To the Graduate Council:

I am submitting herewith a dissertation written by Michael William Ruddell entitled "Quaternary Vertebrate Paleoecology of the Central Mississippi Alluvial Valley: Implications for the Initial Human Occupation." I have examined the final copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Anthropology.

Walter Klippel, Major Professor

We have read this dissertation
and recommend its acceptance:

Accepted for the Council:

Associate Vice Chancellor and
Dean of The Graduate School

QUATERNARY VERTEBRATE PALEOECOLOGY OF THE CENTRAL MISSISSIPPI ALLUVIAL VALLEY: IMPLICATIONS FOR THE INITIAL HUMAN OCCUPATION

A Dissertation
Presented for the
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Michael W. Ruddell
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Dedication

To my wife Eileen, whose support and love made this all possible.

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Abstract

This study is based upon a Quaternary vertebrate assemblage from the Central Mississippi Alluvial Valley donated to the Memphis Pink Palace Museum, the Connaway Collection. A total of 2288 skeletal elements were analyzed. Of the 2288 analyzed, 1097 were identified minimally to the generic level. Significantly, 610 (NISP) of the elements identified were attributed to animals with a grazing or open grassland adaptation and 431 (NISP) adapted to a woodland or forest edge adaptation. Paleoecological analysis of this fauna along with nearby river valley assemblages, paleovegetetation, geomorphology and microvertebrates assemblages of the Midsouth were analyzed in an attempt to understand the environments of the initial colonization by humans. Subsistence of aboriginal peoples during the Paleoindian period in the southeastern United States has been interpreted as representative of a generalized subsistence strategy, with minimal hunting of extinct megafauna in a closed woodland environment. The reason for this perception is enhanced because of the lack of classic kill sites in the eastern United States. It is important to note that this interpretation is not based upon paleoenvironments of the major river valleys of the East. However, archaeological data collected indicate that the strongest concentration of Early Paleoindian diagnostics and raw lithic material are found in these river valleys, not in the regions between them. Only after the last megafauna extinction event (10,800 yr B. P.) is there evidence of the emergence of the sub-regional cultures and subsistence on an impoverished Holocene fauna. The fauna represented in the Connaway Collection is compatible with the high concentrations of fluted points found in this region and is indicative of a big game open range hunting strategy similar to

the Early Paleoindian of the western United States. The alluvial processes of the river valleys also explain the lack of *in situ* kill sites. A combination of rich mosaic grassland and mixed woodland adapted megafauna and rich sources of chert in the river valleys of the Midsouth likely attracted the earliest immigrants to the region.

Table of Contents

List of Tables

List of Figures

List of Plates

Chapter I

Introduction

Until relatively recently, there was no serious challenge to the Clovis first paradigm (Martin, 1973). In the past claims of archaeological evidence purporting "Pre-Clovis" as an indication of the initial peopling of the New World has been met with a great deal of criticism. In most instances, the critical appraisal of such evidence was well founded. However, the site of Monte Verde in southern Chile (Meltzer *et al.*, 1997) and the Cactus Hill Site in Faifax County, Virginia (Johnson, 1998) has compelled some archaeologists to consider that humans were in the New World potential 1,000 years before the earliest evidence for the Clovis culture in North America. The assumption that people have been in North America significantly longer than previously thought, provides an impetus for re-evaluation of the paleoenvironments relative to the archaeological record. This premise requires reconsideration of the paleoenvironmental record of the late Pleistocene period older than that of the Clovis Horizon.

In light of the revelations from South America, the eastern United States is a likely locality to provide potentially older evidence of human occupation. Recent comprehensive surveys of the occurrence of Paleoindian manifestation in the southeastern United States makes the region a logical place to search for such evidence. Early Paleoindian manifestations in the Southeast have been routinely described as isolated fluted point finds and sparse lithic scatters (Meltzer, 1984; Meltzer & Smith, 1986). However, the combined efforts of professional archaeologists in the Southeast has changed the manner in which the Early Paleoindian Period is viewed (Anderson & Sassaman, 1996; Anderson & Faught,

1998). Assemblages that compare similarly to other regions of North America in extent and diversity are being studied in the Southeast (Anderson, 1995*a*). This recent research in the southeastern United States has revived interest in the hypothesis that the manufacture of the fluted point originated in the eastern United States (Stanford, 1991). In particular, this theory is largely based upon the higher concentrations of Early Paleoindian artifacts recorded (Figure 1) in the East as opposed to the West (Faught *et al.*, 1994; Anderson & Faught, 1998).

This observation has been largely ignored because of the lack of a classic Clovis kill site has yet to be identified from the East. However, recent works by Faught (1996) and Faught and Anderson (1996) have used the high concentration of sites in the eastern North America to form a model of colonization and dispersal routes from the region. The spread of people during this period has been described as resembling a "leapfrog" mode of colonization, and that the major river valleys in the East served as staging areas for the spread of people (Anderson, 1991). This hypothesis is further supported by radiocarbon dates from Clovis sites. Intriguingly, Clovis dates are older in the South than the North and provide alternate hypotheses of the mode of colonization (Faught, 1996; Faught & Anderson, 1996). Thus, river valleys such as the Mississippi, Ohio and Tennessee may play an important role in the model in which the Southeast as well as distant sites such as Monte Verde, southern Chile and other portions of the New World were occupied. Thus, I postulate that the southeastern United States may potentially hold important clues for early human migrations.

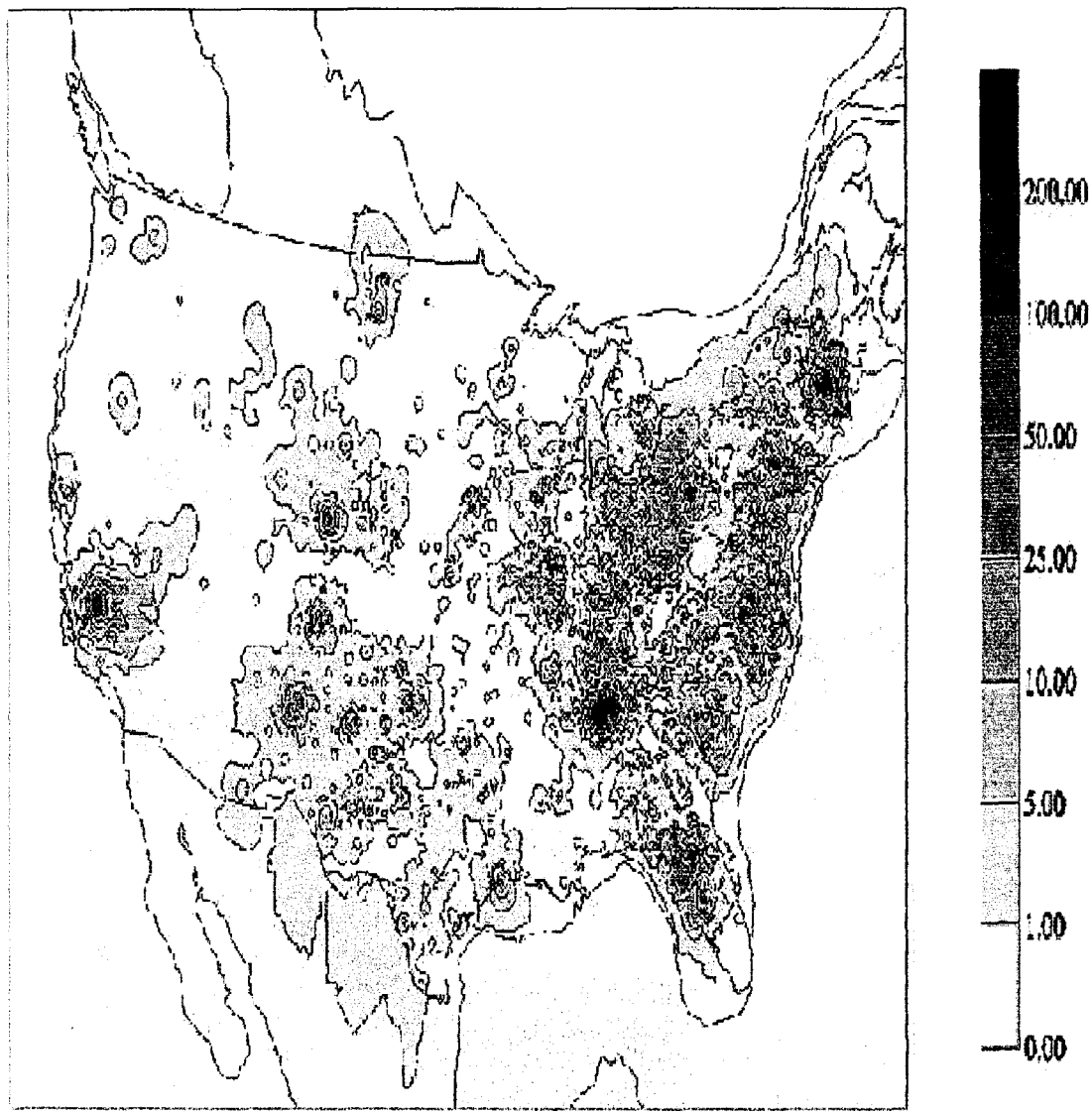

Figure 1. Concentrations of fluted points in the United States (from Anderson & Faught, 1998).

The geographic focus of my dissertation is the Central Mississippi Alluvial Valley (sensu Morse & Morse, 1983). The archaeology and late Quaternary geomorphology have been well studied. To date, only isolated finds of the extinct megafauna have been documented from this region (Hay, 1923, 1924; Morse & Morse, 1983). However, recently large collections of vertebrates (Connaway Collection) from the Central Valley were donated to the Memphis Pink Palace Museum, Memphis, Tennessee. This collection represents the collecting of vertebrate fossils by John Connaway, a professional archaeologist and amatuer paleontologist as well as other amatuer paleontologists for a span of approximately 20 years. Geographically the fossils were collected from southwestern Tennessee, southeastern Arkansas, and northwestern Mississippi from gravel bars of the Mississippi River (see Chapter 2). Analysis of these fossils provides new insights into natural history of the region and important implications for re-interpretation of the regional archaeology and paleoecology. Diverse megafauna dominated by grassland-adapted species may have attracted early human colonizers entering the region. My goal is to interpret the vertebrates identified from the Connaway Collection within the context of late Pleistocene environments and archaeology lines of evidence of the Central Mississippi Alluvial Valley. Consequentially, the aim of this undertaking is fourfold:

1. Prepare a systematic paleontology of the vertebrate fossils collections donated to the Memphis Pink Palace Museum as part of a broader understanding of the natural history for the Central Mississippi Valley;

2. Interpret the taphonomic nature of the fossil assemblages within the regional context of the late Quaternary geomorphology of the region and hypothesize the possibles of the original deposition of the fossils;
3. Integrate various lines of plant, micro-vertebrate and Pleistocene megafauna evidence for the late Quaternary paleoenvironmental reconstruction;
4. Evaluate the significance of the fauna in relationship to subsistence need for the initial human invaders of the region.

This work will emphasize an ecological anthropology approach. My goal is to access the paleoecological and archaeological significance of the vertebrates of this region by analyzing the Central Mississippi Valley as a dialectic macrocosm. The premise of ecological anthropology furnishes the theoretical foundation for the regional approach (Mandryk, 1995). An ecological approach utilizing a regional framework concentrates chiefly on the environmental setting in which human adaptation takes place. Hence, it is the ecosystem that provides a conceptual framework for interpreting human behavior (Butzer, 1982, 1991). Explicitly, an ecological anthropological paradigm requires a multidisciplinary approach. Only then, can the constraints of a given environment encountered by humans be rigorously examined. This sort of analysis seeks to determine the relationship of cause and effect in a culture's interaction with a given environment. This approach stems from the work of Julian Steward and Leslie White and their development of the ecological anthropology approach paradigm to aid in understanding cultural change (Steward, 1955; White, 1949). This approach allows an anthropologist to better understand the relationship

between human behavior and the resources available in a given environmental setting (Moran, 1979).

The use of an ecological anthropological approach becomes more complex when dealing with the highly unstable environments of the late Pleistocene. Archaeologists utilizing an ecological approach in the context of the late Pleistocene often ignore the spatio-temporal variability inherent for this period (Dincauze, 1996). The environments of the late glacial were dynamic and very unstable. It is likely that the human interaction with this highly variable environment was also very complex. Therefore, simple and broad explanations for the colonization of the New World likely fall short of being a valid interpretation of the subsistence practices of these early American cultures. For instance it is not sufficient to link the presence of a diverse megafauna in the Central Mississippi Valley to a big game hunting adaptation. Instead, this supposition requires multiple lines of evidence. The explanatory search for the initial human occupation of the region must stress the intricate components of causality. Looking for an individual analytical factor such as the presence of one variable oversimplifies the issues of human adaptation (Soffer, 1985).

In attempting a multivariate approach to causality requires that the variables examined be analyzed coincidentally. This leads to the philosophy of using an heterarchy of variables as a counter to the more common concept of hierarchy. The elemental usefulness of the concept of heterarchy lies in the attention it draws to the natural, and multifaceted dimensions in relation to the importance of elements that occur in dynamic systems, typical of the late Pleistocene (Mandryk, 1995). The debate on when and where humans first

entered the American continent demonstrates an example of the lack of an heterarchial approach.

There are differing explanations of how people arrived in the New World. Some researchers postulate that people arrived via a "ice free" corridor from Beringia and studied the potential for this route (Martin, 1973; Moisman & Martin, 1975; Mandryk, 1995, 1996; Burns, 1996). This methodological approach contends that "big game" hunters followed their prey to North America. Oppositely, some researchers have suggested a coastal route for the initial entry into the Americas (Gruhn, 1994; Fladmark, 1979, 1990). This method of colonization required that the first people had a maritime subsistence adaptation, and were not dependent upon terrestrial megafauna. It is not necessary to view either of these paradigms as necessarily exclusive of each other. My intention is to analyze the environment of the Central Mississippi Valley as it might have been upon the initial arrival by humans from any of several possible migration routes. I do not believe that it needs to be implicit that people followed a megafauna into the region, via the ice-free corridor as a single explanatory colonization model. All of the initial populations in the New World may not have had the same technology. Instead, a more logical approach from an ecological anthropology point of view would be to consider the context of the environment in which an interpretation is made. Since the first members of the genus *Homo* ventured out of Africa, they encountered many varied environments. Out of necessity the human species had to devise ways to cope with their new surroundings. For example, the widely used Achulean Tool Tradition of *Homo erectus* was not found in Java or Asia, and yet populations of these hominids thrived in the these regions for well over a million years (Rightmire, 1990). The

success of these hominids in Asia and Java represent an environmental adaptation to a region devoid of workable chert (Pope, 1989). This sort of scenario can apply to the initial peopling of the Americas. If a given group enters using a coastal route, versus another group that makes an inland migration, it would be expected to find differences in material culture based upon the environmental constraints. The people that first entered the Mississippi Valley may have originally entered via a coastal or possibly an inland route, but quickly adapted to resources available within the region.

Human behavior is adapted not to simply their occupation of an archaeological site but to the region (Willey & Phillips, 1958). It is dependent upon the landscape heterogeneity and mosaic. Because of this, the region in general is the appropriate unit of analysis. The environmental archaeological approach is an attempt to assign more significance to the significant lithic evidence for Paleoindians in the region (Gillam, 1995, 1996*a*, 1996*b*). Unlike the early Paleoindian sites typical of the Southwest and Plains of the United States, the early Paleoindian Period of the Southeast suffers from a geoarchaeological bias. The early occupation for the Eastern Woodlands instead appears to be mainly located in large alluvial valleys, where actions of the river would more than likely obscure or destroy *in situ* sites (Dunnel, 1990; Tankersley, 1998) similar to classic Clovis sites described by Haynes (1991). Because of these factors, a different approach must be taken to explain the earliest archaeology of the region in question. Therefore, this analysis shall focus on the physical environmental evidence for the Central Mississippi Valley as it relates to the material culture recovered. This endeavor has been undertaken to provide a more holistic view of the region

as it relates to the early archaeological record. The intent is to present an alternative hypothesis for the early human colonization of the region.

Chapter II

Methods and Materials

John Connaway, an archaeologist from Greenville, Mississippi has been collecting fossils on geomorphically recent gravel bars of the Mississippi River for the last two decades. He documented provenience on the fossils he collected. Although the specimens were collected on Holocene age deposits, approximately 90 % of the collection is Pleistocene in age. The collection of the fossils geographically provenience based upon river miles of the Mississippi River. The fossils were collected in Shelby County, Tennessee, Crittenden, Lee, Phillips, Desha, and Chilcot counties in Arkansas, Bolivar, Washington, Cohoma, Tunica, and Desoto Counties in Mississippi. Details on the exact provenience of individual fossils are also available at the Memphis Pink Palace Museum, Memphis, Tennessee. The collecting follows the southerly meandering behavior of the Mississippi River from southwestern Tennessee to southeastern Arkansas and to northwestern Mississippi. The vertebrate fossils I examined are part of the Connaway Collection, donated by Connaway and housed in the Memphis Pink Palace Museum in Memphis, Tennessee. John Connaway made a concentrated effort to prevent any bias in his collecting and for the other collectors that he advised. He accomplished this by collecting all types and sizes of skeletal material, no matter how fragmentary, in the chance that even the most fragmentary of remains might be identifiable. The last comprehensive analysis of the megafauna from the Northern and Southern Mississippi Valley was published in the 1920s (Hay, 1923, 1924). Because of this fact, the description and publication of this collection will have a great deal of value for both paleontologists and archaeologists studying the past environments of the area.

