream in the area, and lies one and a half kilometers (1 mile) to the west of the swamp.

The Cockfield aquifer lies beneath the archaeological site and supplies fresh water for both East and West Carroll Parishes. In West Carroll Parish, the aquifer typically occurs at 61-457 m (200 to 1,500 feet) below sea level with an average thickness of 24 m (80 feet) in the Macon Ridge area.

Fresh water is abundant on the surface of the Macon Ridge with some isolated occurrences of salt water. Ground water levels range from one or two to sixteen m (3-52 feet) below the surface. The groundwater in the area is hard and contains large amounts of iron (Poole 1961). Iron concentrations ranging from 0.02 to 6.7 mg/l occur with
Figure 13: Location of the Study Site Depicting Local Hydrology.
some high local concentrations. Chloride concentrations in
the water of West Carroll Parish can exceed 200 mg/l near
saltwater disposal pits, but typically is 50 mg/l (LADOT
1984).

Changes in water level at the Poverty Point site can
be attributed to either atmospheric-pressure changes or the
application or removal of weight at the land surface
sufficient to compress water within the aquifer (Poole
1961).

The Poverty Point site is located outside the hundred
year floodplain. Lenzer (1978) noted that some part of the
Mississippi Alluvial Valley had flooded every year since
1543. Major floods occurred in 1782, 1796, 1809, 1811,
1815, 1823, 1828, 1832, 1859, 1882, 1890, 1897, 1903, 1922,
and 1927. The most severe flood in the Tensas basin
recorded was the 1828 flood. It was estimated that the
water in this flood reached the lower areas toward the west
of the Poverty Point site, including the swamp area, while
the mound complex remained dry (Lenzer 1978). During the
flood of 1973, the mounds also remained dry, but
depressions toward the west, including the swamp itself,
were affected.

Soils

The Poverty Point site lies in the "thick loess"
section of the Macon Ridge. The "thick loess" section
contains loess deposits greater than five feet. On the
eastern-most edge of the Macon Ridge, loess thickness is typically 10 to 14 feet. The soils on the Macon Ridge formed out of these loess deposits.

Soils on the Macon Ridge are easily permeable by water with well developed horizons. Clays and other soluble parts typically have been leached out. In areas of higher pedogenic activity, and usually at the bottom of the soil cores from the area, finer soils are found. More poorly drained soils are usually located in depressions or concave areas. The water table is almost at ground level from December through April, but soils are rarely saturated below two feet.

Soils within the swamp are mapped as Calhoun in the northern section and Calloway in the southern section. Calloway soils are slightly better drained than Calhoun. Water and air percolate slowly through both soils and mottling is characteristic of thixotropic conditions.

Calhoun series soils formed in loess material greater than four feet thick with a slope less than one percent. They are found on broad flats and in swales and narrow depressions along drainageways. Typically, the topsoil is highly acidic, dark grayish-brown silt loam. The subsurface layer (approximately 16 inches thick) is strongly acidic, light brownish-grey silty clay. The subsoil is strongly acidic, brownish-grey silty clay with yellowish brown mottles. Below this level, acidity levels
drop slightly. This soil type is characteristic of areas prone to shallow flooding after heavy rains.

Calloway series soils are characteristic of narrow flats and swales which are better drained areas. The topsoil is medium acid, brown silt loam around eight inches thick. The subsurface layer is medium to strongly acidic, yellowish-brown silt loam with gray mottling down to 30 inches. A fragipan of grayish-brown, light olive brown or yellowish brown silt loam occurs below the B horizon. This soil type is medium to strongly acidic with gray or brown mottles. Below the fragipan, slightly acidic yellowish brown silt loam occurs. Plant roots can easily penetrate the Calloway soil type above the fragipan. The surface layer is wet for significant periods during the winter and spring, but plants lack water during the summer and fall. Climate

The Poverty Point region receives an average of 57 inches of precipitation per year. The peak month for precipitation is March (Figure 14). The average winter precipitation is 5 inches and the average summer precipitation is 4.4 inches. Precipitation levels drop during the month of April and remain steady in summer. The month with the least amount of precipitation is in September. The amount of precipitation during the summer is less than during the winter.
Figure 14: Climatograph for Poverty Point Region (data from NOAA 1990).
The average temperature for the region is 65 degrees F. The winters average 47.9 degrees F and the summers 80.7 degrees F. Temperatures increase during the spring and reached. Temperatures drop during the fall months until the coldest months (December and January) are reached. Plants receive the most stress during the early fall months due to the low precipitation and high temperatures during the late summer months.

Vegetation

Poverty Point lies within Braun's bottomland hardwoods and cypress forest region (Delcourt 1976). Delcourt (1976) reconstructed the presettlement forest cover to include cypress-tupelo gum backswamps, bottomland hardwoods, pine-oak flatwoods and upland pine areas. Shea (1978) pointed out that Lawson's survey of the area in the early 1800s included all of the mentioned communities as possible presettlement communities existing within the vicinity of Poverty Point. The following review of the major vegetation association found within the study region is largely based on Martin and Smith (1993) and Smith (1988).

Cypress-tupelo swamps are usually found along streams in areas with poorest drainage and lowest elevation. Cypress-tupelo swamps are named after the two dominant tree species found: bald cypress (Taxodium distichum) and tupelo gum (Nyssa aquatica). Cypress-tupelo swamps are characterized by the formation of a peat layer, which can
burn during dry years, and silt loams and clay soils. Cypress-tupelo swamps are best developed along broad floodplains of major rivers and dry up at least once a year. Cypress trees are not found in water depths greater than nine to sixteen feet.

The overstory of cypress-tupelo swamps often contains ash (Fraxinus spp.) and water locust (Gleditsia aquatica). Water elm (Planera aquatica), willow (Salix nigra) and water ash (Fraxinus caroliniana) are commonly found in the midstory. There are small amounts of understory species, but buttonbush (Cephalanthus occidentalis), hollies (Ilex spp.) and Virginia willow (Itea virginica) can occur.

Bottomland forests are found in areas which are exposed to less water than cypress-tupelo swamps. Bottomland forests are characterized by long flood periods in winter and spring in addition to alternating wet and dry periods. This allows for the various plant associations which comprise bottomland forests.

Early successional bottomland forests contain fast growing species such as black willow (Salix nigra), sycamore (Platanus occidentalis), and cottonwood (Populus deltoides). The overstory species of later seral forests include many oaks (Quercus spp.), water hickory (Carya aquatica), elms (Ulmus spp.), ashes (Fraxinus spp.), maples (Acer spp.), locusts (Gleditsia spp.), and sweetgum (Liquidambar styraciflua).
The midstory of these later seral forests can contain dogwoods (*Cornus* spp.), red mulberry (*Morus rubra*), and swamp privet (*Forestiera acuminata*) and several vine species. The understory has little herbaceous cover but often include green dragon (*Arisaema dracontium*), thorough-worts (*Eupatorium* spp.) and smartweeds (*Polygonum* spp.). Ironwood (*Carpinus caroliniana*) is found in ecotonal areas.

Pine-oak flatwoods are found between floodplain and upland areas on acidic soils of ridges and slopes. They are subject to less inundation by water than bottomland forests. Along gentle slopes, pines (*Pinus* spp.) may be uncommon, but several oak and hickories occur. Beech (*Fagus*) and southern magnolia (*Magnolia grandiflora*) are more common on steeper slopes, but oaks and hickories can still occur. Sweet gum (*Liquidambar styraciflua*), holly (*Ilex* spp.), wild grape (*Vitis* spp.), and golden rod (*Solidago*) are other common species.

Upland Pine forests are found on the driest soils in the region. They are dominated by pines with post oak (*Quercus stellata*) and dogwoods (*Cornus*) as the primary hardwoods. Ash (*Fraxinus*), beech (*Fagus*), hickory (*Carya*), magnolia (*Magnolia*), poplar (*Populus*), maple (*Acer*), cottonwood (*Populus deltoides*), sassafras (*Sassafras*), and many oaks (*Quercus* spp.) can also be found.
Archaeological Setting And European Land Use History

Sammuel Lockett devoted only a few lines to the Poverty Point site in a several-hundred-page report when he first described the site in 1873. The archaeological community ignored the site because it did not fit into accepted models of the time. Basic questions surrounding the site have remained unanswered today despite over a century of work at the site. Due to the enormous scale of the mounds and the number of artifacts found, only an estimated 1/10 of the site has been excavated to date (Dennis LaBatt, pers. comm. 1994). Today, the site ranks as one of the premier sites in North America. An examination of the history of the site reveals that it has been at the core of several major paradigm shifts within archaeology.

At first, the only archaeologist spending any time on the site was Clarence B. Moore who conducted a cursory study of the site in 1912/1913. Moore was the first to notice that no pottery could be found at the Poverty Point site and to describe the characteristic clay cooking balls at the site (Gibson 1989; Haag 1986; Webb 1944). Without any pottery, the site defiantly predated Hopewellian times and implied that the Late Archaic period contained a Native American culture more advanced than the archaeological community realized. Archaeologists dismissed the site as an anomaly that suddenly appeared, flourished briefly, and vanished without a trace as quickly as it appeared (Gibson 1989).
Unfortunately, massive destruction and looting by landowners and road crews occurred during the early 1900s. Landowners possessed extensive collections of artifacts from the site in their attics and private collections. Clarence Webb negotiated visits of much of these collections during the 1930s and 1940s (Webb 1944). Mound surveys during this time, including Webb's comprehensive survey, excluded the Poverty Point site.