Several publications form a guide for the following analysis. The geological and hypothetical taphonomic context of the fossils has been recently published in treatises for the geomorphology of the Lower Mississippi Valley (Autin *et al.* 1991; Saucier, 1994). The systematic analysis of the collection used several sources for the taxonomic accuracy of this dissertation. Osteichthyes systematics utilized Etnier and Starnes (1993) and Carroll (1988). The taxonomy of amphibians and reptiles utilized Auffenberg (1963), Ernst and Barbour (1972), Mount (1975), Carroll (1988), Conant and Collins (1991), and Sobolik and Steele (1997). Systematics of Aves relied upon Peterson (1980) and Carroll (1988). For mammalian systematics I relied upon Kurten and Anderson (1980), Anderson (1984), and Carroll (1988). In some instances, taxonomies of various taxa have been revised. In those instances, I have attempted to use and document the appropriate and most current taxonomic terminology. NISP is the quantitative method utilized to measure the number of identified specimans per taxon (Grayson, 1984; Lyman, 1994).

Identification of the specimens of the collection was undertaken with a great deal of caution. While I tried to take my identifications to the lowest taxonomic category possible, it is my judgment that it is better to error in a conservative manner. Museum accession numbers and not taxonomic order organize the fauna list found in Appendix B. This has been done in this manner at the request of the Memphis Pink Palace Museum. Chapter 3, the description of the fauna does follow the Linnaean rules of systematic order. Comparative collections used to aid the identification include; the University of Tennessee Zooarchaeological Collection, the Memphis Pink Palace Zoological Department, the George C. Page Museum, the University of Arizona Vertebrate Paleontology Laboratory, the Field Museum of Natural History, and the

private Looper Collection. The natural and/or culturally modified caribou antler was submitted for AMS dating to Stafford Laboratories in Boulder, Colorado. Stafford laboratories prepared the sample and the date was obtained from the Livermore Laboratory in Livermore, California.

Chapter III

Description of the Fauna

Osteicthyes

Lepisosteidae (gars)

Two elements belonging to fish in the family Lepisosteidae were identified. An intermixture of pleisiomorphic and derived skeletal traits characterizes members of Lepisosteidae (Lacepede). Advanced features include an elongated snout, opisthocoeleus vertebra centra, teeth located on the infraorbital, and plicidentine teeth. Primitive features include a heterocercal tail fin, rhombic scales with peg and socket articulations, fulcral scales on median fins, and have ganoin on scales and dermal bone (Wiley, 1976; Wiley & Schultze, 1984). Probably two of the taxa of gars are represented in the Connaway Collection. A partial opercle of *Lepisosteus* sp. and a large vertebra centrum from *Atractosteus spatula* (alligator gar). One large vertebra centrum is referable to *A. spatula* because of its opisthocoeleus morphology and very large size. Although the opisthocoeleus vertebra centrum is an autapomorphic trait of the family Lepisosteidae, it is not a skeletal part that is useful for distinguishing different species of gars. Identification of the vertebra centrum as alligator gar is based upon the extremely large overall size of the specimen. Only the alligator gar reaches a size that is comparable to the Connaway Collection specimen (Etnier & Starnes, 1993). One fragmentary opercle represents the only other element ascribed to *Lepisosteus* sp. The fragmentary element has the typical raised surface with tubercular ornamentation of gar. Although articular surfaces are missing, the element is identified

as being an opercle because of the tubercular ornamentation that consists of a series of bumps and elongate ridges. This character is typical of both fossil and extant gars (Wiley, 1976). Fossil gars from the upper Cretaceous are essentially the same as modern gars (Carroll, 1988). There has been very little change for the past 70 million years. Members of the family Lepisosteidae range in geologic age from the upper Cretaceous to the present. Fossil gars are found in North America, South America, Africa, India, and Madagascar (Gottfried & Krause, 1998). Several living species of gar occur from the upper Midwest in eastern North America to Central America and the Caribbean.

Ictaluridae (catfishes)

One partial supraethmoid of a catfish was identified. The supraethmoid-ethmoid is an osteological element that clearly separates members of the family Ictaluridae. The genus *Pylodictis* (Rafinesque) has a short and wide supraethmoid-ethmoid complex, broadly branched cornua and a large but depthless median cleft (Calovich & Branson, 1964). The partial supraethmoid from this collection appears to be characteristic of *Pylodictis olivaris* (Paloumpis, 1964). The fossil has a broad and flattened stem, in contrast with members of the genus *Ictalurus* (Paloumpis, 1964). The broad and laterally flattened skull of *P. olivaris* is likely an adaptation to its preferred bottom dwelling habitat (Calovich & Branson, 1964). The flathead catfish is the largest documented for this family. Specimens of up to 100 pounds have been routinely reported caught by fisherman (Etnier & Starnes, 1993). The genus *Pylodictis* first appears in the Miocene of North America (Lundberg, 1975; Carroll,

1988). The distribution of this species is restricted to west of the Appalachian Mountain chain in the lower Great Lakes, Mississippi River Basin south to Louisiana, Mobile Bay drainage and into Mexico (Etnier & Starnes, 1993). Flatheads are mainly bottom dwellers and prefer waters of a low to moderate gradient (Page & Burr, 1991).

Scianidae (drums)

A total of two elements of the freshwater drum, *Aplodinotus grunniens* (Rafinesque), was identified in the collection. The elements include one maxilla fragment and a caudal vertebra centrum. The mandible fragment is toothless with only very tiny denticles on the occlusial surface. The freshwater drum is known from the Pliocene to the present (Carroll, 1988). It is restricted to freshwater environments in North America in its fossil and recent natural history. Drums are found in large rivers and lakes south from the Great Lakes, through the entire Mississippi River Basin to the Gulf Coast drainage, in the Mobile Basin south to Mexico, and less commonly in the Hudson Bay drainage and the St. Lawrence area (Etnier & Starnes, 1993; Page & Burr, 1991). They are generally common in bayous and swamps in the lower southern United States and prefer backwaters and sluggish ponds of large river swamps, bayous and lakes (Page & Burr, 1991).

Reptilia

Alligatoridae (alligators)

Two elements of the American alligator were identified from the collection, a dermal scute and a left femur. *Alligator mississipiensis* (Cuvier) is the largest reptile found in North America. It is separated from crocodiles by the presence of broad,

sharply sloped snout and a separated bony septum. Morphologically, the dermal scute recovered is large and compares favorably with *A. mississippiensis* in comparison to that of a crocodile or a caiman. Comparison of the dermal scute to a modern skeleton of an American alligator that measured 4.8 meters indicate that the fossil specimen came from an even larger individual. This is well out of the range and the speckled caiman and larger than the biggest recorded American crocodile (Conant & Collins, 1991). Similarly, the fossil femur also compares favorably with a recent alligator and came from an individual larger than the aforementioned 4.8 meters. While it is not know if these two elements came from the same individual, it can be stated with a reasonable degree of certainty that the fossil bones came from a creature larger than 4.8 meters. Indeed it is within the realm of possibility that the fossils came from a creature that might approach the modern record for an American alligator of 5.84 meters (Conant & Collins, 1991). Similar species found in North America include the American crocodile (*Crocodylus acutus*) and the speckled caiman (*Caiman crocodilus*). The crocodile and caiman are only found in southernmost Florida and islands south of Florida (Conant & Collins, 1991). The family Alligatoridae first appears in Upper Cretaceous and the genus *Alligator* first occurs in the Oligocene and continues until the Recent of North America (Carroll, 1988). The modern distribution of alligators ranges from the coast of North Carolina to eastern Texas (Conant & Collins, 1991). Alligators prefer large river swamps, lakes, bayous and marshes (Conant & Collins, 1991).

Chelydridae (snapping turtles)

Three scapula fragments from snapping turtles were identified. Two scapulae were those of *Chelydra serpentina* (Linnaeus), the snapping turtle, and one was from *Macroclemys temminckii* (Troost), the alligator snapping turtle. The skeletal criterion that separates *Chelydra* and *Macroclemys* was the overall size. The alligator snapping turtle generally reaches a larger size than the snapping turtle (Sobolik & Steele, 1996). The genus *Chelydra* is first known from the Oligocene and *Macroclemys* from the Miocene of North America (Carroll, 1988). Their preferred habitats include deep water lakes, rivers, canals and sometimes brackish waters (Ernst & Barbour, 1972; Holman & Andrews, 1994).

Emydidae (box and water turtles)

A total of seven elements of a pond turtle, *Chrysemys* sp. (Schoepff), were recovered. The materials include four partial plastrons, two partial carapaces, and one plueral. The taxonomic history of this group has been fraught with a great deal of contention and debate. The pond turtle is part of what is described as the *Chrysemys/Psedemys/Trachymys* division (Sobolik & Steele, 1996). Because of the difficulty in distinguishing the fragmentary elements of this group, the elements identified were be placed in the genus *Chrysemys* following the taxonomic classification set forth in Weaver and Rose (1967) and Zug (1966). The genus *Chrysemys* is first known from the Eocene of North America (Carroll, 1988). Their preferred habitats are freshwater lakes, ponds and areas of calm water with abundant vegetation (Ernst & Barbour, 1972).

One partial carapace and one partial plastron from the box turtle, *Terrapene* sp. (Linnaeus), have been identified. The two common box turtles that presently occur in the Central Mississippi Valley are *T. carolina* and *T. ornata*. The diagnostic skeletal character is the presence of a vertebral keel on *T. carolina* (Sobolik & Steele, 1996). Because of this the elements identified were only taken to the generic level. The genus *Terrapene* first occurs in the Pliocene of North America (Carroll, 1988; Ernst & Barbour, 1972). *Terepene carolina* prefers prairies, moist woodlands and open forested areas. *T. ornata* is found in habitats similar to *T. carolina*, but prefers prairies and grassland habitat (Sobolik & Steele, 1996).

Testudinidae (tortoises)

A total of 17 elements that can be ascribed to the giant extinct land tortoise, *Geochelone crassiscutata* (Leidy), was identified. The elements, although fragmentary, can be distinguished from the smaller extinct land tortoise from North America, *Geochelone incisa*, based upon the overall larger size of *G. crassiscutata* (Auffenberg, 1963). The genus *Geochelone* first occurs in North America in the Eocene and became extinct at the end of the Pleistocene (Carroll, 1988). The latest terminal date on *G. crassiscutata* comes from the Paleoindian Little Salt Spring site in Florida. This species has archaeological significance because of a date of 12,030 $\pm$ 200 yr B. P. obtained from a wooden stake found *in situ* of a Florida *G. crassiscutata* kill site (Clausen *et al.* 1979). The preferred habitat of the giant tortoise has been hypothesized to be similar to its living representative, the Aladabra Giant Tortoise,

Geochelone gigantea. *Geochelone crassiscutata*, like *G. gigantea*, have been hypothesized to be adapted to xerophytic habitats (Holman & Clausen, 1984).

Trionychidae (softshell turtles)

The softshell turtle is represented in the collection by seven partial plastrons and two carapace fragments of *Apalone spinifera*. This genus was formally known as *Trionyx*, but was changed to *Apalone* based upon biochemical analysis (Meylan, 1987). The plastrons of the genus *Apalone* display a raised surface ventrally, and have a multitude of pebble like bumps. The plastron fragments represented in the collection all display a raised ventral surface with pebble like bumps. Comparisons of the fossil material with both *A. spinifera* and *A. mutica* indicate a great deal of variation seems to occur on the textured ventral surface of the plastron. Morphological differences are distinct between species if all or most of the plastron is available. Because of this identification of the fossil plastron fragments was taken no further than the generic level. However, unlike *A. mutica*, *A. spinifera* has a dimpled carapace surface. Based upon this fact, the two carapace fragments were identifiable to the specific level (*A. spinifera*).

Both the Eastern (*A. spinifera spinifera*) and Western (*A. spinifera hartwegi*) spiny softshell turtles and the smooth softshell (*A. mutica*) are found in the Central Mississippi River Valley (Conant & Collins, 1991). The fossil plastron fragments identified in the collection may represent either the western or eastern species of spiny softshell turtle or the smooth softshell species of the genus *Apalone*. In addition, the Gulf Coast variant (*A. spinifera aspera*) cannot be ruled out. Although *A. s. apera*

presently found in the Lower Mississippi Valley, the occurrence of coastal adapted *Trichechus manatus* (Manatee) has been recovered from a similar context as the fossils in the Connaway Collection in the central valley (E. Manning unpublished manuscript on file, Memphis Pink Palace Museum). The family Trionychidae originates in the Cretaceous and continues into the Recent (Carroll, 1988). Fossil and modern forms can be found in Africa, Asia, Europe and North America. *Apalone spinifera* has a modern distribution in North America from western New York to northeastern New Mexico (Conant & Collins, 1991). Spiny softshell turtles occur in a variety of aquatic habitats. They are commonly found in rivers, creeks, lakes, and large ditches. They also prefer environments with sandy, silt bottoms (Graham *et al.* 1983). *Apalone mutica* has a range that includes much of central North America. The smooth softshells are found in the Ohio, Missouri and Mississippi rivers and their tributaries, which drain into the Gulf of Mexico. Their preferred habitats range from small streams to large rivers (Conant & Collins, 1991; Ernst & Barbour, 1972; Mount, 1975).

Aves

Phasianidae (grouse, quails and turkeys)

A single right tarsometatarsus from the turkey, *Meleagris gallopavo* (Linnaeus), was identified. Elements of the birds in the genus *Meleagris* (*Agriocharis*) have been identified from the upper Miocene to the Recent (Carroll, 1988). Turkeys occur in the southwestern and eastern United States and northern

Mexico. Their preferred habitats include wooded areas, mountain forests and wooded swamps (Peterson, 1980).

Ardeidae (wading birds)

A single left tibiotarsus of the great blue heron, *Ardea herodius* (Linnaeus), was recovered. The genus *Ardea* is first found in the middle Miocene of North America (Carroll, 1988). They are found from southern Canada to Mexico, and spend winters in North America and South America. The preferred habitats include marshes, swamps, shorelines, and tidal flats (Peterson, 1980).

Anatidae (ducks, geese and swans)

A single right humerus of the Canada goose, *Branta canadensis* (Linnaeus), was identified. Distribution of this species is highly dependent upon the season of the calendar year. The Canada goose has a North American range from Alaska, Canada and the northern United States, and some may winter as far south as Mexico (Peterson, 1980). Their preferred habitats include lakes, ponds, bogs, marshes, and open fields near bodies of water.

Mammalia

Edentata

Dasypodidae (armadillos)

A total of three elements have been identified and ascribed to the beautiful armadillo, *Dasypus bellus* (Simpson). Morphologically, the Pleistocene armadillo, *D. bellus* was osteologically identical to the modern nine banded armadillo, *Dasypus novemcinctus*. However, mature Pleistocene individuals were approximately twice as large (Anderson, 1984; Kurten & Anderson, 1980). *Dasypus bellus* is known from the

Blancan of Florida through the late Rancholabrean (Kurten & Anderson, 1980). Extinction of *D. bellus* occurred at the end of the Wisconsinan glacial period. It has been hypothesized that they were replaced by the nine-banded armadillo, *D. novemincinctus* (Auffenberg, 1957; Simpson, 1930; Slaughter, 1961). The Pleistocene distribution ranged from north central Texas to Florida. The species appears to be most abundant in Pleistocene sites in Florida (Kurten & Anderson, 1980). The genus *Dasypus* can currently be found from southern Kansas and Missouri to northern South America (Anderson, 1984). *Dasypus bellus* has demonstrated a trend toward a general size increase in Blancan through Rancholabrean age faunas (Kurten & Anderson, 1980). This supposition is primarily based upon specimens from Florida. In contrast to the size increase through time in Florida, specimens from other regions establish that *D. bellus* from late Pleistocene contexts were intermediate in size between the Florida *D. bellus* and *D. novemcinctus* (Guilday & McCrady, 1966; Klippel & Parmalee, 1984). The aforementioned statements were based upon the size of recovered dermal scutes. Although no dermal scutes are part of the Connaway Collection, the gross overall size of the three specimens identified may be more similar to late Pleistocene armadillos from Florida than other regions of the southeastern United States. The differences in size of the Florida and Mississippi Valley *D. bellus* may lie in the availability of food. Kurten and Anderson (1980) suggest that the limiting factor in the distribution of *D. bellus* was the availability of insect food. It is also likely that it might have been important in the overall size variability from region to region. The predominance of large herding animals for the

late Pleistocene of the Central Mississippi Valley as evidenced by the Connaway Collection may have provided an environment in which *D. bellus* was able to take advantage of the large insect populations found in association in areas dominated by large herd animals. A combination of the presence of open grazing areas as well as nearby forested regions may have provided an ideal environmental mosaic for *D. bellus* to exploit.

Megalonychidae (megalonychid ground sloths)

A total of 21 skeletal elements have been identified as those of Jefferson's Ground Sloth, *Megalonyx jeffersonii* (Desmarest). *Megalonyx jeffersonii* was named in honor of Thomas Jefferson who first attempted to describe its fragmentary remains by calling it "An animal of the clawed kind" (Kurten & Anderson, 1980). The genus *Megalonyx* has been recognized from the Pliocene, with *M. jeffersonii* being the largest and most recent chronologically. North American *M. jeffersonii* is significantly larger than *Northrotheriops* and a close second in overall size only to *Paramylodon harleni* (Anderson, 1984; Kurten & Anderson, 1980). The genus *Megalonyx* demonstrates an increase in size through the Pleistocene and provides evidence of a north/south size gradient, with some of the smallest specimens found in Florida (McDonald, 1977). The stratigraphic range of *M. jeffersonii* begins during the Illinoian through the terminal Wisconsinan (Kurten & Anderson, 1980). Paleogeographically it was cosmopolitan in the eastern North American woodlands, along the North American West Coast and has also been found in eastern Texas (Graham & Lundelius, 1994; Kurten & Anderson, 1980). It has been found primarily

in what has been traditionally interpreted as woodland and forest environments, and is in the minority compared to finds of *Paramylodon* and *Nothrotheriops* in sites that have been interpreted as being more open environments such as Ranch La Brea (Stock, 1925, 1956). *Megalonyx jeffersonii* is thought to have been adapted to a browsing mode of subsistence, and mainly ate leaves, twigs and possibly nuts (Anderson, 1984; Kurten & Anderson, 1980).

Megatheridae (megatherian ground sloths)

A single element of the small late Pleistocene ground sloth, *Nothrotheriops sp.* (Hoffstetter) was identified. This represents a very significant paleozoogeographical find. This specimen fills a geographical void in the distribution of *Nothrotheriops* between Florida and Texas (McDonald & Ruddell in press). The specimen consists of a braincase and is missing the rostral region. Two species of *Nothrotheriops* are currently known from North America, *N. shastensis* from the late Rancholabrean and *N. texanus* from the Irvingtonian and possibly the early Rancholabrean (McDonald, 1995). The earlier species is usually slightly more gracile than the later form. The two species are separated by morphometric differences in the length of the maxillary aveolar length relative to the pre-dental length, and in the comparative width of the pre-dental section of the maxilla. Because the maxillary portion of the skull is missing, the specimen cannot be assigned to either species with any confidence. The dimensions of the occipital region of the Mississippi skull was compared with that of skulls from Rancho La Brea, San Josecito Cave, Rampart Cave, Las Vegas Wash and the Leisley Shell Pit. The Mississippi skull falls within the range of *N. shastensis* and

N. texanus (McDonald & Ruddell in press). The diet and food preferences of the Shasta ground sloth has been well documented from caves in the Southwest where its dung has been preserved (Hansen, 1978; Laudermilk & Munz, 1934; Martin *et al.* 1961; Thompson *et al.* 1980). *Nothrotheriops shastensis* subsisted on a wide variety of xeric vegetation. The expansion of mesic vegetation has been hypothesized to be related to the disappearance *N. texanus* of the Irvingtonian of Florida (McDonald, 1995). Although, it cannot be determined which form of *Nothrotheriops* lived in Mississippi, it is important to note that there is a probability that a significant amount of xeric vegetation was available than has been postulated macroecologiclly for this region (Delcourt *et al.* 1997*b*).

Mylodontidae (mylodontid ground sloths)

Eight elements of Harlan's ground sloth, *Paramylodon harleni* (Owen) were identified. *Paramylodon* is distinguished from *Megalonyx* and *Nothrotheriops* by an overall larger size, dermal ossicles, lack of femoral third trochanter, broad flattened metatarsals, and lobate dentition. The limb bones are very robust, lumbar and sacral vertebrae are fused. *Paramylodon* is considered to have been a grassland adapted species and had a broad range in both the Irvingtonian and Rancholabrean of North America (Kurten & Anderson, 1980). Along with *Megalonyx*, *Paramylodon* may well have influenced the vegetation patterns of the environment in which they coexisted. Their large massive and powerful limbs and claws were likely used to defend themselves against predators (Kurten & Anderson, 1980) and clear areas of woody vegetation (Owen-Smith, 1987, 1988).

Carnivora

Mustelidae (weasals)

A single dentary of the river otter, *Lutra canadensis* (Schreber) was recovered. Although no teeth remained in this jaw, the posterior portion of the alveolus for the M/2 is partially found on the ascending ramus. The river otter first appears in the Irvingtonian (Kurten & Anderson, 1980). As is likely for the past, presently river otters can be found in waterways from Florida to Alaska. The only regions not habitable are those of extreme aridity.

Canidae (dogs, wolves and coyotes)

Five elements belonging to the genus *Canis* were identified. Of these, only one was identifiable with any confidence to the specific level. A single left mandible with full dentition can be referred to *Canis familiaris* (Linnaeus). The mandible displays characteristics of a shortened muzzle and more gracile dentition typical of the domestic dog (Olsen, 1985). The mandible is curved ventro-medially and the premolar and molars are crowded. The right mandible identified only to *Canis sp.* lacks dentition and, although it is gracile, it lacks the ventro-medial curve diagnostic of *C. familiaris*. Because of the lack of teeth and ventro-medial curve, there is a possibility that the element might have been from a small coyote (*Canis latrans*). Postcranial elements were from a small canid and were too small for the large extinct dire wolf (*Canis dirus*) or the gray wolf (*Canis lupus*). The postcranial material was too fragmentary to allow separation between *C. familiaris* and *C. latrans* as well. The genus *Canis* dates from Blancan to the Recent (Anderson, 1984; Kurten & Anderson,

1980). The small wolves of Asia (*Canis lupus chanco*) have been proposed to represent the taxonomic group from which the domestic dog originated, and the process may have began as early as the middle Pleistocene with their association with *Homo erectus* (Olsen & Olsen, 1977; Olsen, 1985). However, Clutton-Brock (1984) demonstrated that the origin of the domestic dog may have came from several different subspecies of *C. lupus*. The supposedly earliest evidence of the domestic dog in North America comes from Jaguar Cave, Idaho (10,370± 350 B. P.) (Anderson, 1984; Kurten & Anderson, 1980; Lawrence, 1968; Olsen, 1985). However, reanalysis of this date utilizing AMS dating has revealed a much younger 2,000 to 3,000 year age for the specimen (Gowlett *et al.* 1987). A date of 12,000 years ago for domestic dog comes from the Natufian of Israel (Davis & Valla, 1978; Morey, 1990). Presently, the earliest accepted North American date for *C. familiaris* is 8,000 to 9,000 years ago in the Great Basin region of North America (Grayson, 1988).

Ursidae (bears)

Two elements of the giant short face bear *Arctodus sp.* (Leidy) and 11 elements of the American black bear *Ursus americanus* (Pallas) were identified. I will first discuss the short face bear and its significance. The genus *Arctodus* is separated from *Tremarctos* by its larger and higher crowned premolars and molars as well as larger and more powerful canines (Kurten & Anderson, 1980). Differentiation of *Arctodus* from members of the subfamily Ursinae is the presence of a double masseteric fossa on the mandible, an accessory cusp on the lower first molar at the junction of the triginoid and talinoid (Kurten & Anderson, 1980). Overall size is also

commonly used to distinguish short-faced bears from the extant ursids of North America. The length of the snout, a more gracile dention, more diminutive post-cranial material, paleozoogeographic data has been used to separate *A. pristinus* from *A. simus* (Guilday, 1971; Kurten, 1967; Kurten & Anderson, 1980; Richards *et al.* 1996; Webb, 1974). In the case of the Connaway *Arctodus* specimans, the right distal humerus lacks an entepicondular foramen typical of felids, although it has been found in a small percentage of ursids. Prominent crests on the lower potion of the humerus indicate a heavily muscled animal. The femoral head extends above the greater trochanter in height. The femur head is enormous proportionally to the shaft of the element and has a large fovea. Both elements demonstrate gross overall size and robusticity above of the range of *Ursus americanus*. In addition, in comparison with *Ursus arctos* size again indicates the two elements can be ascribed to the genus *Arctodus*. While *U. arctos* limbs are long and can fall in the lower range of *A. pristinus*, they are much more gracile. The genus *Arctodus* is known from the Pleistocene of North America Irvingtonian and Rancholabrean and South America. Its fossils have been described in deposits dating from the Irvingtonian Land Mammal Age to late Rancholabrean Land Mammal Age (Kurten & Anderson, 1980; Anderson, 1984). *Arctodus simus* has been a fairly commonly in western North America Rancholabrean contexts, and apparently extended its range east of the Mississippi River. However, it is not thought to have occupied the extreme southeastern United States; this region had been occupied by *A. pristinus* since the middle Irvingtonian (Richards *et al.* 1996). The species has only a sparse late Wisconsinan record

(Graham & Lundelius, 1994). The Central Mississippi River Valley was likely an area of sympatry for *A. simus* and *A. pristinus*. I have examined the cast of a nearly complete left mandible from *A. simus* collected from a gravel bar in Desha County, Arkansas. In addition to overall larger size, the specimen can be distinguished from *A. pristinus* by the presence of very broad and crowded tooth row. Based upon current paleozoogeographic data, the presence of *A. pristinus* may represent an expansion for the taxon's western distribution. The lack of overlap between the two species of *Arctodus* has been theorized. The theory suggests that *A. pristinus* was adapted to a more closed woodland environment similar to *Ursus americanus* and that *A. simus* preferred a more open habitat (Richards *et al.* 1996). This view is supported by the relative longer limb bone lengths *of A. simus* and secondarily the sympatry of *A. pristinus* and *U. americanus* and the sympatry of *A. simus* and *U. arctos*. Further support of this hypothesis stems from the likelihood that competition of the extant ursids may have been one of the mitigating factors leading to the eventual extinction of both species of *Arctodus* (Kurten & Anderson, 1980).

Ursus americanus (black bear) differs from *Ursus arctos* (grizzly or brown bear) in its smaller size and certain occlusial tooth patterns. However, it is important to note that black bears demonstrate a size increase for the Wisconsinan and a subsequent size decrease beginning in the Holocene (Kurten & Anderson, 1980; Graham, 1991). The anterior premolars of *U. americanus* tend to be less reduced in comparison to *U. arctos*. The second upper molar (M2), has been the most reliable osteological criterion for separating the two North American ursids. The M2 is widest

anteriorly for *U. arctos* and medially for *U. americanus* (Hoffmeister, 1986). Both mandibles identified demonstrate more molarization of the premolars in comparison to that of *U. arctos*. Based upon size and degree of fossilization of one right mandilble (Memphis Pink Palace Museum, 1995-22.7) likely is Wisconsinan in age, while another right mandible (Memphis Pink Palace Museum, 1995-7.666) may be from the Holocene. Unfortunately no upper teeth were recovered, so, the more reliable measurement of the M2 was unavailable for this study. This hypothesis also applies to the right ulna (Memphis Pink Palace Museum, 1995-40.29). It is large in contrast to modern *U. americanus*, but small for *U. arctos* and appears to be fossilized. The remainder of the referred post-cranial material is well within the range of modern black bear and lacks evidence of similar degree of fossilization and is likely recent in age. *Ursus americanus* range stratigraphically from the Irvingtonian to the present and it is the most common bear represented in the Quaternary deposits of North America. It demonstrates a very cosmopolitan distribution from Alaska to Florida. The small sample representative of *U. americanus* in the collection somewhat supports the widely held supposition that Wisconsinan age specimens tended to be larger than those Holocene in age. In addition, the evidence change in black bear morphology during the transition of glacial climates to the modern regime supports the already abundant evidence of dramatic climate changes. Unlike the short-faced bear *Arctodus*, the black bear was able to adapt to the dynamically changing environment and avoided extinction.

Felidae (cats)

Three elements of the extinct American lion, *Panthera leo atrox* (Leidy), were identified. They include a left mandible with dentition, a left carnassial (P4), and right distal humerus. The American lion is differentiated from other Nearctic felids based upon overall size, long slender limb bones, and dental and mandible morphology. Only the Eurasian cave lions, *Panthers leo fossilis* and *Panthers leo spelaea* (Kurten & Anderson, 1980) rival the tremendous size of the American lion. In North America *P. l. atrox* is first known from the Sangamonian and became extinct in the late Wisconsinan (Harington, 1971). The lion was a far ranging animal during the Pleistocene. It ranged from Africa to Eurasia, North America and South America. It may have been the broadest ranging wild land mammal of any time (Graham *et al.* 1996; Kurten & Anderson, 1980). Although it had a very wide distribution in the Pleistocene, from the Sangamonian to its extinction, it appears to have been restricted to open country (Anderson, 1984). It has been hypothesized that its restriction to open environments can be traced to the early supposition that the Nearctic lions hunted in prides similar to the extant African lion (Merriam & Stock, 1932).

Rodentia

Sciuridae (squirrels)

A single left tibia was identified from an immature ground hog, *Marmota monax* (Linnaeus). The genus *Marmota* extends back to the Miocene Clarendonian Land Mammal Age in North America (Kurten & Anderson, 1980). *Marmota monax* is known from Rancholabrean to the Recent. The groundhog or woodchuck is mainly

found in the eastern half of North America and as far south as Alabama. It is, however, found from Labrador to central Alaska. It prefers open woods, brushy, rocky areas and clearings with available soil for burrowing. It is diurnal and feeds on succulants and in northern lattitudes hibernates from October to February (Guilday *et al.* 1969*b*).

Castoridae (beavers)

A total of six elements of the extinct giant beaver *Castoroides ohioensis* (Foster) the giant beaver were recovered. They include three incisors, a left lower molar, and a left tibia. *Castoroides ohioensis* was the largest rodent ever to occupy North America. It reached a size comparable to a black bear (Kurten & Anderson, 1980). The giant beaver is noted for its unique incisors. The species had huge convex incisors with enamel on the anterior and labial outward aspect with longitudinal fluting. The tips of the incisors are blunt and circular in comparison to the distinct rectilinear border found in the modern beaver, *Castor canadensis*. The cheek teeth contain flattened tubes of enamel that envelop dentine, which are held together with cement (Kurten & Anderson, 1980). *Castoroides ohioensis* first appears in the Upper Pliocene and becomes extinct in the late Wisconsinan of North America (Carroll, 1988). Although it has been found in fossil deposits from Alaska to Florida, it appears to be the most abundant in the region immediately south of the Great Lakes (Kurten & Anderson, 1980). *Castoorides ohioensis* was thought to inhabit primarily lakes, ponds and swamp areas. Habitat preference has been hypothesized to be similar to the muskrat *Ondatra zibethica* rather than *Castor* (Anderson, 1984; Kurten & Anderson,

1980). It is possibly important to note that *O. zibethicus* also can be found in slow moving streams as well (Sealander & Heidt, 1990) and is not necessarily a ideal model for the habitat preferences of the giant beaver. The cause of extinction of the giant beaver is thought to be the loss of its preferred habitat and competition with *C. canadensis* (Saunders, 1977).

Two elements of the extant beaver *Castor canadensis* (Kuhl) were identified. They include a right lower molar and a right femur. *Castor canadensis* was a very wide ranging, and common species during the Pleistocene of North America. Fossil dams of beavers have been identified in several Quaternary age localities and have been regarded as a potential taphonomic agent for disturbing pollen stratigraphy (Kaye, 1962). *Castor canadensis* first appears in the Lower Pliocene of North America (Carroll, 1988). During the Pleistocene, beavers were cosmopolitan in much of the waterways of North America. It was apparently abundant in Florida, which is presently out of its modern range (Kurten & Anderson, 1980). Other than humans, beavers modify their environment to suit their needs more than any other mammal in North America. As previously mentioned *C. ohioensis* habitat preferences were thought to be more similar to *O. zibethica* than *C. canadensis*. However, it should be noted that like the modern beaver, the giant beaver also felled trees (Anderson, 1984) and likely was a significant modifier of the environment. Because of this it presumably had a greater impact on the environment due to its enormous size.

Lagomorpha

Leporidae (hares and rabbits)

A single left proximal femur of the eastern cottontail rabbit, *Sylvilagus floridanus* (Allen), was identified. The element was placed in *S. floridanus* after comparison with *Sylvilagus aquaticus*. In comparison with the larger *S. aquaticus* and hares (*Lepus* sp.), the element in question appears to be within the size range of *S. floridanus*. *Sylvilagus* is known from the late Blancan and *S. floridanus* from the late Irvingtonian (Kurten & Anderson, 1980). The eastern cottontail has the largest geographic distribution of any species of *Sylvilagus*. They are found from the Canadian Life zone to southern Tropical Life zone.

Perissodactyla

Equidae (horses)

A total of 245 elements of the horse, *Equus* sp. (Linnaeus), was identified. Of the 245 elements, 148 represent isolated teeth. The taxonomy of Pleistocene equids has been complicated by the naming of new species of *Equus* based upon dention that has a high degree of ontogenetic variability (Davenport *et al.* n.d.). There have been 58 different species of *Equus* named during the last two centuries (McFadden, 1992), but this number now has been greatly reduced as a result of detailed comparative morphological studies (Churcher & Richardson, 1978; Dalquest, 1978). The number now stands at five taxa based upon morphometric analysis (Winnans, 1989). Unfortunately, this method falls short for good comparative analysis because of overlap in the measurements of the five species proposed, based upon only

morphometric criteria (Scott, 1997). Because of the environmental focus as opposed to a strict taxonomic used for this endeavor, no attempt has been made to take the equid material past the generic level. On a general level, there appears to generally be two sizes of horses represented in the collection, but it is not clear whether this represents sexual differences or inter-specific variation. In addition, small percentages (<5 %) of the elements identified as *Equus* are likely very recent modern equids. This determination is based upon the complete lack of fossilization and molar morphology.

The genus *Equus* first appears in the early Blancan and is well dated at 3.5 million years ago at the Hagerman Horse Quarry in Idaho (McFadden, 1992). *Equus simplicidens* from the early Blancan was likely derived from the Hemphilian *Dinohippus* (Dalquest, 1978). The well documented evolution of the hypsodont teeth of horses places them in a class of obligate grazers. This process began with a cooling and drying of worldwide climates during the Miocene, ending with the late Wisconsinan (Webb, 1977).

Tapiridae (tapirs)

A total of 11 elements of large tapir, *Tapirus haysii* (Leidy), has been identified. They include six right mandibles with teeth, five left mandibles with teeth, an occiput, and one left distal tibia. *Tapirus haysii* was the largest tapir of the Pleistocene of North America. Ray and Sanders (1984) subsumed all the large tapirs of the Pleistocene age under this taxon. The upper second premolar demonstrates progressive molarization. The upper first molar is exceptionally large transversely, and has significant development of the protocone and has a heavily ridged basin as

described by Simpson (1945). *Tapirus haysii* is separated from *Tapirus veroensis* by only two dental apomorphies, but are problematic because of intraspecific variation and inadequate sample sizes (Hulbert, 1995). Lower dentition materials are ascribed to *T. haysii* based on large size alone (Ray & Sanders, 1984). The genus *Tapirus* is first known from the Miocene of China (Dawson & Krishtalka, 1984). *Tapirus haysii* ranges from the late Blancan to the late Rancholabrean of North America (Kurten & Anderson, 1980). However, in Florida, *T. haysii* has thought to be found only in the Irvingtonian (Hulbert, 1995). Hulbert (1995) suggests that the Rancholabrean age large tapirs were found only in the western United States. They can only be tentatively placed in *T. haysii* until western forms are compared with eastern forms. Jefferson (1989) has suggested that the western forms be placed in separate taxon, *Tapirus merriami*. Hulbert (1995) has suggested the possibility that *T. haysii* and *T. veroensis* may represent a chronocline of a single polytypic species as their geographic and chronological distributions fail to intersect.