In 1953, however, another worker in the area showed a 1934 aerial photograph of the site to Clarence Webb and James Ford of the American Museum of Natural History. They were the first archaeologists to realize the extensive scale and geomorphic pattern of the earthworks (Gibson 1989; Haag 1986). While evidence as to the importance of the site mounted, the archaeological community became more vehement in their dismissals of the site as an anomaly. To fail to do so would have destroyed nearly every model of cultural development to date and shake the very paradigm of their existence.

The American Museum of Natural History, however, decided to conduct a full scale excavation in the early 1950s under the guidance of Ford and Webb. This was the first true excavation of the site, and has provided all of the baseline information about the site for subsequent research at Poverty Point (Gibson 1989; Haag 1986; Webb 1968; Ford and Webb 1956).
Ford and Webb (1956) proved that humans built the ridges (Figure 2). This finding was important because Ford and Webb needed to prove that the mounds were not geologic features. The swamp was assumed to have been part of a relic channel of the Arkansas river. Both Ford and Webb (1956) assumed that agriculture must have been practiced at the site.

To prove this theory, Ford and Webb (1956) took samples from the bottom of the excavation pit from the swale at ridge 6 and somewhere in Harlan Bayou. They mailed the samples to Yale for Paul Sears to search for the presence of corn pollen. Sears found no pollen in the swale, but did find corn pollen at a depth of 9.14-10.67 cm (36-42 inches) in a shallow core from the present swamp location. Sears estimated that the swamp was less than 50 years old (Ford and Webb 1956). This early palynological attempt is flawed by the lack of dating control. Ford and Webb were not palynologists which may have affected data collection. Even palynology was still developing as a method during that time.

It was during the late 1960s that Congress designated the site a National Historical Landmark. In 1970 the Louisiana Office of State Parks initiated an excavation plan after the site became part of the Louisiana state parks system. William Haag conducted large-scale excavations of the site in 1956 in 1973, 1974, and 1975.
William Haag was the main archaeologist at the site during the 1960s and 1970s. Haag (1986) believed that the site must have been an astronomical alignment, as Stonehenge is in England. Some alignments were found, but not greater than what could be attributed to chance (Purrington and Child 1989). The hypothesis that the swamp may not have been a relic channel but a borrow pit originated during the Haag investigations.

Jon Gibson, a student of Haag's, did his master's and doctoral work at the site in the 1970s and has continued intensive work ever since. Mesoamerican influences were determined not to be found at the site during the 1970s (Gibson 1986).

New World Investigations, Inc. investigated the peripheries of Poverty Point in 1978 (Thomas and Campbell 1978). Their survey showed occupation unevenly scattered over a 6 km² area. Thomas and Campbell (1978) and Gibson (1986) interpreted this as an attempt to stabilize the edge.

Two theories exist explaining site use. One interpretation of the site views it as a vacant ceremonial center, with occupation occurring in the peripheries only. Under this interpretation, the mounds were symbolic and used only for ceremonies. Another interpretation of the site is that it was a metropolis, implying occupation and daily use of the mounds.
In the 1980s Gibson found postmolds on the ridges, indicating the existence of houses. The late 1980s and 1990s also saw the beginnings of a systematic soil coring project conducted jointly by Glen Greene and Jon Gibson. The objective of these coring expeditions was to explore the interridge and intraridge variations at Poverty Point and to discover how the site was used (Gibson 1993).

The Poverty Point Culture

Theories concerning the origins of the culture are outlined in Gibson (1980). The Poverty Point site was occupied from approximately 1500 B.C. to 500 B.C., but the Poverty Point culture began around 2200 B.C. This defines the culture as Late Archaic, but the site continued into Early Woodland (Figure 15).

The Archaic period is characterized by more sedentary hunters and gathers (with some fishing) as opposed to the migratory large game hunters of the Paleoindian. The Poverty Point people settled along alluvial floodplain-wetland ecotones in linear arrangements along the Macon Ridge (Gibson 1980). Trade was introduced during the early Archaic period due to the semipermanence of settlements. No permanent settlements or agriculture is believed to have been practiced during the Archaic. Characteristic artifacts found at Poverty Point sites include clay cooking balls, microflints, and intricately carved stone beads and pendants (Haag 1968). The Poverty Point site has many characteristic
Important Events during the Historic Period:

- 1542: Explorer Expeditions
- 1703: Early Settlement
- 1817: Abandonment of Poverty Point Plantation
- 1870: Start of Poverty Point Plantation
- 1930: Gas Mining

Prehistoric Period:

- 12000 B.C.: Paleoindian
- 8000 B.C.: Archaic
- 1000 B.C.: Woodland
- A.D. 1000: Historic

1500 B.C.: Poverty Point Site
500 B.C.: Poverty Point Plantation
A.D. 1500: A.D. 1995
features of the Late Archaic period: the use of stone and pottery containers, fired clay for cooking balls, pipes, and figurines; an increase in long-distance trade; and atlatl and plummet use (Haag 1971). The Woodland Period is marked by the emergence of agricultural economies in the Southeast and the first use of pottery. No pottery is believed to have occurred in the Archaic period. Seeds of squash and bottle gourd found at various sites suggest the beginnings of agriculture are in the Woodland period. Plummets are introduced along with smaller projectile points that lead to the introduction of the bow and arrow. For more information on the Woodland period (named Tchefuncte in Louisiana chronology) see Ford and Quimby (1945) and Quimby (1941). Newman (1984) states that little has changed about the Tchefuncte culture in Louisiana making these references important works.

The primary importance of the Poverty Point site lies in the mammoth scale of the mounds (see chapter 3 and Gibson (1986)) and their geometrical pattern (Figure 3) for that period. At the time of completion, the earthworks at the Poverty Point site were among the most extensive in North America. The size and scale of the Poverty Point site makes it the largest site of the Poverty Point culture.

The second reason why the Poverty Point site is one of the premier sites in Southeastern archaeology concerns its implications for social organization. To build the mounds,
someone had to mobilize a large number of people. An estimated 405,214 m$^3$ (530,000 cubic yards) of earth were moved to construct the ridges. An additional 344,049.7 m$^3$ (450,000 cubic yards) of earth were moved to build the two large mounds at the site and a nearby smaller conical mound (Sibley 1967). Some hierarchy in the society was necessary to organize the labor force.

Gibson (1974) argued that Poverty Point may have been the first chiefdom in North America. The Poverty Point site was the center of a trade and manufacturing network during the Poverty Point period. The Poverty Point culture had influences reaching from the junction of the Mississippi and Arkansas rivers down the Mississippi River Valley to the Gulf of Mexico. Its influence extended as far north in the Mississippi River Valley as Tennessee and Missouri, and as far east as Florida.

Despite much investigation at the site, basic questions surrounding the culture remain unanswered. How and why did the culture develop? What is the purpose of the mounds, how long did it take to build them, and what is the source of fill for construction? What were the subsistence practices of the inhabitants and why did the culture suddenly end? All are intensely debated questions that remain unanswered at this time.

Archaeologists have advanced several hypotheses to explain the reasons behind mound construction. One
hypothesis suggests that the mounds are for burial based on the discovery of an ash bed containing human remains in Motley mound. However, no one has found burials associated with any other mounds at the site. Haag and others believed that the site may have an astronomical significance similar to stonehenges in England while others have suggested their use as fortresses (Gibson 1993).

Many archaeologists believe that the large swamp to the west of the bird mound (mound A) is the remaining borrow pit from constructing Mound A (figure 3) (Gibson 1983). Several problems with the borrow pit hypothesis exist. First, how did the builders penetrate the stiff clay in the area. Proponents of the borrow pit hypothesis retort that the borrow pit is such a large dimension because they could only penetrate the top layers.

Another problem is why is the borrow pit for the largest mound at such a great distance from it? If the borrow pits for the ridges are assumed to be the swales, then why would the same people travel farther to carry more dirt (Dennis LeBatt pers. comm. 1994)? Questions such as these have clouded the borrow pit hypothesis since its inception.

Three main hypothesis exist to explain the subsistence practices at Poverty Point. Ford and Webb (1956) developed the agriculture hypothesis. Only an agrarian based society was capable of efficiently organizing the population needed
to build the site. No one has found concrete evidence of agriculture at the site to date. Kidder (1992) has presented a summary of arguments against this hypothesis.

The second hypothesis is the practice of seed horticulture. Seed horticulture is an early form of gardening in which seeds were used to encourage the growth of edible plants that will grow easily without much attention and can produce large quantities of seeds (Neuman 1984; Byrd and Neuman 1978; Gibson 1993).

The third hypothesis is Gibson's "forest-edge efficiency" hypothesis. The extensive swamps in the region could have easily provided ample year round food supplies if the inhabitants knew the seasonal cycles. By precisely timing hunting and gathering, all of the food needed to sustain the population could have been met without agriculture (Gibson 1989, 1973).