A single left partial mandible of *T. veroensis* (Sellards), the Vero tapir, was the only smaller example of tapir identified. The extinct Vero tapir, *T. veroensis* was slightly larger than the extant Neotropical *Tapirus terrestris* (Kurten & Anderson, 1980), but significantly smaller than *T. haysii* (Ray & Sanders, 1984). In addition to the size difference, the extant tapirs are separated from *T. veroensis* by multiple characteristics of the skull (Lundelius & Slaughter, 1976; Ray & Sanders, 1984; Sellards, 1918; Simpson, 1945). Mandibles and lower dentition of *T. veroensis* are separated from *T. haysii* based upon the relative size differences previously noted. The

geological age of *T. veroensis* is thought to be mainly late Pleistocene with some possibility of occurring in the Middle Pleistocene (Ray & Sanders, 1984). It appears to be restricted to mainly to eastern North America, except for some isolated finds in Missouri and Texas (Ray & Sanders, 1984). The preservation of the specimen is excellent. Identification of the smaller Pleistocene tapir is based upon size alone. None of the more diagnostic cranial material was recovered. As previously mentioned, the identification of *T. veroensis* is solely based upon a significant smaller size in comparison to *T. haysii*. On the surface, using size alone to distinguish between species appears to be tenuous, but at the present, it is the only method available. The dentition of the two species is quite similar, with size being the only means of determining specific identification. This lack of discriminating dental characteristic may be explained by the evolutionary conservatism seen in the fossil record of tapirs (Radinsky, 1965). Or, as previously noted, it is possible that it represents a chronocline of a single polytipic species.

Based upon their brachydont teeth and the habitats of their living relatives, extinct tapirs have been hypothesized to have been browsers and fed upon soft semi-aquatic vegetation (Kurten & Anderson, 1980).

Artiodactyla

Tayassuidae (peccaries)

A single complete right mandible of *Mylohyus fossilis* (Leidy), the long-nosed peccary, was identified. This report follows the taxonomic paradigm that places the long nosed peccary in a single species. In the past *M. fossilis* had an eastern

distribution and *M. nasutus* had a western distribution in North America. It is more likely that the differences represent geographical and sexual variation and therefore should be subsumed under the taxon *M. fossilis* (Ray, 1967; Westgate & Messick, 1985; Wright, 1995). Based upon the laws of taxonomic priority, *M. fossilis* (Leidy 1860) has priority over *Mylohyus nasutus* (Leidy 1869). *Mylohyus fossilis* is distinguished from the flat-headed peccary of the Pleistocene of eastern North America, *Platygonus compressus*, by its long slender snout, mandible, and limbs (Kurten & Anderson, 1980). *Myohylus fossilis* also appears to be both behaviorally and ecologically different from *P. compressus*. The long- nosed peccary was the size of a small white-tailed deer, and similarly cursorial (Anderson, 1984; Kurten & Anderson, 1980). The long-nosed peccary was thought to be solitary, based upon the fact that their remains tend to be isolated finds in caves, while the flat nosed peccary is often found in groups in the fossil record (Anderson, 1984; Kurten & Anderson, 1980). Although no flat-headed peccary were identified from this collection, an entire herd of peccaries became a part of the fossil record because of a catastrophic flood in a nearby tributary of the Mississippi River in western Kentucky (Finch *et al.* 1972). *Mylohyus* and *Platygonus* were ecological equivalents of the domestic pig, *Sus scrofa* and competition with *U. americanus* may have a partial explanation for their eventual extinction (Lundelius, 1960). Because of the cursorial nature of *M. fossilis*, it has been hypothesized to have preferred open areas and forest edges (Kurten & Anderson, 1980). This could indicate that *the M. fossilis* might have been in competition with *Odocoileus virginianus* as well as *U. americanus*.

Suidae (pigs)

A total of five elements of *Sus scrofa* (Linnaeus), the domestic pig, was identified. The very recent domestic pig skeletal element found with a principally Pleistocene fauna represents an interesting taphonomic phenomenon. This fact is further complicated by the fact that one of the jaws is partially fossilized on the ventral border of the corpus of the mandible, and yet other portions of the element look very recent. The suid specimens in the collection cannot be more than 500 years old as pigs were not introduced until the arrival of Spanish explorers in 1500 A. D. (Anderson, 1984).

Cervidae (deer)

A total of four antlers was identified as white-tailed deer, *Odocoileus virginianus* (Zimmerman). A total of 322 antler sections, cranial and postcranial elements of *Odocoileus* (Rafinesque) was identified. Only the four of the aforementioned antler sections retained enough of the original tines that are diagnostic of *O. virginianus*. The first tine off the main antler beam is single and forward curving in *O. virginianus*, while it is bifurcated and shows repeated dichotomous branching in the black-tailed deer, *Odocoileus hemionus* (Olsen, 1964). In all probability most *Odocoileus* material is *O. virginianus* based upon both past and present zoogeographical data (Graham & Lundelius, 1994; Hall, 1981; Olsen, 1964). Summaries of the fossil and recent zoogeographical distribution of the two osteologically similar cervids indicate that the range of the black tail deer was and is a considerable distance west of the Central Mississippi Valley (Graham & Lundelius,

1994; Hall, 1981; Olsen, 1964). However, the author examined one antler specimen, and it had a bifurcated first tine branching from the main beam, a characteristic of *O. hemionus*. In addition, another collection from this region was examined and an unknown observer (E. Manning, unpublished manuscript on file, Memphis Pink Palace Museum), and tentatively identified an element of *O. hemionus*. However, I would argue that this specimen couldn't be placed in that taxon. It does not display the bifurcation of the first beam consistent with *O. heminous*, but simply consists of a skullcap and two pedicles. Because of these conditions, all non-diagnostic skeletal elements have been place in the taxonomic category of *Odocoileus* sp. Three antlers from John Connaway's private identified and were either naturally or culturally modified. The modifications observed were consistant with similar antler material from the Eva Site of Tennessee (Lewis & Lewis, 1961).

Odocoileus first appears in the late Blancan or lower Pleistocene (Carroll, 1988; Kurten & Anderson, 1980). *O. virginianus* generally inhabits woodlands, forest edges, and stream edges (Kurten & Anderson, 1980). *Odocoileus hemionus* also inhabits woodlands, but usually occurs in more open and broken terrain (Kurten & Anderson, 1980).

A total of four partial antlers of caribou, *Rangifer* sp. (Linnaeus), was identified. In addition, a cranium with pedicles was recovered and appears to be either an aberrant or a new species form of caribou (see Appendix A, Plate 7). Caribou are the only members of the family Cervidae in which both sexes have antlers. Antlers of females and sub-adults are smaller and thinner, and in many taphonomic contexts are

less likely to be recovered (Kurten & Anderson, 1980). Of the specimens identified, three were gracile and likely from either sub-adult males or females. A male partial antler from John Connaway's private collection demonstrates modification by either natural or cultural means. The antler fragment is braod and flattened in comparison with antlers from *Odocoileus* and *Cervus*. Because I was only able to give the specimen a brief exam, it could not be unequivocally determined whether or not the antler was modified by humans or by natural means. The Memphis pink Palace obtained an AMS date on the specimen of 7,200 yr B.P. (see Appendix D). This date also raises the question of the possibility the antler may have come from an abberant form of *Odocoileus* or *Cervus.*

Caribou have been commonly recovered from northeastern North American Paleoindian sites (Meltzer, 1984, 1988; Meltzer & Smith, 1986). This is an uncommon find in the Central Mississippi Valley and has potentially important archaeological and zoogeographic implications for the late Quaternary of the region. *Rangifer* was first known from the Irvingtonian of the Alaskan Cape Deceit fauna (Anderson. 1984; Kurten & Anderson, 1980). Rancholabrean records of caribou are numerous southeast of the Great Lakes some as far south as Alabama and South Carolina (Churcher *et al.* 1989; McDonald *et al.* 1996). However, the Mississippi Valley modified specimen represents the southernmost cultural find of this species. Presences of caribou well south of the ice sheets have been used to indicate cooler climates (Kurten & Anderson, 1980). In some of the southeastern localities, it has been hypothesized that the nearness of the periglacial environments of the

Appalachian Mountains provided the necessary paleoenvironmental evidence for the presence of caribou well south of the ice sheets (McDonald *et al.* 1996). The lack of periglacial environments in the way of mountain chains in the Mississippi Valley provides an impetus for further paleoecological reinterpretation for the region.

A single left metatarsal of the stag moose, *Cervalces* cf. *scotti* (Lydekker) was tentatively identified. *Cervalces* cf. *scotti* is proportionally slightly larger than the largest modern cervid, the moose, *Alces alces*, of the Pleistocene of North America (Janis, 1990). Antlers provide the most diagnostic taxonomic character and are the only method for separating the two species of the *Cervalces*, *C. scotti* and *C. latifrons* (Churcher & Pinsof, 1988). Recovery of postcranial material only makes the identification of these taxa much more tenuous. Comparison of the fossil material with both modern wapiti, *Cervus elephas*, eliminated one of the other two large North American cervids. Fragmentary postcranial material of *Cervalces* is difficult to differentiate from *Alces* (Kurten & Anderson, 1980). The left metatarsal is placed in *C.* cf. *scotti* provisionally because of the perceived geographic separation of the two species of *Cervalces* and *Alces* (Graham & Lundelius, 1994). *Cervalces scotti* has a relatively broad Wisconsinan distribution in the eastern United States (Churcher & Pinsof, 1988). The Central Mississippi Valley find of *Cervalces* may be its southernmost occurrence. Peccary Cave in northwest Arkansas was previously the most southern locality for *Cervalces* (Quinn, 1972). *Cervalces* is restricted to the Rancholabrean of North America and likely the early Wisconsinan with one controversial specimen possibly Kansan in age (Churcher & Pinsof, 1988). It has been

hypothesized to have been an inhabitant of muskegs, similar to *A. alces* and its remains are commonly found in bog deposits in the Northeast (Kurten & Anderson, 1980). Competition with *A. alces* may have led to its eventual extinction (Anderson, 1984). Alternatively, McDonald (1994) has suggested that *C. scotti* was in competition with and had similar habitat preferences to *Cervus elaphus* as opposed to *A. alces.*

A total of 10 elements of wapiti, *Cervus elephus* (Linnaeus), was identified. This species is commonly known as the red deer in Europe. In 1777, Eexleben named the North American elk or wapiti *Cervus canadensis*, but it is generally regarded as being the same species as the European red deer (Kurten & Anderson, 1980). North American species all tend to be large. Males have antlers with brow and bez tines and generally three additive tines (Kurten & Anderson, 1980). Because of the rules of taxonomic priority, the material identified in this report will use the name *C. elaphus.* They range in size from larger than *Odocoileus* to slightly smaller than *Cervalces.* Males have short to relatively long beamed antlers that orient obliquely backward, upward and somewhat laterally. The tines number from three to more than 10, and are rounded in cross section with some minimal uppermost flattening, but not to the degree as seen in *Rangifer.* Postcranial elements are easily separated from even the largest deer by their significantly larger size, but fragmentary remains are problematic in comparison with the somewhat larger *Cervalces* in Pleistocene age contexts. *Cervus elephus* is known from the Villafranchian in Europe and the Irvingtonian in North America (Kurten & Anderson, 1980). Habitat preference is similar to

Odocoileus in that they usually are found in both woodlands and forests and feed upon bark, twigs, herbs and grasses. They have a late Pleistocene distribution that virtually mirrors their modern distribution (Graham & Lundelius, 1994). Remains of wapiti have been found in numerous archaeological and paleontological sites in the Holocene, but are not as numerous as *Odocoileus* (Anderson, 1984).

Bovidae (bison, muskox and relatives)

One partial occipital region of the skull of the domestic sheep, *Ovis aries* (Linnaeus), was identified. As with the few elements of *S. scrofa* and *Equus*, this find represents a very recent deposition of skeletal material, with no evidence of fossilization in this specimen.

A total of 19 elements of the muskox, *Bootherium bombifrons* (Harlan), was identified. They include three skulls with horn cores, one horn core, two molars, one left metatarsal, one cervical vertebra, and 10 thoracic vertebrae. *Bootherium bombifrons* at this time represents the largest Pleistocene species of muskox. Proportions of *B. bombifrons* are relatively longer, heavier limbed, and craniocaudally shorter than *Ovibos* and *Praeovibos* (McDonald & Ray, 1989). The skull of *B. bombifrons* is extended and deep, the dorsal bisection of the cranium is narrow in comparison to the ventral half, and has orbits that have limited protrusion. *Bootherium bombifrons* demonstrates strong sexual dimorphism which is reflected in not only relative size but in the diagnostic morphology of their horn cores. Males have horn cores that are longer, curve downward, and have horn core sheaths that extend over the dorsal surface that fuse at the midline of the cranium. A deep median

groove divides the basioccipital region where the two horn cores meet dorsally. Females have relatively shorter horn cores with little downward deflection, minimal extension of base on the dorsal surface of the cranium and are generally very gracile in comparison to males. *Bootherium bombifrons* ranges chronologically from the late Irvingtonian to the late Rancholabrean (Anderson, 1984; Kurten & Anderson, 1980). Extinction occurred at the end of the Wisconsinan glaciation (Mead & Meltzer, 1984; Meltzer & Mead, 1985). The three genera of musk oxen (*Bootherium*, *Ovibos*, and *Praeovibos*) are recognized for the Quaternary in North America and are Holarctic in their distribution. However, only *Bootherium* is from the Nearctic (McDonald & Ray, 1989). As previously mentioned, *B. bombifrons* has been recognized as having a significant degree of sexual dimorphism. Until recently, males of this taxon were placed in the taxon *Symbos cavifrons*. McDonald and Ray (1989) determined that three of the Quaternary taxa, *Symbos*, *Bootherium*, and *Gidleya*, represented minute variation and sexual dimorphic differences of one taxon. The rules of taxonomic priority resulted in designating *B. bombifrons* as the only valid Nearctic taxonomic species. The taxonomic problems associated with the fossil North American muskox can be traced to a taphonomic bias. The males of the species are much more robust, and therefore, their remains were more likely to be preserved. There have been a greater number of male *B. bombifrons* identified in comparison to females (McDonald & Ray, 1989). This fact supports the theory that a taphonomic bias led to multiple species of Quaternary muskox.

Male examples of *Bootherium* first appear in the late Irvingtonian, while females not until the late Rancholabrean (Anderson, 1984; Kurten & Anderson, 1980). This is apparently a size and preservation based chronological/taphonomic bias. The paleoecology of *B. bombifrons* has been somewhat misinterpreted because of the common name of *Symbos cavifrons*, the "woodland muskox". *Symbos* was thought to have inhabited open plains and woodlands and to be adapted to warmer climates than the extant *Ovibos moschatus* (Anderson, 1980; Kurten & Anderson 1980). However, Guthrie (1992) analyzed the botanical remains extracted from the teeth of *Bootherium* and found that they mainly fed on xeric upland grasses and, secondarily on woody plants.

A total of seven skeletal elements of the giant long-horned bison of North America, *Bison latifrons* (Harlan), has been identified. This includes four horn cores, one distal left radius, one left distal humerus, and one left metatarsal. Eleven elements of *Bison bison antiquus* (Leidy) were identified. These include one complete skull with horn cores, five partial skulls with horn cores and five horn cores. Three elements of *Bison bison occidentalis* (Lucas) were identified. These include one partial skull with horn core and two horn cores. Four elements of *Bison bison bison* (Linnaeus) were identified. These include three skulls with horn cores and one partial skull with horn core. A total of 274 elements identifiable as *Bison* sp. were recovered. Because of the lack of diagnostic elements, osteological landmarks and sexual dimorphism, these elements were not taken beyond the generic level. Skeletal elements of *Bison* are second in number only to *Odocoileus* in the collection. Their

extremely long horn cores and large size characterize *B. latifrons*. Other species are distinguished by what are at times subtle differences in horn core morphology (McDonald, 1981). There is a great deal of sexual dimorphism with this species as well as other species of *Bison*. The most reliable method for identifying differences at the specific level is based upon the horn core shape. Bison taxonomy has been almost as controversial as that of *Equus* for the Pleistocene. The taxonomic classification proposed by Skinner and Kaisen (1947) indicates a punctuated equilibrium tempo and mode (Eldridge & Gould, 1972) of bison evolution in North America (McDonald, 1981). The idea that bison evolved in a punctuated mode is a logical paradigm when placed in the context of environments of the Wisconsinan and early Holocene. McDonald (1981) argues that whether you accept that bison changed morphologically, either gradually or rapidly, it was due to changing environments. The dynamically changing environments of the Quaternay created ecological and/or behavioral gaps between species. Because of this, bison should be differentiated at the species level, not subspecies. In contrast, Wilson (1974*a*, 1974*b*, 1980) has suggested that late Pleistocene and Holocene bison represent a form of clinal variability and that they should be regarded as conspecific. Late Quaternary bison probably underwent interbreeding (McDonald, 1981) or genetic swamping and competition with *B. b. antiquus* more than likely led to the extinction of *B. latifrons* (Anderson, 1984). Bison demonstrate a trend toward size reduction from the late Pleistocene to the relatively recent past. This was true of other megafauna during the late Pleistocene (Guthrie, 1984). The major difference was that bison survived into the Holocene. Bennett

(1990) has theorized that the cyclical nature of climate change during the Quaternary served to give the impression that evolutionary change was punctuated in nature. The variation seen in late Pleistocene through mid-Holocene bison may well be an excellent example of these phenomena.

The genus *Bison* first appears in the Rancholabrean with some possibly earlier, but unequivocal finds have been reported in North America (Woodburne, 1987). *Bison latifrons* was most prevalent during the Sangamonian, but survived into the late Wisconsinan in the western United States (Kurten & Anderson, 1980). As previously mentioned, it has been debated as to whether subspecies such as *B. b. antiquus* or *B. b. occidentalis* became extinct or are an example of gradual evolution to the present *B. b. bison* and *B. b. athabascae* (woodland bison). An ecological explanation may well resolve this issue, but in favor of a gradulaistic approach as opposed to the punctuated theory. Bison in North America are best known from the short grass Midwestern Plains and have been described as an obligate grazer found in open plains, exceptions being *B. b. athabascae* and the European *Bison bonasus* (Anderson, 1984). The forms identified in the Mississippi Valley are, however, similar to the Great Plains forms. The occupation and eventual extirpation of bison in the Mississippi Valley are likely related to late Quaternary environmental change.