Several hypothesis explaining the end of the culture exist. Webb (1977) hypothesized that the cultures in the Midwest that were gaining strength and organizing into cohesive groups caused an antipathy in Poverty Point people. This led to a break-up of long-distance trade, resulting in increased competition. The competition may have sparked an increase in militarism and status differences and eventually led to large scale destruction of the culture.

Gibson (1974) hypothesized that the Poverty Point culture experienced a population increase that forced people
to settle outside the traditional areas onto the floodplain. This stressed their redistribution system, eventually destroying their economic base. In reaction to the destruction of their economy, power became more centralized. This could have led to increased unrest and the eventual end of the culture.

European Settlement and Land Use History

Native American populations were already starting to decline when Hernando de Soto arrived in the spring of 1542 (Figure 15) (Neuman 1984). A Spaniard, he was the first European to arrive in northeastern Louisiana. The next explorers to pass through were the LaSalle expedition in 1682 and the Bienville expedition in 1700. Until the 1700s, the only inhabitants of the area were Native Americans.

The study area was part of the Ouachita Valley that covered most of present-day northeastern Louisiana. Immigrants from Canada settled the first mission in the Ouachita Valley in 1703. During the early 1700s, many battles were waged between Native Americans and the European settlers. The warfare became quite bloody and violent as in the Natchez Revolt of 1729-30. Many Europeans were hesitant to move their families into the area out of fear of attacks by Native Americans.

After the end of the battles in the 1740s, massive European immigration occurred. The region was part of the Spanish territory from 1788 to 1803. Lack of adequate
transportation in the region hindered settlement. Northeastern Louisiana in the mid-1700s was accessible only by water or Indian trail (Winters 1984a).

During the late 1700s, the farms established in the area grew corn, tobacco and indigo as cash crops. Bayou Macon was named in honor of the Macon family that settled in the area during this time. Don Alexander O'Rilley took the first census of the area in 1769 that recorded 110 white settlers in Ouachita County (Williamson and Williamson 1939).

A rush of settlement claims were filed by Homesteaders immediately before the Louisiana Purchase of 1803. In 1803, James Floyd became the first permanent settler in East or West Carroll Parish (Figure 15). His settlement was on Lake Providence. Initial settlement of the two parish portion of Ouatchita county continued from 1803 to 1812. Lockett (1874) described initial settlers as immigrants from older states in America who established small farms and numerous villages in North Louisiana.

The first permanent settlement in Carroll Parish was established between 1803 and 1812 with the Poverty Point Plantation being established in 1810 (Williamson and Williamson 1939). Initial settlers used fire to control weeds and to clear land for agriculture. This was witnessed by General Land Office surveyors in the early 1800s (General Land Survey 1834). Little agriculture occurred in Carroll Parish before 1820 (Worthen and Belden 1909).
In 1832, parts of Concordia and Ouachita Counties became Carroll Parish that later became present-day East and West Carroll Parishes. Settlement in Carroll Parish moved westward as more Europeans settled in the parish (Williamson and Williamson 1932, Winters 1984a).

Agriculture on a large, intensive scale began in Carroll Parish in 1840 (Figure 15) (Worthen and Belden 1909). Bayou Macon contained an unbroken line of plantation homes on its eastern side during the 1800s. From 1840 to 1860, Carroll Parish and the surrounding parishes produced more cotton than any comparable region in the world during the Antebellum Period. Nearby Floyd became the parish capital in 1855 (Williamson and Williamson 1932).

Winters (1984a) provided several statistics which attest to the importance of cotton in Carroll Parish. Carroll parish contained the largest white and colored population than any other Mississippi river parish. Carroll Parish was second only to Tensas in slave ownership and in 1860 ranked second to Tensas in bales of cotton grown. Of the twelve largest producers of cotton, seven were from Carroll Parish. For more information on methods of cotton farming in the 1800s see Hilagard (1884).

Besides cotton, plantations grew lots of corn and potatoes in present-day West Carroll Parish during the Antebellum Period. Apples, pears, peaches, plums and figs were very successful crops on the Macon Ridge (Lockett 1874;
Worthington 1909). Worthen and Belden (1909) noted that many wild pecans grew in East Carroll Parish on better drained soil. Worthen and Belden's soil survey encouraged farmers to produce improved varieties commercially for better yields. Most of the planters lived year-round at their plantations.

Worthen and Belden (1909) described the agricultural practices in 1909. This does not date to the time of peak agriculture during the Antebellum Period, but it does illustrate the best way to grow cotton. Farmers planted cotton between the first and middle of April in the parishes. When it was small, cotton was thinned and hoed twice. Most farmers used a sweep plow two or three times to cultivate the harvest. Corn was planted in March with late corn planted in May. Corn was always planted on ridges and received only one or two plowings. Farmers usually neglected corn because of its secondary importance to cotton.

Little crop rotation occurred in the area. Occasionally corn was rotated with cotton, but usually farmers used the same soil as the previous year to grow cotton. Farmers used almost no fertilizers. Farms in West Carroll Parish in 1909 were smaller than East Carroll and operated without negro labor. Some black sharecroppers existed, but the majority were white.
The Civil War was a time of hardship for Carroll Parish. After the blockade of the Mississippi in 1861, farmers grew less cotton and more food crops in the area. Industry expanded in response to the lack of manufactured goods.

After the fall of New Orleans and later Baton Rouge in 1853, the governor of Louisiana ordered all planters to haul cotton to safety in the interior or burn it. Planters burned millions of dollars worth of cotton on Indian mounds in Carroll Parish along the levees in Carroll and surrounding parishes in response to the War (Winters 1984b). Bayou Macon became another refuge from the Union army later in the War for planters who fled the looting of their plantation by Northern troops.

Hensen (1987) provided a record of Union troop activity in northeastern Louisiana. Battles in the Civil War, however, did not reach northeast Louisiana until Christmas, 1862. Sherman marched from Vicksburg to Delhi burning stored cotton and rail depots and bridges besides widespread looting and the theft of slaves. To prevent cotton from attack by Union troops, planters in the area hid their cotton in swamps in the Tensas basin and surrounding areas. If they discovered that Union soldiers were coming, they burned the cotton themselves before Union soldiers could move it. The Union army leaders threatened to burn every house in five miles and hang whoever burned the cotton
before they arrived. More information on the Civil War in Louisiana can be found in Winters (1963).

After the War, slavery was abolished that left the planters without a work force. This was not their only problem; numerous houses and villages had been burned, over half the livestock was destroyed, and neglected levees allowed floodwaters to inundate fields causing nearly complete crop failures. Worthen and Belden (1909) commented that the cotton output in East and West Carroll parishes was less than half the Antebellum totals. Cotton was still the leading crop with corn a close second.

Further illustrations of the devastating effects of the Civil War on the region can be found in Hanson's (1987) population statistics. In 1860, the area consisted of Morehouse, Carroll, Franklin, Madison, Tensas, and Concordia Parishes. In 1870, Richland Parish was added to the area, but the numbers still drop. Capital investments dropped 88 percent, labor 75 percent, and wages 88 percent. While inflation rose 29 percent, the value of products produced in the region declined 55 percent. The Poverty Point plantation operated throughout the Civil War, but the owners abandoned it around 1870 after the war.

The area was a popular location for pirates and desperados, most notably Frank and Jesse James who lived there after the Civil war. While they did not commit any escapades, they hid in the area in between escapades
(Williamson and Williamson 1932). East and West Carroll parishes were separated in 1877. Floyd remained the capitol until 1913.

A review of the history of the timber industry in Louisiana is provided by Kerr (1963). The lack of transportation into the region prevented commercial timbering in Louisiana until the 1870s. The railroad finally came to Carroll Parish in 1861, just before the Civil War. Trees accounted for over 85% of the land area in the early 1870s. Once transportation was introduced, the state lumber output increased from 76 million board feet in 1869 to 2.5 billion board feet in 1904. Virtually all of the early commercial timbering was in the cypress swamps. As regions became nearly completely logged, the industry moved north into the shortleaf pine uplands which include the Poverty Point region.

Peak commercial timbering in Louisiana occurred between 1904 and 1913. The peak in commercial timbering operations came in 1913 when the state output reached a high of 4.2 billion board feet. Paper mills were established in the 1920s allowing early stands to be timbered. Bottomland hardwood forests were not heavily harvested until the 1920s and 1930s, with intensive cutting occurring during the 1950s.

The 1930s to 1940s saw the development of natural gas fields in the area next to the site and throughout the Macon
Ridge. Intensive use occurred until the 1950s. In the 1970s, Tennessee Natural Gas leased a dome for underground storage and they relocated all fifty six wells. The 1970s saw the incorporation of the site into the State Parks system as a State Commemorative Area. Today, there are 56 natural gas wells left. Some natural gas exploration to the north and west of the study site occurs, but cotton farming is the primary land use in the area.

**Summary**

The Poverty Point site is important due to the size of the earthworks and the labor organization needed to build the mound. The dates for the site span the transition from Archaic to Woodland periods. To have sedentary society with central authorities during this period is highly unusual; it probably occurred only in special ecological niches. Most of the Poverty Point site has yet to be excavated. Shea's (1978) macrofossil study provides some evidence of the forest resources at the time of occupation, but a detailed environmental reconstruction has yet to be available from the site. A palynological study at the site can help resolve the many debates and speculations surrounding both the Poverty Point site and the culture.
Methodology

Fieldwork

A coring expedition to Poverty Point was conducted on October 14-16, 1994. Dr. Kam-biu Liu and several students in the Quaternary Paleoecology class, Fall 1994, participated in the expedition. Eight cores, labelled as PP1 - PP8, were collected from the swamp on October 15, 1994 (Figure 16).

At the time, the swamp contained an average of 70 cm of water, with significantly lower depths in places. Many logs of felled trees were strewn about the bottom of the swamp. While the edges of the swamp were heavily forested, relatively few trees were found inside the swamp where open water existed. The trees seen growing inside the swamp were mostly cypress, tupelo, and planera. Many overgrown vines, shrubs, and aquatic plants were present inside the swamp. This can be attributed to the open canopy inside the swamp. The bottom of the swamp had an uneven topography due to depressions which ran in an east-west direction.

After surveying the aerial photos of the area and outlining our coring strategy, we proceeded into the swamp. We inflated two rubber boats which carried the coring crew. A metal bottom boat carried all of our equipment and more students. A hand-held Global Positioning System (GPS) (Garmin 50) was used to locate the coring sites accurately.
Figure 16: Coring Locations at the Study Site
The corer used was a piston corer developed by Dr. Kam-biu Liu in the Quaternary Paleoecology Laboratory at Louisiana State University. A 2" diameter, 5-ft. long polyvinyl chloride (PVC) tube is fitted with a rubber piston at one end. This is attached to a cable which runs through the piston head. At the other end of the tube is a metal cutting shoe attached with screws. The corer is lowered into position with metal extension rods attached to the top of the core. The piston rests on the top of the sediment and is held into place by another rod placed horizontal to the corer with the cable held by vice grips. The corer is pushed into the sediment by hand until it stops and pulled out by hand after loosening the cable. After coring, caps were placed on either end and the core transported in the PVC tubes to the laboratory before extrusion.

The first core, PP1, was taken at 32°38.19'N, 91°24.83'W at a water depth of 68 cm. A complete core 83 cm long was obtained in one push. A gravel layer occurs at the bottom of the core.

The second core, PP2, was taken at 32°38.20'N, 91°24.83'W at a water depth of 58 cm. This core is 98 cm in length. An organic layer was seen at the top this core. We hit a gravel layer again reinforcing the belief that we obtained a complete core.
The next core taken was PP3. The GPS reading for the site was 32°38.10'N, 91°24.8'2W, and the water depth was 61 cm. This core measured 72 cm. We may have lost 1 cm of sediment from the bottom of the core, although a gravel layer was still present at the bottom of this core. The top 30 cm of this core was disturbed.

Core number PP4 was taken next at 32°38.13'N, 91°24.81'W. This GPS reading was obtained in 2D mode, which means that only two satellites were used to obtain a reading. All other GPS readings were obtained in 3D mode and are more accurate than this reading. The water depth at PP4 was 70 cm and the core measured 56 cm.

The fifth core, PP5, was taken at 32°37.94'N, 91°24.77'W. This core measured 107 cm in length. The meter stick was inadvertently left with the cores recovered that morning, so no water depths were taken. There was no noticeable difference in depth, however, to those who were wading through the swamp. Gravel was present at the bottom of the core.

Until this point, all cores were taken along the same north-south transact. To get cores PP6 and PP8, we moved to the east to capture any lateral variations within the swamp. The sixth core, PP6, was taken at 32°38.02'N, 91°24.77'W. This core measured 71 cm in length. The mud at the surface of this core was much softer than anywhere else in the swamp. This could suggest more organic
deposition in this end of the swamp. A piece of wood was seen at the bottom.

The seventh core, PP7, was taken along the same north-south transact as PP1-PP4 and PP5. PP7 was obtained at 32°38.03'N, 91°24.83'W. This core measured 97 cm. We may have lost approximately 4 cm of sediment at the bottom, but we still hit the gravel layer. A root inside the core was also seen at the bottom of this core. The final core, PP8, was taken at 32°38.06'N, 91°24.81'W. This core is approximately 48 cm and no gravel was seen.

Laboratory Analyses

Sediment color was identified using the Munsell Soil Color Charts (1992 Revised edition). This was performed immediately after cutting open the middle of the cores. A small sample of sediment (approximately 1 cm) was taken from the center of each color area and held to the charts until the best color match was obtained. The color was recorded along with information on the texture of the sediment.

Loss-on-ignition analysis was performed on the following cores: PP1, PP2, PP5, PP6, PP7, and PP8. Loss-on-ignition was performed contiguously at 1 cm intervals following standard procedures (Dean 1974). Calculations were made as follows: Percent water = 100*(wet weight - dry weight)/wet weight. Percent organics = 100*(dry weight - 550°C weight)/dry weight. Percent carbonates = 100*(1000°C
weight - 550°C weight)/dry weight. Percent residue =
100*1000°C weight/dry weight.

After loss-on-ignition analysis was performed, cores
PP5 and PP7 were selected for pollen analysis. Sampling
was performed at 5 cm intervals for the entire length of
both cores. About 0.9 cc of sediment was used for
processing from each level.

Standard processing procedures were followed (Fageri
and Iverson 1975). Two Lycopodium marker tablets were
added to each organic sediment sample to obtain pollen
concentration values. In the clay sections where the
amount of organics averaged only 3-4%, only one Lycopodium
tablet was added. Sodium pyrophosphate was added after the
initial hydrochloric acid (HCl) treatment and before the
potassium hydroxide (KOH) treatment to aid in the removal
of clays (Cwynar et al. 1978). Samples were treated for 30
minutes in hydrofluoric acid (HF), then a hot HCl bath for
5 minutes, and treated with an acetolysis solution (9 parts
acetic anhydride to 1 part concentrated sulfuric acid).
Samples were then stained with safranin, transferred into
vials, and suspended in silicon oil.

After processing, a sample of each vial was mounted on
a slide. For the organic section, the pollen grains were
counted at 400x magnification until 300 grains were
reached. A distinct drop in pollen concentration and
organic matter content was seen in the lower part of both
cores. Below this level, pollen grains were counted to a sum of 150 where possible.

For the last two or three levels where pollen concentration was around 1000 grains/cm$^3$, only 50 grains were counted. Because of the low concentration, 15 slides had to be counted to obtain 50 grains. To shorten the time involved, slides were scanned at 200X magnification for pollen. When pollen was found, the identification was performed at 400X magnification. The pieces of charcoal found were counted on all of the slides along with the pollen.

TILIA spreadsheet and TILIA GRAPH were used to calculate percentages and create pollen diagrams. Pollen concentration (Number of grains/cm$^3$ sediment) was calculated by TILIA using the ratio of Lycopodium tablets to number of pollen counted according to the following equation: original number of marker grains added x fraction in 1 cc sediment = concentration. The pollen sum for each sample included all pollen and spores but not the marker spores. The number of unknowns was tabulated separately from the amount of indeterminables. Indeterminables were separated into the following categories: corroded/degraded$^1$, mechanically damaged$^2$, concealed by detritus$^3$.

$^1$ Exine is etched, pitted, or perforated or thinned.

$^2$ Pollen grains were broken or crumbled obscuring identification.
Charcoal Counts

A summary of the nature, dispersal mechanisms, and deposition of charcoal along with a review of palynological studies employing charcoal analysis can be found in Patterson et al. (1987). Due to the size of the basin, fires up to approximately 30-100 m of the site will be recorded in the charcoal record. When sample intervals are less than 10-20 years, each level will represent one fire event. If the sample interval is more than this, several fires could be represented in one charcoal peak (Patterson et al. 1987). Charcoal was counted for core PP7 only. All fragments > 200 microns were counted on each slide at each level used for pollen counts. The percentage of fragments < 200 microns was estimated for each slide. The general shape of the fragments, whether predominantly blocky and squarish or more linear was noted.

Charcoal abundance was obtained by dividing the number of charcoal fragments counted by the number of Lycopodium markers added. Charcoal-to-pollen ratios or C:P (charcoal abundance/total pollen grains counted) was calculated to minimize differences in the number of marker tablets and pollen counted on each slide. C:P ratio of less than 400 is considered to be background levels and no fires were present. C:P ratios greater than 400 are considered to be the result of fires; the larger the number, the closer

Pollen grains were hidden by other material (mostly clays).
and/or higher the magnitude of the fire. When disturbance horizons are reached, increases in C:P may reflect erosion of mineral soils as well (Rhodes and Davis 1995).

**Lead-210 Dating**

Samples from core PP7 were sent to Dr. Brent McKee of LUMCOM (Louisiana Universities Marine Consortium) for Lead-210 analysis. Lead-210 analysis was chosen because it is applicable for dating sediments less than 150 years old. Examples include Brenner and Binford (1988) and Brugam (1978).

Most of the base of the cores contained organic matter below 5% rendering radiocarbon dating, even with an accelerator mass spectrometer, unreliable. Due to the shallow nature of the swamp deposits, it is assumed that the swamp is less than 100 year old. If this is true, then Lead-210 should still provide an accurate date for the age of the swamp.

In the absence of another applicable dating technique, Lead-210 dates can be cautiously used to extrapolate ages (Brenner and Binford 1988). A constant rate of sediment accumulation is assumed and the sedimentation rate from the dated portion is used to estimate ages in other aspects of the core.