A total of 66 elements of the domestic cow, *Bos sp.* (Linnaeus) was identified. The lone North American Pleistocene representative of this genus *Bos grunniens* from Alaska may not be a valid taxonomic category. An osteological difference in the morphology of the maxilla of *B. grunniens* has been used to return the Yak to its

original taxonomy, *Poephagus grunniens* (Olsen, 1991). Postcranial elements were separated from possibly very recent bison and cow following Lawrence (1951) and Olsen (1960) as well as comparative collections. Because of this, it can be concluded that the genus *Bos* in North America is a very recent occupant first introduced by the early Spanish explorers. Therefore, no fossil record exists for this genus in North America. The skeletal elements identified showed no signs of fossilization and are likely the result of natural deaths on local farms. There also were some longbone elements that had modern saw marks as well. The genus *Bos* chronologically ranges from as old as the early Rancholabrean to the Recent (Kurten & Anderson 1980). It's distribution includes the continents of Asia, Africa, Europe and North America (Carroll 1988).

Proboscidea

Mammutidae (mastodonts)

A total of 49 elements of the American mastodon, *Mammut americanum* (Kerr) was identified. The mastodon is a more heavily built animal in comparison with the other dominant proboscidean of North America, the mammoth. The name mastodon comes from the description of their mastodon or nipple-toothed molars. The cheek teeth have very large cusps that oppose each other and have deep cavities in between. Tusks are present in both sexes, with those of males being larger. Tusks are generally less curved than those of mammoths. Also, the skull is larger and more flattened in comparison with the mammoth. Postcranial differences between the two proboscideans are characterized by the heavier limb bones of mastodon (Olsen, 1972).

The genus *Mammut* first occurs in the upper Miocene of North America (Carroll, 1988; Kurten & Anderson, 1980). *Mammut americanum* ranged from Alaska to Florida during the Blancan to the end of the Wisconsinan when it became extinct. It appears to have been most numerous in the eastern woodlands of North America (Kurten & Anderson, 1980). Mastodons have been hypothesized to have been obligate browsers with a preferred habitat of open spruce woodlands and spruce forests (Anderson, 1984; Kurten & Anderson, 1980). Recent investigations by the Aucilla River Prehistory Project yielded the stomach contents of a well-preserved mastodon (Webb, 1998). As many as 12 species of dicots were recovered from the animal's digesta. This appears to support the contention that *M. americanum* was primarily a browser.

Elephantidae (elephants and mammoths)

A total of 10 elements of *Mammuthus sp.* (Blumenbach) was identified. Post-cranial skeletal elements were distinguished from *M. americanum* based upon Olsen (1972) and comparative skeletal material. Partial dental material lacking sufficient occlusial surfaces were taken only to the generic level. Two relatively complete molars of the Columbian mammoth, *Mammuthus columbi* (Falconer), were identified. Molars of mammoths demonstrate a phyletic trend toward more complex occlusial surfaces through time. The Columbian mammoth molars have numerous plates on each tooth, a decrease in the medio-distal diameter of the plates, decreased spacing of the plates, a thin enamel of the tooth plates, and a prominent height compared to width difference. *Mammuthus columbi* appears to be a progressive member of this genus in

North America, second only to *Mammuthus primigenius* (Maglio, 1973). However, it has been argued that *Mammuthus jeffersonii* is more progressive and that *M columbi* is considered by some to be intermediate between *Mammuthus imperator* and *M. jeffersonii* (Kurten & Anderson, 1980; Osborne, 1942). Maglio (1973) considers *M. jeffersonii* and *M. columbi* to be essentially conspecific, and this nomenclature is adapted for this report. The chronological ages for the progressive complex change in the occlusial surface of mammoths are supported by absolute dating techniques (Agenbroad, 1984).

Mammuthus first appears in North America 1.8 million years ago during the upper Matuyama chron, and is a key species for the Irvingtonian Land Mammal Age (Lindsey *et al.*1975; Woodburne, 1987). *Mammuthus columbi* inhabited the environments well south of the ice sheets and *M. primigenius* the periglacial environments closer to the ice sheets (Agenbroad, 1984). The habitat preference of mammoths are best known from the stomach contents preserved of the tundra adapted *M. primigenius* which fed mainly on grasses and tundra plants (Anderson, 1984). The diet of *M. columbi* also appears to be dominated by graminoids based upon the recovery of dung boluses from Bechan Cave and Cowboy Cave in Utah (Davis *et al.* 1984; Jennings, 1980).

Chapter IV

Geologic and Taphonomic Context

Fossils of Quaternary age and older have been found on modern gravel bars on stretches of the Mississippi River (Figure 2) in southeastern Arkansas, southwestern Tennessee and northwestern Mississippi (Morse & Morse, 1983). Saucier (1994) has produced a detailed overview of the alluvial history of the Mississippi River south of Cairo, Illinois for the last 2.5 million years. The geomorphological mapping set forth in Autin et al. (1991) and Saucier (1994) forms the basis for the following interpretation of the geological and taphonomic context of the vertebrate fossil assemblages.

The specimens were collected (detailed location information is on file at the memphis Pink Palace Museum, Memphis, Tennessee) on Stage 1 meander belts of the Mississippi River in Tennessee, Arkansas, and Mississippi along the Mississippi River southeast of the Eastern Lowlands. Stage 1 meander belts reflect Mississippi River positions over the past 2,000 years of erosion over its easternmost valley wall, the Blufflands (Figure 3). The original thanatocoenoses (paleocommunities) for the majority of the fossils in the Connaway Collection likely lies in the Pleistocene-age sediments within the meander belts northwest of the collecting locality. The most probable source for the fossils lies in the Quaternary braided-stream sands of the Eastern Lowlands east of the Crowley's Ridge interfluve. The Mississippi River initially diverted through the Bell City-Oran Gap to the Western lowlands and Eastern Lowlands circa 16,000 yr B.P. during the late Wisconsinan (Royall *et al.* 1991). The

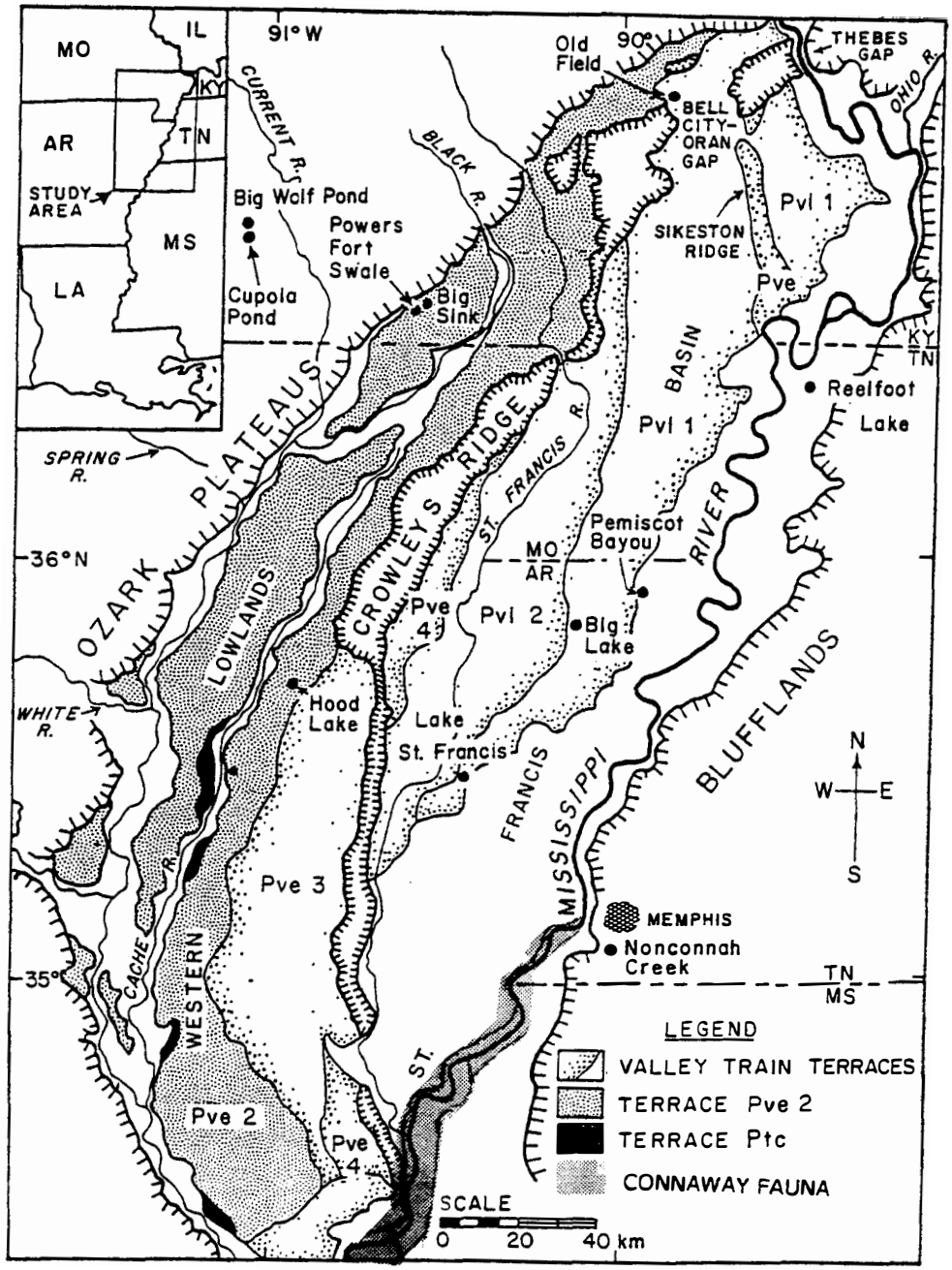

Figure 2. Location map of Quaternary deposits, plant paleoecological sites and vertebrate localities from the northern Blufflands, the Ozark Plateau, and the Western and Eastern Lowlands of the Central Mississippi Valley (adapted from Delcourt and Delcourt, 1997*b*).

final diversion circa 10,000 yr B.P. through Thebes Gap facilitated the merging of the Mississippi and Ohio Rivers and the hydrological shift from a braided to a meandering regime in the easternmost valley. Holocene meandering eroded into two braided stream terraces (Pvl 2 and 1), intrusive into Level 2 and 1 interfluve deposits and relict channels of Late Wisconsinan valley trains. The Late Wisconsin valley trains overlie buried deposits of even older braided-streamsands and gravels deposited during the Early Wisconsinan. These valley trains deposits represent episodic glacial outwash. The age of the Late Wisconsin valley trains range from the Woodfordian (18,000 to 9,500 yr B. P.) and the Late Sangamonian, Early and Middle Wisconsinan (130,000 to 30,000 B. P.). The valley trains remained active until at least 10,890 $\pm$ 130 yr B.P. based upon an AMS date associated with the fossil remains of paleollama (*Paleollama mirifica*) recovered in channel fill deposits between Crowleys Ridge and Sikestown Ridge (Delcourt *et al.* 1997*b*; Graham, 1990). The last braided-stream influx of sediments formed the Charleston Alluvial Fan east of Sikeston Ridge circa 10,000 to 9,500 yr B.P. (Guccione *et al.* 1988; Delcourt *et al.* 1997a). The loess mantled interfluve of blufflands such as Crowleys Ridge northwest of the collection area are also likely an original a point of origin for many of the specimens. *In situ* specimens of *Mammut* and *Mammuthus* have been discovered in blue-black carbonaceous clay under the thick Peoria loess on Crowleys Ridge (Morse & Morse, 1983; Saucier, 1994). The Peoria loess is the uppermost and youngest loess deposit in Crowleys Ridge (Guccione *et al.* 1988). The age of the Peoria loess is late Wisconsinan circa 23,000 to 12,000 yr B.P. (Mirecki & Miller, 1994; Rutledge *et al.* 1996). The Prairie

Complex deposits also lie northwest of the gravel bars where the fossils were collected. The Prairie Complex consists principally of undifferentiated backswamp and levee deposits in this region. The Prairie Terrace Complex (Pve 4) contains two depositional episodes, a younger Early and Middle Wisconsinan allostratigraphic "package" of sediments that overlie older late Illinoian and Sangamonia-age deposits (Autin *et al.* 1991; Saucier, 1994).

The taphonomic history of the fossils of the Connaway Collection is very complex. As Efremov (1940) noted that passage from the biosphere to the lithosphere occurs as a result of many interlaced geological and biological phenomena. Vertebrate remains have been found in three types of sedimentary environments, Crowleys Ridge loess deposits of eolian silt, backswamp deposits of fluviatle silt and clay, and valley train channel fill of fluviatile sands and gravels (Brister *et al.* 1981; Morse & Morse, 1983; Graham, 1990; Saucier, 1994). The enormous variety of river regimes and climatological variability during the late Quaternary in the Mississippi Alluvial Valley greatly affect possible interpretations of where and how the fossils were originally deposited (Schumm & Brackenridge, 1987). The fossil faunas reworked into gravel bars represent a taphonomic reversal of sorts. The meandering behavior of the Mississippi River dislodges the fossil materials from Pleistocene and Holocene sediments and redeposits them onto Late Holocene gravel bars. Because of this, the original conditions in which the bones were deposited can only be speculated based upon the physical condition of the specimens. In other words, fossil bone specimens that demonstrate mechanical fracture and abrasion during stream transport are

interpreted as being an allochthonous assemblage (removed from original place of deposition, sensu Lyman, 1994). All specimens of the Connaway Collection are reworked and transported some unknown distance. Many skeletal elements are heavily permineralized and darkened with bone replaced and supplemented with hematite mineral. Other skeletal materials recovered in the region either appear to be a medium brown or a medium tan in color. The blackened fossils with a high degree of mineral replacement are interpreted to have originally been deposited in backswamp deposits, medium tan specimens were probably initially deposited in loess deposits. Most of the specimens of the Connaway Collection show minimal wear, indicating limited fluvial transport, weathering and carnivore damage (Ruddell *et al.* 1997). I consider the post-depositional and damage to many of the fossils was due to portions exposed to the elements during the syndiagenic phase (early burial) and associated with fluvial redeposition of the fossil. In rare instances, some fossils demonstrate transport damage when the bone was fresh. Because of apparent pebble impact, a small number of elements demonstrate damage channel-bottom transportation. Therefore it appears that the damage seen on much of the material presumably occurred on permineralized bone and took place during redeposition. Most identifiable elements were initially recycled from low-energy depositional environments that inflicted minimal syndiagenic phase damage of uplands (later buried by loess) and swampy swales of backswamps (Figure 3).

The fossil materials were dredged up from two types of autochthonous thanatocoenoses (a fossil's life habitat or living community, sensu Lyman, 1994) and

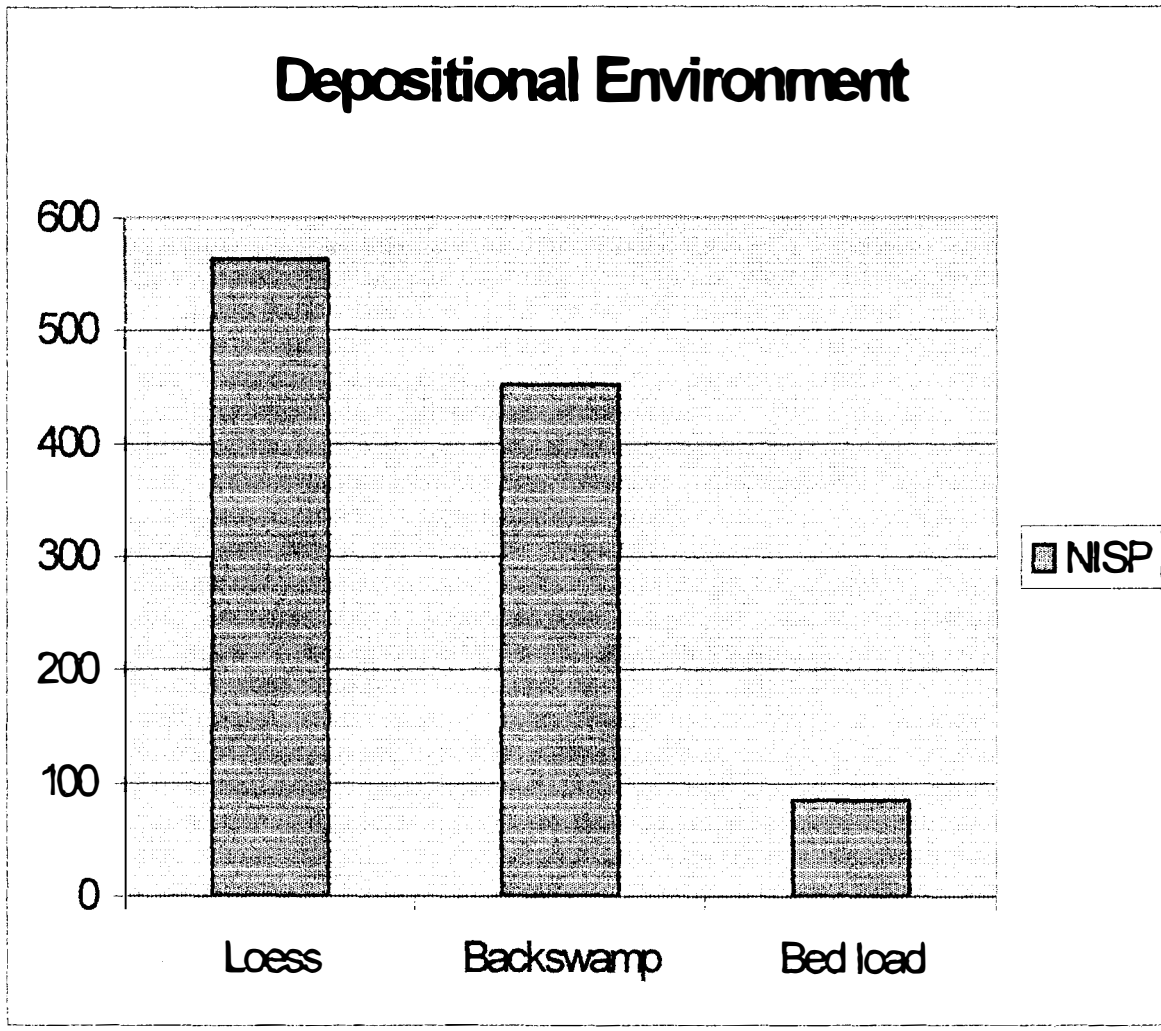

Figure 3 Hypothesized primary depositional regime for the vertebrate remains in the Connaway Collection.

one type of allochthonous taphofacies (multiple modes of deposition, sensu Lyman, 1994). Deposition in either loess-mantled uplands or backswamp indicated by the type of mineral replacement reflected in the color of the specimens. Burial in backswamp deposits meets the criteria of a low energy depositional environment and rapid burial within the original life habitat. Materials originally deposited in loess generally acquire a light tan to medium brown color. Peoria loess from Crowleys Ridge ranges in color from a medium to dark yellowish brown (Miller *et al.* 1986; Rutledge *et al.* 1996; West *et al.* 1980) which is consistent with many fossils in the Connaway Collection. It appears that elements originally deposited in loess were buried rapidly facilitating the excellent bone preservation and lack of postmortem damage. In contrast, fossils found in valley channel fill were likely subject to depositional damage due to the high-energy nature of the braided stream regime in which they were deposited. Postmortem damage on identifiable specimens range from 1 to 4 (Figure 4) in the rating system developed Behrensmeyer (1978). In this system, a rating of 1 to 4 represents minimal (a rating of 1) to a significant amount (a rating of 4) of arial weathering based upon actualistic studies (Behrensmeyer, 1978). Even the reworked bone elements subjected to channel bed load, show very little aerial weathering.