Oldfield and Appleby (1984) describe the principles behind Lead-210 dating. Lead-210 belongs to the Uranium-238 radioactive decay series and has a half life of 22.26
years. Lead-210 is formed in the following manner: Radium-226 (half life of 1622 years) decays to form Radon-226, an inert gas with a half life of 3.83 days. Radon-226 decays via several short-lived isotope stages to form Lead-210.

Radon-226 gets into lake sediments through the erosion of terrestrial sediments (Figure 17). Radon-226 deposited in sediments decays in situ to form Lead-210; Lead-210 formed in this manner comprises the supported component of Lead-210 in sediments. Unsupported Lead-210 in sediments is deposited in sediments from three sources. It can originate from the decay of Radon-226 to Lead-210 in the atmosphere, become in-washed from the catchment area, or decay from Radon-226 in the water.

Lead-210 dating uses only the unsupported component of Lead-210 in sediments because this is the only portion which decays exponentially according to the length of time deposited in sediment. Radon-226 activity is established in the sediment. The amount of supported Lead-210 is roughly equivalent to the level of Radon-226. The supported Lead-210 activity is subtracted from the total Lead-210 activity in the sediment. Lead-210 dates are always given in the form of sediment accumulation rates with the levels of supported and unsupported Lead-210 activity often reported.
Figure 17: Pathways for Lead-210 Deposition in Sediments (Adapted from Oldfield and Appleby 1984)
Results

Sediment Stratigraphy

The sediment stratigraphy of each core is described below based on visual inspection and comparison with the Munsell Color Chart. Sediment terminology can be found in Allen (1986) and Birks and Birks (1980).

Core PP1 (Figure 18)

0-5 cm  10YR 5/2 - dark brown, nearly black organic layer with herbaceous detritus found.

5-12 cm  10YR 6/1 - Silt-clay sediments with a sticky consistence.

12-28 cm  10YR 5/2 - clay sediments with a coarser texture and plastic consistence. A few small, faint mottles were seen from 12-18 cm. Medium, distinct mottles were found from 18-28 cm.

28-72 cm  10YR 5/1 - heavy dark clay with faint white concretions seen. A break occurred at 3.5 and 53 cm.

Core PP2 (Figure 19)

0-3 cm  10YR 3/1 - organic layer.

3-5 cm  10YR 5/1 - silt-clay layer, possible fragipan layer.

5-25 cm  10YR 6/1 - Clay layer, plastic consistence and very moist. Fine black concretions were seen.

25-73 cm  10YR 5/1 - Clay sediments with distinct dark red mottling common. The abundance and prominence of
Figure 18: Core PP1 Sediment Stratigraphy.
Figure 19: Core PP2 Sediment Stratigraphy.
mottling increases from 25-50 cm. No mottling is seen from 50-73 cm where clay becomes more friable.

73-82 cm 2.5Y 3/1 - dense, coarse, drier clay sediment with grains felt. A crack in the core occurred at 56 cm and a root penetrated the core from 65-73 cm.

**Core PP4 (Figure 20)**

0-12 cm 2.5Y 4/2 - clay layer with a few faint mottles seen.

12-32 cm 5Y 4/1 - clay layer, drier and darker and with a more plastic consistence.

32-55 cm 10YR 4/1 - even denser and darker clay layer. Fine roots were seen at 40 cm and 50 cm.

**Core PP5 (Figure 21)**

0-8 cm 2.5Y 4/2 - organic sediments.

8-23 cm 2.5Y 6/2 - clay sediments with faint herbaceous detritus in the form of fine roots. Extremely sticky constance.

23-32 cm 2.5Y 5/1 - clay layer with prominent medium mottles seen (10YR 6/3) occurring in bands. Noticeable herbaceous detritus (plant roots).

32-53 cm 2.5Y 5/1 - amorphous clay layer, loose consistence. Herbaceous detritus seen. Layer was noticeably drier from 44-53 cm.
Figure 20: Core PP4 Sediment Stratigraphy.
Figure 21: Core PP5 Sediment Stratigraphy.
53-71 cm  10YR 5/2 - thicker grained, darker, extremely stiff clay layer. Drier than previous layer and herbaceous detritus (fine roots) with distinct dark red mottling was common from 62-71 cm.

71-108 cm  5Y 4/1 - Very thick, densely compacted clay layer. Mottles are found around the roots (10YR 4/4) similar to 62-71 cm mottles with the same consistence as 0-8 cm, but more plastic. From 38 to 44 cm, a large root found in growth position was extracted from the core 6 cm long. Breaks in the core occurred at 103 cm.

Core PP7 (Figure 22)

0-17 cm  10YR 2/1 - organic sediments containing lots of herbaceous detritus (fine (<2 mm) roots). Extremely friable consistence. Bark was seen horizontal in the core 8-12 cm.

17-64 cm  2.5YR 4/1 - clay layer with darker concretions seen. The appearance matched core PP8 from 27-45 cm, but has a less stickier consistence.

64-84 cm  5YR4/1 - clay layer with prominent medium red mottles and some faint black mottling. A break in the core occurred at 64 cm.

Core PP8 (Figure 23)

0-8 cm  10YR 3/1 - organic layer containing much ligneous and herbaceous detritus.
Figure 22: Core PP7 Sediment Stratigraphy.
Figure 23: Core PP8 Sediment Stratigraphy.
8-13 cm  2.5YR 4/2 - wet organic layer, very loose consistence, nearly amorphous. No detritus was seen.

13-45 cm  2.5YR 4/1 - faint mottling was seen on the inside the core only. Plastic consistence and some grains were felt from 13-25 cm. Below 25 cm, sediment is a friable consistence. Dark concretions were seen from 38 cm to the bottom and no grains felt. A root was seen at 34 cm, and a crack in the core occurred at 38 cm.

Loss-on-ignition analysis

Core PP1

From the bottom of the core upward to 8 cm, the percent organics average 3-4% (Figure 24). The amount of organics remains constant except for a small increase to 10% at 20 cm. An increase in organics can be seen from 8-5 cm to 25%. A decrease in organics to 5% is seen around 3 cm followed by another rise to 20%.

The percent water follows the same pattern as the organics. The water averages 20-25% from the bottom of the core upward to 8 cm. An increase in the percent water is seen from 8-5 cm from 20 to 60%, followed by a decrease to 40% at 3 cm and another recovery to 55% at the top of the core.
Figure 24: Core PP1 Loss-on-ignition Results.
Core PP5

The amount of organics in this core remains steady from the bottom upward to 23 cm (Figure 25). Except for a peak at 100 cm due to a break in the core, the level of organics averages 4-5%. A rise can be seen from 23-12 cm. A small peak in organics is seen at 10 cm where it reaches 15%. This is followed by a decrease to 10% at 8 cm. Another peak (to 35%) occurs at 5 cm followed by a decrease in organics to 20% at the top of the core.

The amount of water averages 20-25% from the bottom of the core up to 23 cm. Slight peaks for water (to 30%) occur at 73 and 60 cm. A decrease for water is seen at 100 cm. From 23-12 cm, the amount of water rises upward to a peak is reached at 10 cm (55%). A decrease to 45% for water is seen at 8 cm, followed by an increase to 75%.

Core PP7

The amount of organics remains around 3-4% from the bottom of the core upward to 17 cm except a small increase to 6% at 42 cm (Figure 26). A small peak (10%) in organics is seen at 15 cm followed by a rise in organics to a second peak at 8 cm (20%). A major peak in organics occurs at 5 cm where it increases to 28%. This is followed by a decrease to 15% at 3 cm.

The amount of water remains at 25-30% throughout the core upward to 17 cm. The percent water rises to 75% from
Figure 25: Core PP5 Loss-on-ignition Results.
Figure 26: Core PP7 Loss-on-ignition Results.
17-8 cm with small peaks occurring at 15 and 8 cm. A drop to 65% is found at 3 cm.

Core PP4

From the bottom of the core upward to 17 cm, the level of organics is 2-3% (Figure 27). An increase in organics is seen from 17 cm upward to 8 cm where a peak (15%) is found. The percent organics drops slightly at 5 cm followed by a rise to 23% at 3 cm.

The percentage water remains around 25-30% from the bottom of the core upward to 17 cm. This is followed by an increase between 17 and 8 cm. A peak (15%) in percent water is found at 8 cm. This is followed by a slight drop at 5 cm and subsequent rise to 75% at 3 cm.

Lead-210 Results

Six samples were sent to Dr. Brent McKee of the Louisiana University Marine Consortium for Lead-210 dating. Lead-210 dating revealed that the sedimentation rate was 0.18 cm/yr. The lead-210 profile produced by the laboratory is shown on figure 28. The diamonds represent the supported portion or total amount of lead-210. The squares represent the supported portion or excess lead-210. The line drawn is the decay curve formed by the excess lead-210. Age extrapolation below 20 cm was performed assuming an unchanging sedimentation rate. No error bars were provided by the laboratory, so all extrapolated dates are approximate dates. Without enough material for
Figure 27: Core PP8 Loss-on-ignition Results.
Figure 28: Lead-210 Dating Results. (Diamonds are supported portion and squares are unsupported portion)
radiocarbon dating, however, this is the only means of approximating dates for the lower levels of the core. As a result, all dates below 20 cm should be interpreted with great caution.