The general condition of the fossil bone lead to several tentative taphonomic conclusions. First, the original depositional environment can be inferred based upon the general condition and color of the bone, or type of mineral replacement. Second, complete burial of the identified skeletal elements took place shortly after death.

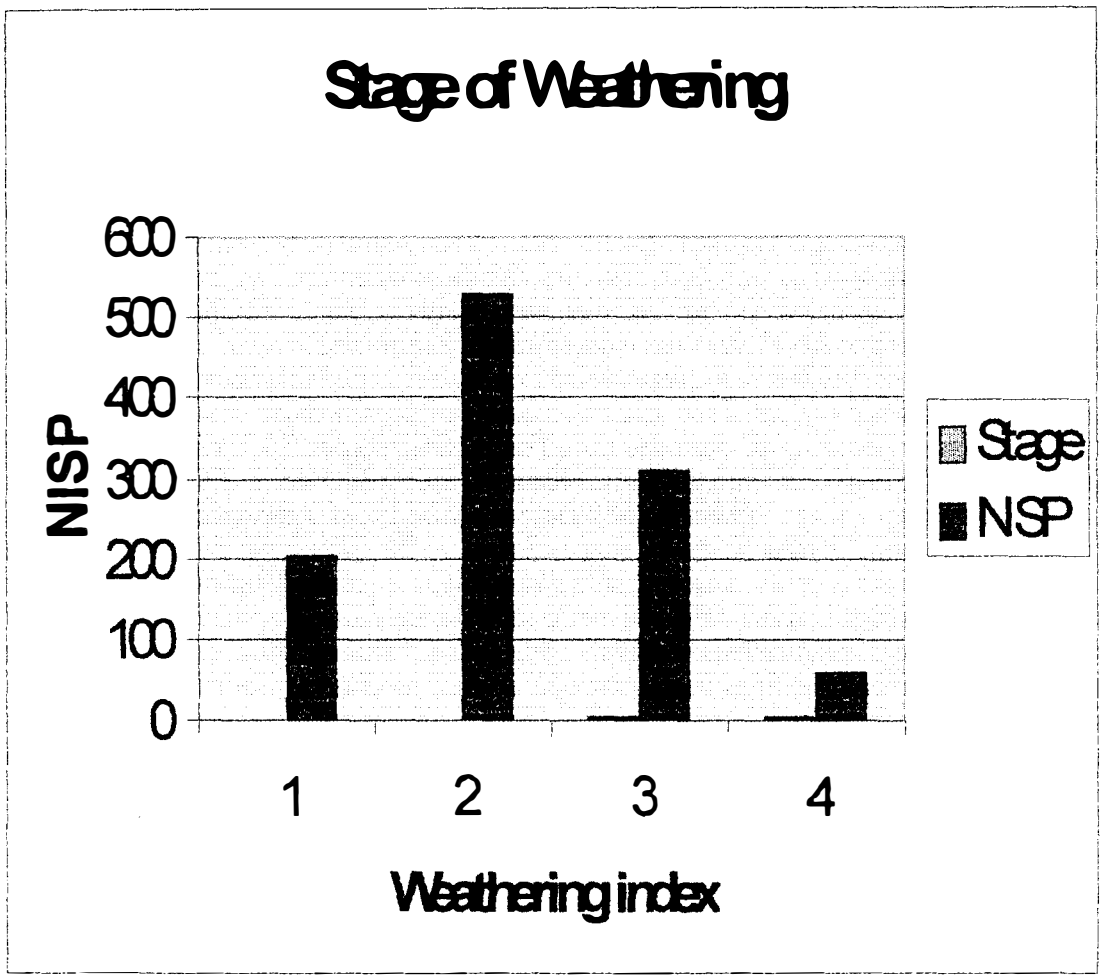

Figure 4. Degree of weathering of fossils identified from the Connaway Collection (After Behrensmeyer, 1978).

Thirdly, secondary depositions on late Holocene gravel bars were from relatively short distances because of the general lack of damage to the fossils. The spectrum of vertebrate taxa identified reflects the ecological diversity of the paleoenvironments, in which they once lived and died. However, it must also be concluded that the Connaway Collection mainly represents the larger members of the regional terrestrial fauna, and, to a lesser extent, aquatic fauna (Figure 5). The bias for large grazing animals in the collection may be due to accumulation episodes that resulted from seasonal herd migration mortality occurring on large floodplains (Voorhies, 1969). This supposition is further supported by the preponderance of male to female cervids represented. Winter die-offs are common in cervids and it represents the post rut period when males are at their weakest (Barnosky, 1985). The combination of a rapidly changing post-glacial environments and post rut stress may explain the abundant number of male cervids identified in the collection.

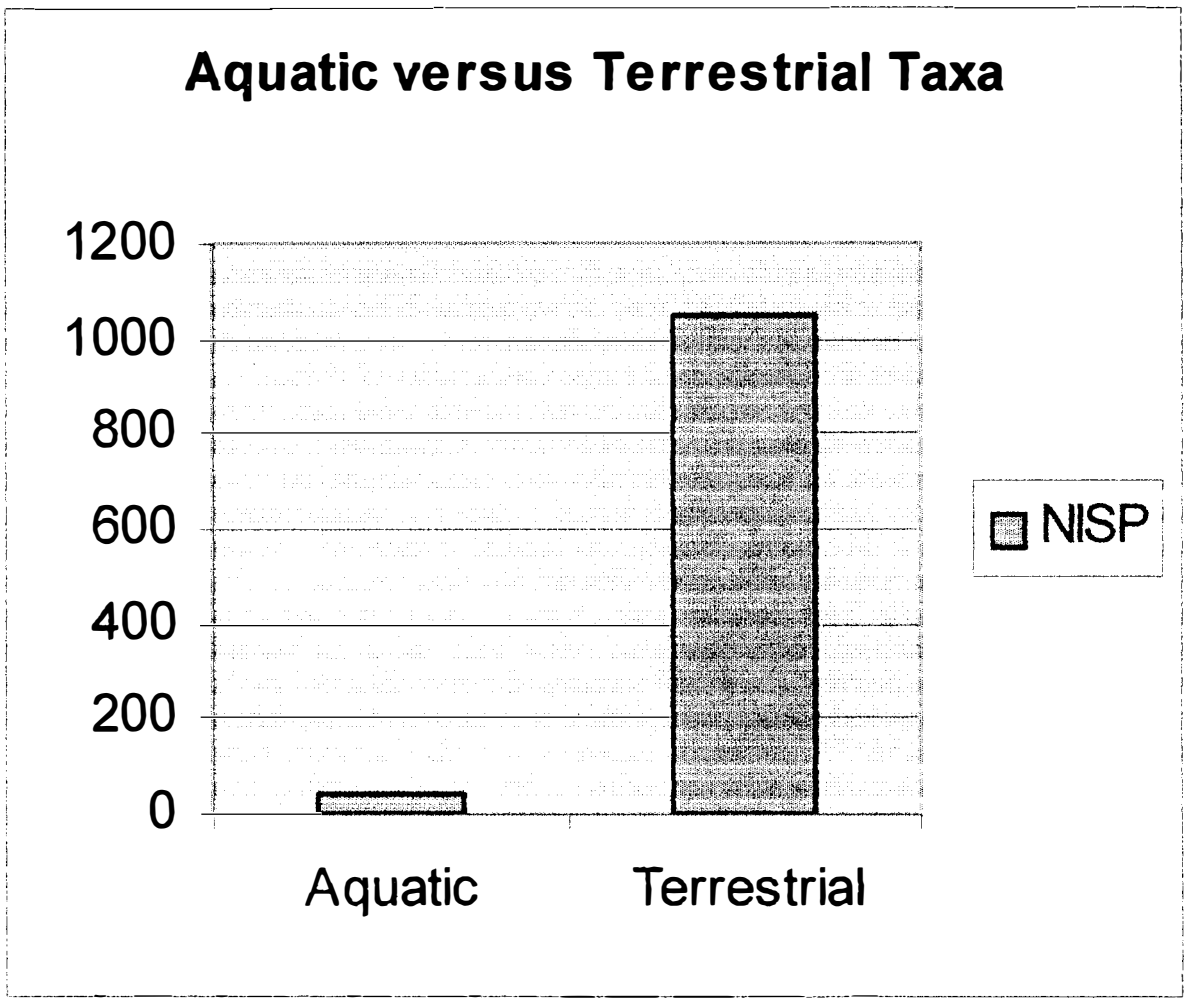

Figure 5. NISP of aquatic versus terrestrial species identified from the Connaway Collection.

Chapter V

Age of the Fauna

The age of fauna derived from the Central Mississippi Valley gravel bars is problematic because of their taphonomic context. Time resolution of attritional floodplain and active channel deposits is imprecise (Behrensmeyer, 1982). It is often difficult to distinguish younger bone from bones many thousands of years older (Behrensmeyer, 1984). In the Connaway Collection, very recent taxa such as *S. scrofa*, *B. taurus*, and *O. airies* along with animals that have been extinct since 10,800 yr B.P. is an example of the inherent imprecision for dating the gravel bar fauna

The presence of bison fossils indicates some portion of the fauna can be place in the Rancholabrean Land Mammal age (Woodburne, 1987). The beginning Rancholabrean Land Mammal age began as early as 550,000 years ago and as late as 200,000 years ago (Reppening, 1987; Woodburne, 1987). Analysis of microtine faunas place the beginning of the early Rancholabrean at 400,000 $\pm$ 25,000 years ago based upon the appearance of *Microtus pennsylvanicus* and the late Rancholabrean begins at 150,000 $\pm$ 25,000 years ago based upon the appearance *of Microtus xanthognathus* and *Bison* (Repenning, 1987). Thus the Connaway Collection contains fossils potentially that are, at the earliest, late Illinoian in age and corresponds with faunal material recycled from old terraces (Pve 4).

Analysis of the taphonomic condition of the majority of the fauna helps estimate a more resolute age of the fossils in the collection. Most vertebrate specimens appear to have been originally buried in many of the extensive loess deposits within the Mississippi Valley and in the Blufflands. The Peoria loess

appearance and color is compatible with the color of the sediment-stained fossils. In the Mississippi Valley, the capping layer of Peoria loess is late Wisconsinan in age (Autin *et al.* 1991; Guccione *et al.* 1988). A complementary *in situ* find comes from the nearby Chickasaw Bluffs of western Kentucky. A herd of well preserved fossils of flat-headed peccary was recovered just below a blanket of Peoria loess (Finch *et al.* 1972). I believe that most of the Connaway Collection is late Wisconsinan in age.

Fossils originally deposited in either channel or backswamp deposits are highly problematic. Two dates have been obtained from primary fossil contexts. A single date has been taken on the extinct camelid *Paleollama mirifica* from the Siltstown Ridge area of the Central Mississippi River Valley (Graham, 1990). The fossil received and AMS date on an isolated amino acid of 10, 890 $\pm$130 yr B. P. (Delcourt *et al.* 1997*b*). The other absolute date from the region comes from Nonconnah Creek in Memphis, Tennessee. The date of 17,195 $\pm$505 yr B. P. was taken on a white spruce cone and black walnut associated *in situ* with *Mammut americanum* (Brister *et al.* 1981). These two dates appear to indicate the possibility that the fossils deposited in either channel fill and backswamp deposits may be late Wisconsinan. However, the presence of *Nothrotheriops* in the Connaway Collection may indicate a Sangamon or possibly Middle Wisconsinan the fauna recovered backswamp deposits (McDonald & Ruddell, in press). The presence of *Nothrotheriops* in backswamp deposits is unexpected based upon the physical evidence of the habitat preferences of this ground sloth (McDonald, 1985). The Sangamonian or Middle Wisconsinan age on the ground sloth specimen is largely based upon the chronology of the local geology of

backswamp deposits in the general region where the fossil was found (Autin *et al.* 1991; Saucier, 1994). During the Sangamonian interglacial and Farmdalian interstadial intervals, formation of Prairie Complex backswamp deposits of the Mississippi River were prevalent, a hydrological response aggrading base levels and the rise in sea level (Saucier, 1994). Obviously, this represents only a very generalized relative chronology and would require an allostratigraphic analysis to confirm the deduction.

The Connaway Collection represents a unique Quaternary vertebrate collection for North America because of the diversity of the bison material identified. The collection contains four forms of bison, one at the specific level (*B. latifrons*) and three at the suspecific level (*B. bison antiquus*, *B. bison occidentalis*, and *B. bison bison*). The aforementioned varieties of bison represent a gradation of three subspecies of bison. This analysis follows the taxonomy of designating the different grades of bison at the subspecies level (Wilson, 1974*b*, 1975) as opposed to using the species level for the different varieties of late Quaternary bison (McDonald, 1981). The semantics of the opposing taxonomic viewpoints are however not relevant to a discussion on using bison as means of a relative chronology. Whether the apparent differences are at the specific or at the subspecific level, the different populations do appear to represent a late Quaternary clinal gradient (Anderson, 1984).

The long-horned bison (*B. latifrons*) first occurs in North America during the late Illinoian, but survives well into the late Wisconsinan (Kurten & Anderson, 1980). *B. latifrons* has a late Wisconsinan date from Rancho La Brea, California of 13,500 $\pm$

170 yr B.P. on bone amino acids (Marcus & Berger, 1984). The long-horned bison has also been dated at about 12,000 yr B.P. from the Mojave Desert of California (G. Jefferson, personal communication, 1997). The *B. latifrons* material from the Mississippi River Valley is similar in state of preservation to the material ascribed to *B. bison antiquus* and may therefore be contemporaneous. This is compatible with the hypothesis that *B. latifrons* became extinct in the late Pleistocene because genetic swamping incurred with its contact and competition with populations of *B. bison antiquus* (Anderson, 1984; Kurten & Anderson, 1980).

Three different grades of late Quaternary bison appear to represent a clinal gradient. This morphological gradient has been suggested to conformwith a north-south geographical gradient in their ecological niche, with *B. bison occidentalis* farthest north and *B. bison antiquus* farthest south (Anderson, 1984). Both now extinct subspecies of bison were extensively hunted by Paleoindians in the North American plains (Anderson, 1984; Frison, 1978; Wilson, 1974*b*). The different grades of bison also have been utilized as a relative means of dating archaeological sites of the North American northern plains. Wilson (1980) noted that bison from the late Pleistocene and early Holocene grade into *B. bison antiquus*, early to mid-Holocene forms as *B. bison occidentalis* and middle to late Holocene forms *B. bison bison.* This is also complimentary with the dwarfing of large herbivores that either survived or became extinct during the late Wisconsinan or early Holocene (Guthrie, 1984). The presence of all four forms of bison in the Connaway collection provides a means to relatively date the bison components of the fauna. The bison material from the Central

Mississippi Valley gravel bars can be hypothesized as representing a late Quaternary chronocline. Late Pleistocene bison are adapted to a short grass prairie (Anderson, 1984). This seems to suggest that significant tracts of grasslands, wet meadowlands, or savannahs were present during the late Quaternary in the valley.