Pollen Analysis

Core PP5

This core can be divided into four pollen zones based on visual inspection and comparison with the lithology. A summary pollen diagram is given in figure 29. Pollen percentage data for major taxa are presented in figure 30, and minor taxa in figure 31. Pollen was absent below 60 cm. 15 to 25 slides at selected levels (60, 65, 70, 90 and 100 cm) were scanned for pollen, but no pollen was found. The percentages of indeterminable pollen increase steadily down-core. This suggests that no pollen is preserved below 55 cm in this core.

Zone 1 occurs from 55 cm to 32 cm. This covers the time period before 1820/1830. Pollen preservation is poor in this zone as suggested by the amount of indeterminables (20-40%) in figure 29. Pollen concentrations are extremely low throughout this zone and remain steady around 2000-3000 grains/cm$^3$.

Trees and shrubs comprise 50-60% of the taxa in Zone 1 (Figure 29). Pinus pollen dominates this zone with significant amounts of Liquidambar and Quercus found. The percentages of Quercus remain steady throughout the zone.
Figure 29: Summary Pollen Diagram for Core PP5.

Depth vs. Percentage of Pollen Types:
- Trees and Shrubs
- Upland Herbs
- Ferns and Fern Allies
- Aquatic Herbs
- Indeterminables
- Pollen Concentration

Zone 1, 2, 3, 4

Analyst: K.L. Thomas
Figure 30: Pollen Diagram for Core PP5 Depicting Major Taxa Found.
Figure 31: Pollen Diagram for Core PP5 Depicting Minor Taxa Found.
Carya is present at the beginning and end of this zone comprising 10%. Liquidambar decreases in abundance along with Pinus at 45 cm where Taxodium is found (Figure 30).

Minor arboreal taxa (Figure 31) present in Zone 1 include Magnolia, Liriodendron, Juniperus-type, Juglans and Fagus. Most notable is the relatively high percentages of Magnolia pollen, but this may be an artifact of differential pollen preservation and the small pollen sum in these samples. Acer is present at 50 cm, the level where Carya drops out (Figure 30). At the same level, a decline in virtually all other minor taxa is seen. No aquatic components are seen in this zone.

Few herb pollen can be seen in Zone 1. A peak in Tubuliflorae pollen is seen at 50 cm. Chenopodiaceae-Amaranthaceae (Cheno-Ams) pollen are present from 45 cm upward. Both are grains which are highly resistant to oxidation and weathering and are easily recognized even when degraded. As such, their percentages may be overrepresented. A slight decrease, however, is seen in Cheno-Ams around 40 cm where Ambrosia and Gramineae pollen are first found (Figure 30). Non-arboreal taxa, except Umbellifereae at 35 cm, are virtually absent in the minor taxa diagram (Figure 31).

Pollen zone 2 occurs from 32-23 cm and spans the period from 1820/1830 - 1901 (Figure 29). Pollen concentration rises only very slightly at 32-25 cm. Pollen
preservation is good at this level and the percentages of indeterminables have dropped below 20%.

This pollen zone can be distinguished from the others by the peak in herbaceous pollen types and decline in arboreal taxa (Figure 29). Sharp decline in arboreal component is most noticeable at 25 cm, especially in Carya and Pinus (Figure 30). Peaks in Gramineae (20%), Tubuliflorae (10%), and Cheno-Ams (20%) can be seen at 25 cm. Six grains of cultivated species (Zea mays and Solanaceae pollen) are present at 25 cm. Almost all aquatic and upland herbs are present in Zone 2. A peak in Cornus can be seen at 30 cm.

Solacanaceae pollen grains are tricolporate with psilate surface. When closely examined, their texture is not echinate. The transverse furrow of Solacanaceae grains have an elbow-like extension. The colpi are usually sunken giving the grain a lobed appearance in a polar view. These features match the two Solacanaceae grains found at 25 cm.

Zea mays (Corn) can be distinguished from Gramineae pollen grain based on its size. Both are monoporate pollen grains with psilate surface. The pore is annulate. Zea mays (Corn) (58 to 98 microns) is larger than non-cultivated gramineae pollen. The lower size limit of Zea mays (Corn) pollen is at the extreme upper limits of Gramineae pollen grain size (Fearn and Liu 1995).
Another diagnostic feature is the pore which is 8.7 to 17.4 microns in size with a mean of 13.5 microns. This gives *Zea mays* (Corn) pollen an axis:pore ratio of about 5.7 (Fearn and Liu 1995). All four of the pollen grains considered to be *Zea mays* (Corn) found in the core were are larger than 70-80 microns. This places the pollen grains firmly within the boundaries for *Zea mays* (Corn).

Pollen Zone 3 occurs from 23-8 cm (Figure 29). This is a zone of sharply increasing pollen concentrations from 5000 - 30,000 grains/cm³. Preservation is excellent, and the amount of indeterminables is around 10%. The period covered by this zone is from 1901 to 1951.

This zone is distinguished from the other zones through the occurrence of a *Carya* peak at 10 cm (40%) (Figure 30). The amount of trees and shrubs increases throughout this zone and a decline in herbs is seen. Aquatics begin to occur, but their abundance remains below 10% (Figure 29).

*Pinus* frequencies rise in this zone, but do not reach the percentages as in Zone 1. *Liquidambar* recovers to the same abundance as in Zone 1 (Figure 30). The percentages of *Quercus* decline slightly in this zone, and *Taxodium* is hardly present. A rise in *Fagus* is seen in the minor components diagram (Figure 31), and *Ulmus* is present around 10 cm. Aquatic trees *Nyssa, Fraxinus, and Salix* are first
found in this zone. *Salix* rises sharply to 10% in the zone; an increase in *Fraxinus* occurs later (15 cm).

Cyperaceae, *Sagittaria*, and *Nymphaea*, all aquatic taxa, are present in Zone 3 (Figure 30). Some *Typha* is present from 10 cm. *Ambrosia* continues to rise upward to a peak (20%) is reached at 15 cm, which is followed by a sharp decline. Gramineae disappears in this zone, and Cheno-Ams drop to less than 5%. Decreases are also seen in Tubuliflorae (Figure 30) and *Alnus* (Figure 31).

Pollen Zone 4 occurs from 8 cm to the top of the core. This pollen zone covers from 1951 to the present (Figure 29). Pollen preservation is excellent with concentrations over 300,000 grains/cm$^3$. Nearly all of the indeterminables are grains hidden by detritus.

This zone is dominated by aquatic taxa which comprise 30% of the pollen sum (Figure 29). *Sagittaria* is the most important taxa in this Zone. It increases to 20%, and *Nuphar* is present for the first time (5%) (Figure 30). Cyperaceae increases along with *Nyssa*. *Fraxinus* remains high and *Salix* is present throughout. *Carya* declines to less than 5% and *Pinus, Quercus*, and *Liquidambar* are present in lower frequencies. *Taxodium* increases slightly towards the top. Upland herbs are present, but in low percentages.
Core PP7

This core can also be divided into the four pollen zones as delineated in Core PP5. Pollen percentage data is summarized in figure 32. Major taxa are presented in figure 33, and minor taxa in figure 34. No pollen was found below 55 cm; At 55 cm, the indeterminables comprise nearly half the pollen sum and the pollen concentration is 1500 grains/cm³. Data from both core PP7 and PP5 seem to suggest that the swamp is barren of pollen below a depth of 60 cm in the sediment.

Zone 1 occurs from 55 cm to 32 cm, and contains pollen deposited before 1820 (Figure 32). Pollen is poorly preserved in this zone. The amount of indeterminables decreases upward from 45% to 30% in this zone. Pollen concentrations remain low around 2000-3000 grains/cm³ except for a slight increase to 5000 grains/cm³ at 45 cm. Trees and shrubs dominate the pollen taxa in this zone comprising 50-60% of the taxa found. Pinus is the dominant taxa with 20-30% of the taxa (Figure 33). Quercus and Carya are both well represented. Some Liquidambar is found at the beginning and toward the end of the zone, but the percentages below 5%. Ulmus, Juglans, and Acer have peaks from 45-40 cm, and Liriodendron is present as well (Figure 34). Only two aquatic species are present: Myrica at 50 cm and Platanus at the end of the zone.
Figure 32: Summary of Pollen Taxa found in Core PP7.
Figure 33: Pollen Diagram for Core PP7 Depicting Major Taxa Found.
Figure 34: Pollen Diagram for Core PP7 Depicting Minor Taxa Found.
Gramineae is present throughout this zone, and *Ambrosia* is present at the bottom of the zone and drops off at 45 cm (Figure 33). Cheno-Ams is well represented at the bottom of the core, but drops off at 45 cm. *Tubuliflorae* is present throughout this zone, but drops off at 40 cm when *Ambrosia* and Cheno-Ams begin to increase. The only aquatic herbs found is *Cyperaceae* at 45 cm.

Pollen Zone 2 is found from 32-17 cm and covers the period from 1820-1901 (Figure 32). Pollen concentrations are slightly higher than the previous zone. The amount of indeterminables continues to decline from 30% to 15%.

In Zone 2, the percentage of trees and shrubs declines as herbaceous taxa increases (Figure 32). The decline in trees and shrubs is most apparent in *Pinus*, the dominant taxa (Figure 33). A peak in *Carya* (15%) is seen at 30 cm, followed by a decline as well. The amount of *Quercus* (Figure 33) and *Acer* (Figure 34) remains stable throughout Zone 2. *Liquidambar*, however, increases from less than 5% to a peak of 10% at 25 cm. No *Ulmus*, *Juglans*, or *Fagus* is seen in this zone. *Magnolia* and *Liriodendron* percentages drop through this zone. Wetland tree taxa begin to appear toward the end of this zone.

Gramineae, *Ambrosia*, *Tubuliflorae*, and Cheno-Ams all increase in this zone (Figure 33). *Platanus*, *Rosaceae*, and *Cyperaceae* are all present in this zone in low amounts (Figure 34).
Pollen Zone 3 occurs from 17-8 cm and is distinguished from the other zones by the dominance of trees and shrubs (Figure 32). It covers the period from 1901-1951. Pollen preservation is very good in this zone, and there is a drop in the amount of indeterminable pollen grains from 20% to 10%.

Tree and shrub taxa comprise 60-70% of the pollen sum in this zone (Figure 32). *Carya* and *Pinus* pollen comprises most of this percentage with peaks of 20% (Figure 33). *Quercus* is also well represented (15%). Both *Pinus* and *Liquidambar* percentages rise throughout the core. *Nyssa, Salix,* and *Fraxinus* are present in this zone.

A decline in *Ambrosia* abundance to 10% is seen in this zone above 20 cm (Figure 33). Gramineae and Tubuliflorae percentages drop off at 15 cm in this zone. Some *Alnus* is present as well (Figure 34).

Zone 4 spans the period from 1951 to the present and is characterized by a peak in Wetland taxa (Figure 32). It encompasses the uppermost 8 cm of the core. Pollen concentrations remain high around 300,000 grains/cm³. Pollen preservation in this zone is excellent.

Trees and shrubs decline in abundance while herbs remain stable (Figure 32). The decline in trees and shrubs can be attributed to a sharp drop in *Carya,* the dominant taxa in the previous pollen zone (Figure 33). *Carya* drops to 5% from a peak at 20% (10 cm). *Pinus, Liquidambar,*
Salix, and Fraxinus all see a decline as well. Minor arboreal taxa are present at background levels (Figure 34). A peak in Taxodium (Figure 33, 20%) as well as in Sagittaria is seen in this zone. Nymphaea (Figure 33, 10%) and Nuphar (Figure 34, 5%) have peaks in this level as well.

Charcoal Results

The results for charcoal analysis for core PP7 are presented in figure 35. Concentration values for charcoal are relatively high at 55 cm (11076 fragments) and drop off toward 45 cm (5187 fragments). A peak in charcoal abundance is seen at 40 cm where the concentration of charcoal reaches its peak (13387 fragments).

The charcoal concentration drops to 5814 fragments at 30 cm. This is followed by a slight increase in concentration at 25 cm to (8949 fragments). Charcoal concentration values drop off from 20 cm (1820 fragments) to the top of the core (78 fragments).

The charcoal to pollen (C:P) ratio displays similar trends as the charcoal concentration values. An increase in charcoal is seen from 55 cm (165.3:1) to 40 cm (291:1). Between 40 and 30 cm, the percentage of pollen increases as the amount of charcoal decreases until a C:P ratio of 58.1:1 is reached at 30 cm.

A slight increase in charcoal is seen at 25 cm (92.7:1). This is followed by a decline in charcoal from
Figure 35: Charcoal results for core PP7.
25 cm to 15 cm. Above 15 cm, the values of charcoal are lower than the pollen values.
Discussion

Environmental Reconstruction

A buried soil horizon is believed to be present below 55 cm. This is the zone containing highly oxidized clay sediments where no pollen is preserved in the cores. Pollen is not preserved well in soil and is generally found in less abundance with increasing depth (Dimbleby 1961). A change from unmottled to mottled clay can be found at 55 cm in core PP5 (Figure 21) supports the interpretation that this is a buried soil horizon containing no preserved pollen. The implication is that the swamp was an exposed soil layer prior to European settlement, and a different hydrologic regime existed in the past.

Pollen zone 1 describes pre-European settlement forest cover. The forest before European occupation probably contained high amounts of Pinus, Carya, Quercus, and Magnolia trees with a moderate understory layer. These species are characteristic of pine-oak-hickory upland forest indicating very different hydrologic conditions than that of today.

Thomas et al. (1980:3) in their checklist of plants in West Carroll and surrounding parishes mentioned Poverty Point as preserving "a small area of upland mixed hardwood vegetation." The rest of the area is a vast expanse of bottomland hardwood forests making this vegetation community an unusual occurrence. The present-day community
surrounding Poverty Point could be interpreted as containing relics of the pre-European settlement community described in the pollen diagrams.

Fire was a common part of the landscape as suggested by the high charcoal concentration values and C:P ratios (Figure 35). The high abundance of pine can be attributed partly to the fire tolerance of this species.

European settlement and farming at the Poverty Point Plantation can be seen in Zone 2. Historical records show that farming occurred at Poverty Point in the mid-1800s. The farming is seen in the pollen diagrams as peaks for herbaceous pollen types. The date for this herbaceous pollen rise is approximately 1885 A.D. according to the Lead-210 chronology. The presence of cultigens in core PP5 at this level can be attributed to farming at the Poverty Point plantation.

*Zea mays* (corn) was also found by Sears (Ford and Webb 1958) at the site at a level which was not dated. This corroborates the finding of corn pollen in core PP5, suggesting presence of agriculture. A conversation with the park rangers confirmed that the Poverty Point plantation harvested cotton with some corn.

A general land survey map from 1843 shows farming around the Macon Ridge bluff. From field observations and some old maps and descriptions of the area, an active channel of Harlan Bayou was postulated to have cut through
the present-day swamp. This finding is confirmed by the land survey map. The old stream channel is noticeable when wading through the swamp today as a north-south trending depression.

Immediately before the peak agricultural period (Figure 35, 25 cm), a peak in both charcoal abundance and C:P ratio is seen in core PP7. This peak indicates the occurrence of the most frequent and severe fires immediately prior to the agricultural phase. Some fires may have been started through lightning strikes. A review of the land surveyors' notes from the 1830 survey indicates several freshly burnt areas surrounding Poverty Point. This peak, therefore, can be interpreted as European burning of the forest for agricultural purposes. This has been documented in other palynological studies (e.g., Foster et al. 1992).

Post-farming environmental conditions that occurred during the early part of this century can be seen in Zone 3. Before the swamp phase (Zone 4), a bottomland hardwood forest existed within the basin. The bottomland hardwood forest was characterized by the dominance of *Carya* and *Liquidambar* in both cores and the occurrence of *Salix* and *Fraxinus* in increased frequencies. The Mississippi River Alluvial Valley has been dominated by bottomland hardwood forests both currently and historically. Fire frequency
and severity was probably decreasing to background levels during this period.

The *Carya* pollen peak could suggest the existence of a nearby pecan (*Carya illionensis*) orchard. Native pecans typically grow in alluvial valleys. Louisiana is a center for commercial pecan orchards which can be found growing alongside cotton. Pecans were first grafted for cultivation during the Civil War and widespread orchards could be found a few decades later (Puls 1978).

Pecan pollen in an orchard is distributed by wind (i.e., anemophily) over distances of a half mile or more. Pollination occurs either early or late in the growing season depending on the variety of pecan tree (Puls 1978). A pecan orchard does not have to be immediately adjacent to the swamp for a large amount of *Carya* pollen to be deposited.

Modern conditions at the study site are shown in Zone 4. Wetland taxa rise sharply in this zone with *Sagittaria* and *Taxodium* being the dominant taxa. Small amounts of Gramineae and *Ambrosia*-type pollen reflect the open fields which presently occupy the ridges. The presence of hardwood pollen (*Liquidambar, Quercus*, and *Carya*) can be attributed to the mesic forest surrounding the swamp and the occurrence of hardwoods on Mound A (Figure 2). The charcoal record reveals that few, if any, fires occurred during this time.
The basal date for Zone 4 is around 1950. Due to the post-1940 date inferred from the Lead-210 chronology, the origin of the swamp cannot be attributed to the Poverty Point people of 3000 years ago.

Further evidence for Zone 4 reflecting the swamp phase can be found in the loss-on-ignition (LOI) diagrams. The peak organic content in the LOI diagram for core PP5 (Figure 25) occurs from 8 cm to the top with a small peak at 10 cm (the Carya rise). This peak agrees with the boundary for Zone 4 in the pollen diagrams (Figures 29-31). The organic section in the LOI diagram for core PP7 (Figure 26) is found between 12 cm and the top. A peak in organics occurs at 5 cm and 10 cm with a drop seen at 8 cm. The boundary for Zone 4 in core PP7 (Figures 32-34) can be found at 8 cm. The Carya peak can be seen in core PP7 at 10 cm (Figure 33).