The Memphis Pink Palace Museum, Memphis, Tennessee, obtained an amino acid AMS date 7,200 $\pm$ 60 yr B.P. from on the modified caribou antler (Appendix D). The date would be approriate for the modified antlers of *Odocoileus*, as they are somewhat similar to modified antler material from the Eva site (Lewis & Lewis, 1961). However, this radiocarbon date seems to be paleoecologically incompatible with this species and the Hypsithermal conditions of the Midsouth. Alternative explanations include the possibility that a refugium existed in the region that allowed caribou to exist in the Midsouth during the early middle Holocene. Spruce survived well into the early Hypsithermal in the Midsouth (H. Delcourt, 1979). Another possible explanation is that the antler was a trade item for humans brought from the north. The third possible explanation is that the radiocarbon date is in error. Critiquing the above explanations is difficult, but I believe that two of these likely can be eliminated. The idea of a refugium appears attractive, but in my estimation unlikely. Caribou would have been an excellent source of protein for Archaic people of the region. But there has never been a report of caribou remains from any Archaic Period archaeological context in the Southeast. Instead, the white tailed deer appears to be the main staple in the diet of Middle Archaic people (Meltzer & Smith, 1986). And although there may have been remnents of spruce in the region during this period,

caribou are a herd animal (Speiss, 1979) and it is unlikely the mechanism that might allow patches of spruce to occur would not also allow for herds of caribou. The likelihood that the date is in error is also an unlikely scenario. Dates that are too young routinely result when there is not enough collagen preserved for the extraction of individual amino acids (Stafford *et al.* 1991). The amount of collagen preserved in the antler was of a more than adequate amount (see Appendix D for AMS assay). Additionally, the low standard deviation is also a good indicator of the precision of the date obtained. This leaves the hypothesis that it represents a trade item from well north of the region. Caribou has been identified from an Early Archaic context from Prairie Creek, Davies County, Indiana, but this is a tenative identification (Churcher *et al.* 1989). While this sort of long-distance trade does have some precedent (Griffin, 1952), in the context of the region in question, it appears to have been a very rare occurence. Finally one other possible explanation is possible. There is always the chance that the antler came from an aberrent *Odocoileus* or *Rangifer* specimen. It might also be suggested that based upon its shape, it might have been used as an atalatl weight, which would be reasonable, based upon the Early Middle Archaic age AMS date.

It is also important to note that the other specimens identified as caribou were not culturally modified. Because of this, I suggest that the other elements identified as caribou in the collection are likely Pleistocene in age, not Holocene. The important question then becomes when was caribou in the Central Mississippi Valley? A review of radiocarbon-dated occurences of caribou further supports my premise. Graham et

al. (1983) reports two radiocarbon dates from Christian Bog, Hancock County, Indiana, 13,220 ± 100 and 12,060 ± 100 yr B.P. respectively. A date from Michigan of 5870 ± 400 yr B.P. comes from Genesse County (Wilson, 1967). In Tennessee a date of 10,560 ± 200 yr B.P. was obtained from Baker Bluff and 19,700 ± 600 yr B.P. at Guy Wilson Cave, Sullivan County (Guilday *et al.* 1975, 1978). In Alabama a date of 11,820 ± 490 yr B.P. comes an associated fauna from Bell Cave, Colbert County (Churcher *et al.* 1989). A date of 13,460 ± 420 comes from Saltville in Smyth County, Virginia (Ray *et al.* 1967). Dates of 17,060 ± 220 to 28,250 ± 850 yr B.P. come from deposits containing caribou at New Trout Cave, Pendleton County, West Virginia (Grady & Garton, 1982). Two dates come from the Atlantic Coastal region, >36,830 yr B. P. from Atlantic Ocean Beach near the North Carolina/Virginia border and 27,990 ± 775 yr B.P. from Myrtle Beach, Horry County, South Carolina (McDonald *et al.* 1995). The site of Dutchess Quarry, Orange County, New York has an associated date of 10,580 + 370 yr B.P. (Funk *et al.* 1969, 1970). A date of >12,000 yr B.P. comes from the McBride site, Rice Lake (Savage, 1981) and 4,950 ± 80 yr B.P. the Auger Site near Mount St. Louis (Churcher *et al.* 1989), both in Ontario, Canada. The geographic distribution of the undated and dated sites for caribou in the eastern North America depicts a lobate pattern similar to the Wisconsinan glacial system (Churcher *et al.* 1989; McDonald *et al.* 1995). The areal shape of the distribution of caribou for eastern North America supports the idea that it was a boreal animal and likely reached its southernmost distribution during glacial periods (McDonald *et al.* 1995). The exception appears to be the specimens identified

from the Atlantic Coast and the Central Mississippi Valley specimans described in this dissertation. A logical explanation for the occurence along the Atlantic is that during glacial periods, sea level was lower and there was an emergence of the Continental Shelf and boreal environments extended toward the coastal regions. This is supported by reconstruction of the vegetational conditions during glacial periods for the region (Delcourt & Delcourt, 1986).

With the presumption that the modified caribou antler was a product of long distance trade, or from an aberrant cervid species, the question that must be asked is "how can paleontologically indigenous caribou be explained for the Central Mississippi Valley?" It can be assumed to not have occurred during an interstadial, based upon the habitat preferences and current distribution of caribou. If it was pre-Woodfordian, then it was also likely Pre-Farmdalian or greater than 28,000 yr B.P. It could be hypothesized that the caribou might have lived in the nearby Ozark Mountains, which contained a mosaic of habitats including patches of tundra capable of supporting a boreal microfauna as well as caribou herds. Paleoenvironmental reconstruction indicate the treeline of the Appalachian mountains during the late Wisconsinan had just such an environment based upon elevation and latitude between 20,000 to 13,000 yr B.P. (Delcourt & Delcourt, 1998). The same scenario would logically apply to the Ozark Plateau as they are paleoecologically similar to the Appalachians (Semken, 1988).

The melting of the Larentide ice sheet after 13,000 yr B.P. created a braided stream regime in the valley and provided fluvial disturbance maintaining wet

meadows and shrub thickets on active stream channels. These settings permitted graminoids to colonize on grasslands and, to attract large herds of grazing animals. More importantly, the glacial meltwater provided a local cooling in the valley and the nearby blufflands (Delcourt & Delcourt 1977; Delcourt *et al.* 1980). The combination of the braided stream regime and cooling by way of glacial meltwater may have provided a late Wisconsinan refugium in the Blufflands or in the valley for caribou just as it maintained geographical boreal outliers of spruce and tamarack forests (Delcourt *et al.* 1997*b*; Delcourt *et al.* n.d.).

Chapter VI

Regional Paleovegetation

The use of paleobontany is essential for reconstruction of past environments. Reconstruction of past environments in which prehistoric people once lived is crucial for understanding the type of adaptations necessary for occupation of a given region. Much of the paleoecological reconstruction and interpretation used by archaeologists have utilized very broad generalizations for their reconstruction of Paleoindian and later cultural subsistence strategies. Use of some of these very broad paleoecological interpretations has led to flawed hypotheses of past subsistence practices for the earliest colonists of the southeastern United States. The late Pleistocene Eastern Woodlands paleo-communities have been interpreted by archaeologists, as mosaic of boreal and deciduous trees with the southern latitudes being essentially modern by 16,000 years ago (Meltzer, 1984). However, the waning of the last full glacial began at approximately 16,500 yr B. P. Alternatively, paleovegetation research demonstrates that the paleoenvironments of the mid-latitudes of the Southeast were becoming essentially modern between 12,500 and 10,000 yr B. P. (H. Delcourt, 1979; Delcourt & Delcourt, 1984). It is significant to note that this is the region with the highest concentration Paleoindian assemblages. The highly diverse pollen record has also been used to support the interpretation that a generalist adaptive subsistence strategy was adopted in this region (Meltzer, 1984, 1988; Meltzer & Smith, 1986). The late Pleistocene plant communities were a mixture of boreal and temperate taxa, and have poor modern analog. Due to the diversity and poor-analog nature of late Wisconsinan plant communities, they represent much more complex biological phenomena than recent

communities. The following represents a summary of how paleovegetation of the Central Mississippi Valley was reconstructed and is necessary to better understand how the paleoenvironments have been interpreted.

For the purpose of this endeavor, reconstruction of the paleoenvironment of the late Quaternary is chronologically restricted to late Wisconsinan and early Holocene. I am assuming that people probably did not enter the Mississippi Alluvial Valley until after the Woodfordian based upon the assumption that people were unable to enter the region until possibly after 16,500 yr B. P. when the Midwestern glaciers began their full retreat. If it were assumed that people entered the valley via the ice-free corridor, it would have been impassable before 16,500 yr B. P. and likely not until after 12,000 yr B. P. (Mandryk, 1995, 1996). However, alternate migration routes have also been proposed. For example, although the coastal migration route proposed by Fladmark (1979) has received little attention by archaeologists, the theory is being revived (Hall, 1999). A general revival of how people reached the New World has been propagated by the acceptance of evidence an early occupation at Monte Verde in southern Chile and at the Cactus Hill Site in Virginia. In addition, paleoenvironmental data from the central Mississippi Valley indicate that the region would be habitable for early colonizers (Brister *et al.*1981). Because of this fact, I will consider in this paper the paleovegetation of the last full glacial of the late Wisconsinan. The past vegetation of the Central Mississippi Valley that will be reviewed will be restricted to mainly the Western and Eastern Lowlands and secondarily the adjacent Western Blufflands.

The paleo-vegetation of the Central Mississippi Valley has been well studied for the late Quaternary. The late Wisconsinan paleoecological maps developed for the Central Mississippi Valley are based upon broad vegetation groups (See Appendix E). These broad vegetation types are based upon upon four criteria (Delcourt *et al.* 1997*b*; Delcourt *et al.* n.d.):

"(1) from the fossil-pollen diagrams, we determined the suite of taxa represented and the timing of immigration or of local extinction at each site; (2) for each landscape setting represented by paleoecological data, we selected the dominant pollen type and a second, subdominant or "indicator" pollen type, based upon ecological requirements for temperature, soil fertility and moisture, and tolerance to disturbances such as wildfire and flooding (Burns & Honkala, 1995); (3) for each palecological site, we designated a spectrum of vegetation types potentially occupying nearby hydric wetlands, mesic terraces or uplands settings; and (4) we extrapolated the mapping of the vegetation units across the corresponding habitat as portrayed on the paleogeographic reconstructions of geomorphic environments."

Evergreen conifers, with some fir (*Abies*) (Delcourt *et al.* 1997*b*; Delcourt *et al.* n.d) essentially occupied the full glacial forest (18,000 yr B.P.) of the region. This appears to indicate that boreal elements found much further north after deglaciation, were depressed southward due to the presence of Laurentide ice sheet. During the full glacial, the Western Lowlands was an area of frequent geomorphic disturbance because of the active valley trains produced by a braided stream regime (Saucier, 1994). The presence of spruce (*Picea* spp.), fir, tamarack (*Larix laricina*), and willow (*Salix*) further indicate that the region was flooded repeatedly and was part of a shifting web of mid-channel bars (Royall *et al.* 1991; Delcourt

& Delcourt, 1996; Delcourt *et al.* 1997*b*; Delcourt *et al.* n.d.). The loess mantled Eastern Lowlands were mesic and supported a mixed forest of spruce, oak, and cool-temperate hardwoods including beech (*Fagus grandfolia*), sugar maple (*Acer saccharum*), black walnut (*Juglans nigra*), tulip tree (*Liriodendron tulipifera*), ironwood (*Ostrya/Carpinus*), and ash (Fraxinus) (Delcourt *et al.* 1980; Delcourt *et al.* n.d.). The Crowleys Ridge region was inferred to have had a more xeric dry sandy plains habitat on terraces of inactive valley trains and would be conducive for the succession of a Spruce-Jack Pine Forest (Delcourt *et al.* 1997*b*; Delcourt *et al.* n.d).

The paleovegetational maps produced for 14,500 yr B. P. indicate the region was undergoing a gradual warming following the retreat of the continental glaciers (Delcourt & Delcourt, 1994). The braided stream terraces of the Western and Eastern Lowlands indicate a replacement by an oak (*Quercus*) and hickory (*Carya* spp.) forest with ironwood in the Blufflands and Crowley's Ridge (Delcourt *et al.* 1997*b*; Delcourt *et al.* n.d). Species-poor Ash-Willow Forest became established on ephemeral sluiceways in the bottomlands (Royall *et al.* 1991; Delcourt *et al.* 1997*b*). The Spruce-Willow Forest has been postulated along the active valley trains fed by the Mississippi and Ohio river meltwater east of Crowlys Ridge (Delcourt *et al.* 1997*b*; Delcourt *et al.* n.d.). The region was undergoing major shifts of its community structure during the deglaciation event.

At 12,000 yr B.P., thought to be the time of the earliest arrival of people to the New World (Delcourt *et al.* 1995), vegetation was responding an increasingly alternating climate and hydrologic environmental factors. An oak and hickory Forest expanded on the abandoned braided stream terraces east and west of Crowleys Ridge and an oak-ironwood

forest could still be found in the Blufflands (Delcourt *et al.* 1997*b*; Delcourt *et al.* n.d.). This period has been characterized as being highly transitory because of a rapidly fluctuating hydrological regime and climate (Delcourt & Delcourt, 1996). This period coincides with the late Pleistocene megafauna extinction. The ephemeral nature of the vegetation during this period along with other factors may be significant in explaining the megafauna extinction event.

At 10,000 yr B.P. there is evidence of a change to a warm temperate transition from the late glacial into the early Holocene, which can be seen in the vegetation, and geological record of the Western Lowlands. This period saw the continued expansion of oak-hickory forest on the abandoned braided stream terraces east and west of Crowleys Ridge and the development of a willow-cane plant community in the active meander belts of the Mississippi River (Delcourt *et al.* 1997*b*; Delcourt *et al.* n. d.). The first continuous representation of sweetgum (*Liquidambar styraciflua*) occurs at approximately 10,000 yr B.P. along with the earliest record of bald cypress (*Taxodium distichum*) and tupelo gum (*Nyssa*) in the Western Lowlands (Delcourt & Delcourt, 1996; Delcourt *et al.* 1997*b*; Royall *et al.* 1991). The Eastern Lowland sites of Big Lake and Pemiscot Bayou records the replacement of Ash-Willow forest in sluiceways throughout the lowlands (Delcourt *et al.* 1997*b*). The transition from a braided stream regime to that of the modern meandering stream behavior of the Mississippi River began during this period (Saucier, 1994). The seasonal Holocene climatic pattern characterized by the shift of the polar front northward and increased frequency of storms further indicates a shift toward a warm-temperate climate (Delcourt *et al.* 1997*a*, 1997b; Kutzbach & Webb, 1993). The megafauna has become

extinct by this period (Meltzer & Mead, 1983, 1985; Mead & Meltzer, 1984), and emergence of sub-regional cultural manifestations is reflected in the archaeological record (Morse & Morse, 1983; Ruddell & Davenport, in press).

By the middle Holocene at approximately 8,000 yr B.P., the warming and drying episode known as the Hypsithermal is documented through geomorphological and palynological evidence. The water table was dropping during this period in both the Western and Eastern Lowlands. A sweetgum-elm forest, which included hackberry (*Celtis/Machura*), box elder (*Acer nugundo*), sycamore (*Platanus occidentalis*), river birch (*Betula nigra*), and water locust (*Gleditsia aquatica*), dominated in the Western Lowlands (Delcourt & Delcourt 1996; Delcourt *et al.* 1997*b*, Delcourt *et al.* n. d.; Guccione & Van Arsdale, 1995; Royall *et al.* 1991; Scott & Aasen, 1987). A significant change was underway on the abandoned braided stream terraces. A grass (Family: Poaceae) and ragweed (*Ambrosia*) savannah-like environment (Brookes & Reams, 1995; Delcourt *et al.* 1997; King & Allen, 1977) were displacing the oak-hickory forest. It is important to remember that this succession took placed during a period of relative geomorphic and climatic stability (Saucier, 1994; Wright, 1983) and increasingly more permanent human settling in the region (Morse & Morse, 1983).

It can be concluded from the previous summary of the paleoenvironments of the Mississippi Valley, that from the full glacial period (18,000 yr B.P.) up to the onset of the Hypsithermal (8,000 yr B.P.) provides evidence of 10,000 years of dynamic change. These significant changes occurred in the hydro-geomorphology, biogeography and cultural ecology of the area. During this 10,000 years, the first humans colonized the valley, plant

communities broke up and reorganized many times over, and a large segment of the mammalian population became extinct. These events were very much affected by the sometimes drastic changes in the climate and instability and relative stability of the hydro-geomorphology of the region. The paleovegetation maps created using rigorous palynological evidence appear to be the most precise method available for archaeologists attempting to reconstruct the environments of the initial colonization and cultural change within the valley. But because of the static nature of earlier paleovegetation maps (Delcourt & Delcourt, 1981) combined with the dynamic nature of the late Quaternary perturbations of the central Mississippi Valley, the question of the validity of their use by archaeologists must be noted. More recent paleovegetation mapping has better demonstrated the dynamic nature of the late Quaternary environments of the Southeast. In the following chapters of this dissertation, analysis of the vertebrate paleontology in conjunction with the record of paleovegetation and geomorphology previously discussed can provide a more comprehensive environmental archaeological interpretation for the Central Mississippi Alluvial Valley.

Chapter VII

Micro-vertebrate Paleoecology

The micro-vertebrate record somewhat mirrors the paleobotanical record for the late Wisconsinan. The concept of disharmonious faunas or micro-vertebrate assemblages that have poor modern analog are derived from multiple analyses of eastern North American late glacial faunas (Graham, 1976, 1985; Graham & Mead, 1987; Guilday *et al.* 1978). The disharmonious faunas are those in which there are mixtures of boreal and temperate adapted species occurring together at the same time and in the same space. Boreal and southern temperate small mammals have been found to be contemporaneous at three southeastern United States sites: Peccary Cave in Arkansas, Baker Bluff Cave in Tennessee, and Natural Chimineys Cave in Virginia (Semken, 1988). In addition to disharmonious small mammals, similar associations of late Wisconsinan avifauna and herptofauna were noted at Cheek Bend Cave in Middle Tennessee (Klippel & Parmalee, 1982*a*). Conclusions about the paleoenvironments of the eastern United States are that the north/south faunal gradient was much less extreme during the late glacial compared to Holocene environments, and suggests that the climate was more equable. The paleoenvironmental response of plants to the rapidly changing climate was individualistic in nature. Similarly, small mammals responded to the change based upon their own individual tolerances. The cold adapted species theoretically were able to use, for example, the Appalachian Mountain chain to migrate to northerly latitudes during the late glacial warming. More than likely this was a very gradual process. As previously noted, the transition to modern conditions occurred over a 2,500-year period. This satisfactorily explains the migration route of boreal mammals during the late glacial

period, but not the prairie-adapted species found with the boreal and temperate woodland species in many of the southeastern United States micro-vertebrate localities.