Sedimentological data further support the interpretation of Zone 4 as the swamp phase. The organic section for core PP5 (Figure 21) can be found from approximately 8 cm to the top of the core. This section is the same zone as in the LOI diagram (Figure 25) and in the pollen data (Figures 29-31). For core PP7, the organic section in the stratigraphy (Figure 22) can be found from approximately 8 cm to the top. This section also corresponds with the pollen diagram (Figure 32-34) and the LOI diagram (Figure 26). This organic zone is also seen in
core PP8 (Figure 23, 8-top). In core PP7, a piece of bark was found lying horizontally from 8-12 cm in the core, below the swamp phase.

**Swamp Origins**

The pollen data, loss-on-ignition curves, and sedimentary records all indicate that the swamp phase did not occur for very long. Lead-210 results confirm that the swamp phase began less than 50 years ago. The first mechanism proposed for the swamp formation is drainage disruption in the surface water. This disruption could be a result of a hydrological change due to a number of causes.

A change in hydrology can be attributed to the addition or removal of weight at or near the land surface. The source for the surface water for the area is the underlying aquifers. A change in the aquifers will result in changes in surface water availability. If a lot of weight is removed from the ground surface, less pressure is applied to the aquifers. Less pressure to the aquifers will significantly affect surface water conditions. Water will pool up below the area of lesser pressure causing less water to be available to other areas.

Natural gas mining was extremely active in the 1930s at Poverty Point. The natural gas can be found below the surface, but above aquifers. The quantity of natural gas extracted from the ground may have lessened the amount of
weight on the aquifers. Because natural gas was extracted away from the study site, less water would have been available at the site.

Agricultural activities could have also disrupted water availability. Irrigation for crops causes changes in the surface water channels. The water source for irrigation on the Macon Ridge is the aquifers. The primary crop grown in the Macon Ridge is cotton which demands extremely large volumes of water for a successful harvest. Large amounts of water pumped out of the aquifer for irrigation may have disrupted water levels in the aquifer, disrupted surface water drainage, and caused channel silting.

Irrigation pumps are also used in natural gas mining. Natural gas mining is still occurring, but much less actively than in the 1930s and 1940s. Modern irrigation pumps which allow for huge quantities of water to be extracted began to occupy the area around 1950 or 1960. The only source of water to drive the pumps is, once again, the aquifer.

Hydrological changes, however, are not the only mechanism for the swamp formation. Hydrological changes could be linked to disruption by human activities. Both natural gas mining and water pumping may have induced subsidence in the area. Salt domes are present in north Louisiana near the site. Extraction of both salt and
natural gas in large quantities may create gaps below the land surface. This may have caused the surface to cave in or subside.

Saucier (1995) points out that the Mississippi River Valley is experiencing widespread erosion. Starting in the early 1800s, erosion and gulling in nearly all upland areas increased by many orders of magnitude due to land clearing for agriculture and timber. Saucier (1995: 71) comments that "it is reasonable to conclude that there has been as much erosion in the last 150 years as there was in the preceding several thousand years if not several tens of thousands of years." Erosion has been most severe in the loess areas, such as the one where Poverty Point is located.

Another possible clue to the mystery can be gleaned during our two field trips to the study site. On our first trip in October 1992, the swamp contained little open water. The soil was hard enough to support our weight. The rangers said that the swamp fills with water when it rains or floods in the spring, but dries out usually by the summer (Dennis LaBatt, pers. comm. 1994). Only a few spots in the southern end hold water year-round. From their description, Core PP5 may be located in one of these spots.

When we returned a year later, the swamp contained at least half a meter of water. A different vegetational community was seen during this visit than in the previous
visits. The rangers described their losing battle to the beavers since the previous spring (Dennis LaBatt, pers. comm 1994). The "deep water" swamp we cored in 1994 is different from the swamp of 1992 because of beaver activity.

Thus, another explanation for swamp formation is by beaver activity. Beavers were in the area before European settlement in nearly all aquatic areas (Naiman et al. 1988). Beavers cut down mature trees for use as food and building material. Dam-building has been shown to change annual stream discharge, decrease current velocity of streams, alter channel gradient, expand the flooded area, and increase the retention of sediment and organics (Naimen et al. 1988). Studies on beaver activities cite beavers as being able to create wetlands (Naimen et al. 1994, Smith et al. 1989). At the study site, a beaver dam could have led to the creation of the swamp and drastically changed the ecosystem.

In summary, three mechanisms for swamp formation are proposed: a disruption of surface water through hydrological changes, subsidence, or beaver activities. These three procedures are not mutually exclusive and might have worked together to cause swamp development.

The borrow pit hypothesis

The basin in which the modern swamp is found is not likely to be the fabled borrow pit that archaeologists
believe. If the Lead-210 date is extrapolated downward, it would place the age of the core bottom to be around A.D. 1400, a thousand years after the end of the Poverty Point culture.

The Poverty Point site naturally had many surface depressions up to a meter deep. Excavation from the mounds indicates that there is a half meter or more of fill before mound construction begins (Haag 1986). This leveling was necessary to obtain a level surface on which to build the complex. During the time of occupation, the basin could have easily been just another depression subject to periodic inundation by water, and possibly containing some sediments. In that case, the Poverty Point people could still have dug the depression. Either a few hundred or several thousand people could have built the mounds depending on the rate of construction. They could have dug until a hard gravel layer is reached and kept increasing the size of the excavation until all necessary fill was obtained. The digging of the builders could have altered the course of the river causing the stream to flow through the current swamp creating a different environment. Without a radiocarbon date from the base of the core, this scenario cannot be ruled out.

Another scenario is that the study site could have been an active channel of Harlan Bayou at the time of mound construction. The surveyors in 1830 found a stream running
through the channel. The course of Harlan Bayou since the 1843 land survey map has changed. Portions of it currently dissect some ridges. Beaver activity in combination with human activity could be the leading factor behind stream channel alteration. Aerial photographs taken in 1932 show an unchanging forest cover following the same path as the stream in the plat.

This can be interpreted as evidence that the stream was probably not altered until after the swamp had been formed. The age of the stream - whether it dates to Poverty Point times - is unknown. Gibson (1989) in his reconstructions of the mounds included the stream as following the course in the land survey map. Proof of this hypothesis, however, can not be accomplished on the basis of this thesis. The stream could have occupied the borrow pit created by the Poverty Point people, or it could have occupied a naturally occurring depression.
Conclusions

The main contribution of this thesis is solving the puzzle about the age of the swamp. Lead-210 dating has revealed that the swamp dates to the 1950s, much younger than most had speculated. No conclusive answer could be found on whether or not the basin in which the swamp formed is the fabled borrow pit. The basin was either a depression or an active stream channel at the time of occupation, but it probably contained some water during part of the year.

Due to the low abundance of organic matter in pre-swamp sediments, radiocarbon dating could not be used. Whether or not the bottom of the cores dates back to the Poverty Point period cannot conclusively be answered. Pollen preservation is too poor below 55 cm to assess the environmental impacts by the Poverty Point people. Further studies on other swamps or lakes in the area may provide answers to this question.

This study also provides a reconstruction of the pre-European settlement forest cover. Pollen analysis is successful in reconstructing the environmental impacts of European settlement, especially with regard to the Poverty Point Plantation. The results can be summarized below.

The pre-European settlement forest cover at the site was dominated by Pinus, Carya, Quercus, and Magnolia trees with a moderate understory. Fires were an important part
of the landscape at that time. This is reflected in the pollen diagrams as Zone 1.

European settlement occurred approximately around 1810 and is reflected in Zone 2. This includes the farming phase in the middle to late 1800s and is corroborated by historical records. Solanaceae and Zea mays pollen, both cultivars, were found in this zone. A charcoal peak immediately before this zone suggests the use of fire to clear land for agricultural purposes by European settlers.

The farm was abandoned before the turn of the century and the forest recovered in the line of Zone 3. The bottomland hardwood forest that developed was characterized by Carya and Liquidambar with increasing abundance of Salix and Fraxinus. A pecan grove may have been planted in the area around 1935.

The current swamp was formed around 1951 and is reflected by Zone 4. This is correlated by the loss-on-ignition diagrams and the sediment stratigraphies. Sagittaria and Taxodium are the dominant taxa in this zone and a mesic hardwood forest surrounded the site.

Most palynologists prefer lakes to swamps when choosing study sites. The Southeast, however, has a notable paucity of lakes. Rivers are poor for local studies due to the large amount of fluvially transported pollen input (Chmura and Liu 1990). Swamps are reducing environments that allow for good preservation of pollen in
high concentrations. Palynologists working in the Southeast should not exclude swamps and wetlands from possible coring locations due to concern about poor pollen preservation and low pollen concentrations.

A dendrochronological study on the numerous felled trees which litter the bottom of the swamp is needed. This could provide further age correlation as to the age of the swamp, its possible origins, and fire history of the area. Geochemical analysis of the cores, most notably core PP5, could also provide supplementary data on the environmental history of the site.

The search for answers to the subsistence and further information on the environmental resources at Poverty Point must continue. Other Poverty Point sites should be explored using palynological methods to reconstruct a regional environmental history. This thesis has solved the question of the antiquity of the swamp at the site and has provided information on the presettlement forest cover. The environmental impacts of European settlement at the study site are also documented. This thesis is one of a few palynological studies in the Lower Mississippi Valley region and one of a small number to document environmental changes during the historic period in the area.
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