Interpretations of the micro-vertebrate paleofaunas have been used to indicate that significant tracts of open grasslands were present (Guilday *et al.* 1978; Semken, 1984). Prairie grassland adapted species such as thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*), plains pocket gopher (*Geomys bursarius*) and prairie chicken (*Tympanus cupido*) were also members of these disharmonious faunas (Lundelius *et al.* 1983). The two grassland-adapted mammals demonstrate a random distribution in the Southeast for the late Wisconsinan (Graham & Lundelius, 1994). During the mid-Holocene Hypsithermal they delineate Prairie Peninsula expansion of grassland in the Eastern Woodlands (Graham & Lundelius, 1994).

Grassland faunal components are found in paleontological sites east and west of the Central Mississippi Valley. East in the Ozarks and portions of Missouri and Arkansas, thirteen-lined ground squirrel is a significant component of several late Wisconsinan faunas. This ground squirrel, adapted to short grass prairie, was identified from eastern Missouri at Crankshaft Cave (Parmalee *et al.* 1969), the Kimmswick archaeological site (Graham *et al.* 1981; Graham & Kay, 1988), the Barnhart site (Graham & Kay, 1988), and Little Beaver Cave (Schubert, 1997), Bat Cave (Hawksley *et al.* 1973), and Brynjulfson Caves (Parmalee & Oesch, 1972) from central Missouri. Also to the west of the Mississippi Valley, it was recovered from Peccary Cave in northwestern Arkansas (Semken, 1984), and Conard Fissure (Sealander & Heidt, 1990), and from central Arkansas the Ten-Mile Rock site (Sealander & Heidt, 1990). East of the region this grassland adapted sciurid was recorded in Tennessee at

Cheek Bend Cave (Klippel & Parmalee, 1982a) and in Kentucky at Welsh Cave (Guilday *et al.* 1971).

The plains pocket gopher has been found east and west of the Central Mississippi Valley. The sites include Peccary Cave (Semken, 1984), the Ten-Mile Rock site (Sealander & Heidt, 1990), Welsh Cave (Guilday *et al.* 1971), the Barnhart site (Graham & Kay, 1988), the Kimmswick archaeological site (Graham *et al.* 1981; Graham & Kay 1988), and Cheek Bend Cave (Klippel & Parmalee 1982*a*; Parmalee & Klippel, 1981). I interpret the relative proximity of the geographically isolated southeastern pocket gopher (*Geomys pinetis*) as evidence that open areas were present during the late Wisconsinan in the regions from where pocket gophers have been identified (Guilday *et al.* 1971). The presence of *S. tridecemlineatus* in the deposits also containing *G. bursarius* appears to support this supposition (Semken 1983, 1984). This hypothesis is utilized because of the osteological similarities of *G. bursarius* and *G. pinetis* make them difficult to separate with complete certainty.

The idea that much more open ground (grassland/prairie) was present in regions that are now occupied by a closed canopy forest is evident based upon the presence thirteen-lined ground squirrel, plains pocket gopher and prairie chicken. However, the presence of open ground adapted micro-mammals does not necessarily indicate the regions had extensive dry prairies (Semken, 1984). However, it can be suggested that habitats were a complex mosaic of open woodlands. Klippel and Parmalee (1982*a*, 1982*b*) have suggested that an open cedar glade may have been present in the late Pleistocene mosaic environments of the region near Cheek Bend Cave as they are presently. Paleovegetation investigations of the nearby Mingo

and Anderson ponds demonstrate only a minor percentage of the recovered pollen attributable to graminoids compared to arboreal pollen (H. Delcourt, 1979). However, when taphonomy is applied to the pollen percentages present (Davis, 1969, 1986), the pollen spectra of graminoids may represent a more significant percentage and may well explain the presence of thirteen-lined ground squirrel and plains pocket gopher at Cheek Bend Cave. The presence of cedar glades in the Ozarks of Missouri and Arkansas and the Cumberland Plateau region of Kentucky and Tennessee was optimal during the Farmdalian of the late Wisconsin and the Hypsithermal of the middle Holocene (Delcourt *et al.* 1986). A combination of high groundwater tables and boreal coniferous forest indicate a significant reduction in cedar glades for the period between 24,000 and 12,500 yr B. P. (Delcourt *et al.* 1986; King, 1973; King & Lindsey, 1976). However, AMS dates based upon high resolution individual amino acids on grassland adapted micro-vertebrates indicate their presence in late Wisconsin deposits prior to 12, 500 yr B.P. Guilday (1984) suggested that the open grasslands in late Wisconsinan contexts may have been ephemeral in nature and suggests that large grazing mammals such as bison were also transient in the woodland environments of the southeastern United States. However, at least in the river valleys of the Midsouth, this assumption appears invalid if it can be assumed that large herding mammals were constantly present in the river valleys. Although, I believe this to be unlikely, I believe large grassland type areas were likely more significant, but also ephemeral in a lesser degree. It is likely that the environments of the Midsouth river valleys were different paleoecologically from the Ozark Highland and the Columbian Plateau. The significance of the river valleys as a possible migratory route for the adapted species to open grassland should not be ignored.

Did the grassland adapted micro-vertebrate species become locally extinct or is there evidence of migration routes, similar to the Appalachian Mountain chain, afforded to the boreal animals? How significant and large were the grassland components of the late Pleistocene mosaic paleoenvironments in the river valleys? The answers to these two questions may well lie in the Quaternary megafauna record of major river valleys of the southeastern United States.

Chapter VIII

Megafauna and Paleoecological Interpretation

The megafauna record for the southeastern United States has only been examined in a cursory manner relative the study of early human association. This is directly related to the lack of human associations with extinct megafauna. However, diverse late Pleistocene megafauna has been found in regions rich in early Paleoindian diagnostics. Early interpretation of the early Paleoindian period of the Eastern Woodlands was based upon kill sites in the western United States (Mason, 1962). There was a generally implicit assumption that underlies the concept of Clovis subsistence in the temperate Eastern Woodlands. The supposition was that the Clovis culture used its technology on the grassland-adapted *Mammuthus columbi* (Columbian mammoth) and *Bison antiquus* (extinct bison) in the arid West and the woodland-adapted *Mammut americanum* (mastodon) in the East (Anderson, 1984; Kurten & Anderson 1980; Saunders, 1977, 1980). While it is true that grassland-adapted species such as mammoth and bison dominate the western half of the country and the woodland-adapted mastodon, the eastern half (Agenbroad, 1983,1984; Anderson, 1984; King & Saunders, 1984), the environments of the late Pleistocene are not that simple. The use of large vertebrates as environmental indicators has been criticized because it is largely based upon creatures that are now extinct (Graham *et al.* 1987). However, large mammals have been used to predict past vegetation of extant and extinct assemblages in the Old World (Reed, 1998). In this regard, large vertebrate remains from three river valleys of the Midsouth demonstrate a potentially different paleoenvironmental interpretation. Faunas

identified from the Red River Valley in southwestern Arkansas, the Black Belt region of Mississippi and in the Central Mississippi Alluvial Valley (Table 1) have significant occurrences of open grassland adapted taxa (Hemmings, 1982; Kaye, 1972; Morse & Morse, 1983; Ruddell *et al.* 1997*a*, 1997*b*).

Analysis of the gravel bar fauna from the Central Mississippi Valley provides potentially meaningful paleoecological information. A total NISP of 610 was identified for grassland adapted taxa (bison, horse, mammoth, Harlan's muskox, American lion, Harlan's ground sloth and giant tortoise) and 431 for woodland and forest edge adapted taxa (deer, elk, mastodon, black bear, Jefferson's ground sloth, tapir, long-nosed peccary, beautiful armadillo, and turkey) from the Connaway Collection. This species bias adapted to grassland versus woodland or forest-edge adapted species lends supports for the hypothesis that there were significant areas and periods of time in which grassland predominated in the region. A comparison with faunas from other river valleys of the Midsouth provides further confirmation of this hypothesis.

Hemmings (1982) described a Quaternary fauna from the recent channel bar deposits of Red River of the Great Bend region in southwestern Arkansas. The deposition upon the point bars resulted from the erosion of the local floodplain. The erosion events deposited a combination of paleontological and archaeological remains. This includes possible late prehistoric burials due to the presence of human skeletal materials in both gravel bar faunas. Much of the archaeological remains have been attributed to the Caddoan occupation of the last thousand years, but fluted points have also been recovered (Hemmings, 1982). The taphonomic pathway of the fauna and artifacts analyzed from the Red River appears to be

Table 1 . Presence/absence of species identified from the Central Mississippi Valley, Mississippi Black Belt Region, and Red River Valley, Arkansas.

Taxa	Central MS Valley	MS Black Belt	AR Red River Valley
Fishes			
Lepisosteus sp.	X		
Atractosteus spatula	X		
Pylodictis olivaris	X		
Reptiles			
Aplodinotus grunniens	X		
Alligator mississippiensis	X		
Chelydra serpentina	X		
Macroclemys temmincki	X		
Chrysemys sp.	X		
Terrapene sp.	X		
*Geochelone crassiscutata**	X	X	
Apalone spinifera	X		
Chelonia	X	X	X
Birds			
Meleagris gallopavo	X	X	
Ardea herodius	X		
Branta canadensis	X		
Mammals			
Didelphis sp.		X	
*Holmesina septentrionalis**		X	
*Dasypus bellus**	X	X	
*Megalonyx jeffersonii**	X		X
Emotherium sp.*		X	
Nothrotheriops sp.*	X		
*Paramylodon harleni**	X		
Lutra canadensis	X	X	
Canis sp.	X		X
Canis familiaris	X		X
*Canis dirus**	X		
Urocyon sp.		X	
Procyon lotor		X	
Arctodus sp.*	X	X	
Ursus americanus	X	X	X
*Panthera leo atrox**	X		
Felis cf. *weidii*		X	
Felis sp.		X	X
Lynx rufus		X	
Marmota monax	X		

Table 1 (Continued)

Taxa	Central MS Valley	MS Black Belt	AR Red River Valley
Castoroides ohioensis*	X	X	
Castor canadensis	X	X	
Ondatra sp.		X	
Hydrochoerus sp.		X	
Sylvilagus floridanus	X		
Sylvilagus cf. *aquaticus*		X	
Equus sp.**	X	X	X
*Tapirus haysii**	X		
*Tapirus veroensis**	X		
Tapius sp.		X	
*Myohylus fossilis**	X	X	X
Platygonus sp.*		X	
Sus scrofa	X		
Hemiauchenia sp.*		X	
*Paleollama mirifica**	X		
Odocoileus virginianus	X	X	X
Odocoileus sp.	X		
Rangifer sp.	X		
Cervalces c f. *scotti**	X		
Cervus elephus	X	X	
Ovis aries	X		
*Bootherium bombifrons**	X		X
Bos taurus	X		
*Bison latifrons**	X	X	
*Bison bison antiquus**	X		
*Bison bison occidentalis**	X		
Bison bison bison	X		X
Bison sp.	X	X	X
*Mammut americanum**	X	X	X
*Mammuthus columbi**	X		
Mammuthus sp.*	X	X	
Total diversity	52	31	13

* Extinct.

** Extinct and later reintroduced

very similar to the gravel bar faunas analyzed herein. The Red River fauna has a combination of fossil, sub-fossil Early or Middle Holocene, and very recent skeletal material, as does the Connaway Collection. Both faunas represent a mixture of both grassland and mixed forest adapted species. The Red River fauna contains fossil forms of *M. americanum*, *M. jeffersoni*, *M. nasutus*, and *O. virginianus* (mixed forest), but are dominated by *Bison* sp. and *Equus* sp. (grasslands). Also similar to the Mississippi Valley fauna, aquatic animals compose only a minor percentage of the species identified. A similar taphonomic pathway is suggested by a mainly floodplain taphocoenosis (death assemblage sensu, Lyman, 1994). The Red River fauna differs taphonomically because of a greater degree of transport damage due to saltation during the transportation process (Hemmings, 1982). The southwestern Arkansas fauna is also less diverse than the Central Mississippi Valley fauna (Table 1). However, possibly the most important feature that both faunal groups share is the mixture of grassland and mixed woodland species and evidence for early fluted point making cultures in each respective region. No attempt was made to directly date the fauna. However, the fossils have been compared favorably to a similar fauna 56.7 km west of the Red River locality, the North Sulpher River in Texas (Hemmings, 1982) from which Slaughter and Hoover (1963) obtained dates on a hearth (11,135 yr B. P.) and antler tine (9,550 yr B. P.).

Another fauna studied in the Midsouth demonstrates further similarities to both the Red River Valley and Central Mississippi Valley fossils. Kaye (1974) described thousands of fossils from the Black Belt region of Mississippi. The bulk of these fossils were originally in floodplain deposits redeposited on recent gravel bars in a region also containing early

Paleoindian lithic material. The physical conditions of the Black Belt fossils are more similar to the Red River assemblage. The Black Belt skeletal elements are fragmentary and show evidence of greater transportation distance than the Connaway Collection specimens. The Black Belt taphonomic pathway appears to be very similar to the other two faunas. Again, because aquatic species are rare, a terrestrial floodplain taphocoenosis is hypothesized. The overall diversity of the Black Belt fauna is comparable to that of the Central Mississippi Valley assemblage. The Central Mississippi Valley is slightly more diverse in aquatic species, but this may be a preservational bias. The paleoecology of the Black Belt fauna is very complimentary to that from the Mississippi River gravel bars. Both collections have a mixture of grassland and mixed-woodland adapted species. The Black Belt fauna contains *Equus* sp., *Bison* sp., *Geochelone crassiscutata*, *Mammuthus* sp., *Platygonus* sp., *Hemiauchenia* sp., *Arctodus* cf. *simus*, *Holmesina septentrionalis* (grassland), *M. americanum*, *Tapirus* sp., *M. jeffersoni*, *O. virginianus*, *Mylohylus* sp., *U. americanus*, *D. bellus*, *C. elaphas*, *Procyon lotor*, and *Meleagris gallopavo* (mixed/woodland). Similarly, the grassland-adapted bison and horse make up the highest percentage of the fauna. The Black Belt fauna contains more equid material than bison, whereas the Connaway Collection contains slightly more bison than horse (NISP values). The presence of the giant tortoise, *Geochelone* in both areas is indicative of mild winters. Antithetically, the presence of *Rangifer* sp. in both regions implies a more boreal habitat. A series of radiocarbon dates taken on bone apatite fractions range from > 33,000 to 3,260 yr B. P. and have generally high standard deviations (Kaye, 1974). Unfortunately, the dates do not provide a valid chronology for the fauna. Bone apatite dates have been found to be

exceedingly unreliable (Meltzer & Mead, 1983, 1985; Mead & Meltzer, 1984) and dates on extinct Pleistocene bone younger than 10,800 yr B. P. are due to contamination (Stafford, 1990; Stafford *et al.* 1991). Nevertheless, the fauna identified from the Black Belt region appears to demonstrate a diverse mosaic of Late Pleistocene fauna with evidence diagnostic lithic materials of early Paleoindian age.

Whereas the Central Mississippi, Black belt and Red River faunas appear to be attritional faunas accumulated over as yet undetermined period of time, a find from western Kentucky provides a potential snapshot in time. A fossil herd of *Platygonus compressus* was recovered and described from just southwest of Hickman, Kentucky along the Chickasaw Bluffs of the Mississippi River (Finch *et al.* 1972). The interment of the peccaries appears to have been the results of a catastrophic event. It was hypothesized they were possibly caught in a duststorm as they traveled away from the Mississippi River (Finch *et al.* 1972). The significance of this find is the context in which they were found, their proximity to the region in which the Connaway Collection was recovered, and the hypothesized habitat preference of the flat-headed peccary. The fossils were recovered 1.2-1.6m above the Wisconsinan age Roxana silt and two paleosols and were overlain by the Peoria loess. The fossils were recovered above a two paleosols and can be stratigraphically correlated with Farmdalian paleosols (Guccione *et al.* 1988; Mierecki & Miller, 1994; Rutledge *et al.* 1996). The Roxana silt has been correlated to be late to middle Wisconsinan and the Peoria loess to be late Wisconsinan (Mirecki & Miller, 1994; Rutledge *et al.* 1996). A radiocarbon date of >34,000 yr B.P. was obtained on mollusca associated with the skeletons. This date is compatible with thermoluminescence dates obtained from sediments within the Roxana silt

(Millard & Matt, 1994). However, the TL date is not in accord with dates obtained on the Farmdalian paleosols and Peoria loess. Because the skeletons overlie the well-dated Farmdalian paleosol and are covered by the Peoria loess, a latest Wisconsinan age is likely. A majority of the Connaway fossils recovered were likely preserved under a loess mantle lithologically similar to the Peoria loess. The habitat preference of *P. compressus* has been hypothesized to be an open grassland environment. The flat-headed peccary dominated a fauna from Welsh Cave in central Kentucky (Guilday *et al.* 1969*b*). It was concluded that the anatomy of *P. compressus* was such that it was adapted to something other than a dense forest. The combination long limbs and dependence upon vision indicated a habitat preference for more open grassland habitat preference (Guilday *et al.* 1969*b*).

These diverse large mammal records for the Midsouth require a more rigorous evaluation of the plant paleoecological record. What is the evidence for open grassland regions in the southeastern woodlands in the plant paleoenvironmental record? The predominant opinion of Late Pleistocene vegetation has emphasized paleoecological reconstruction based upon arboreal pollen. It is important to point out that early paleoenvironmental vegetation maps were made on a meso-scale for both space and time. Hazel and Paul Delcourt (1988, 1991) have developed a four-tiered hierarchy for the spatial-temporal sphere that is influenced by environmental effecting functions, biological reactions, and vegetational forms. The four spatial-temporal scales include mega-scale (1 million to 4.6 billion years), macro-scale (1,000,00 to 100,000 years), meso-scale (500 to 100,000 years), and micro-scale (1 to 500 years). The paleoenvironmental maps used by many archaeologists are on the meso-scale and thus may not be sensitive enough to trace an

individual species response to environmental change. Davis (1986) notes that significant environmental disturbances preclude communities from migrating as intact units. In addition, there is a significant taphonomic bias between arboreal versus non-arboreal pollen. Certain trees produce a larger volume of pollen and have a larger area of dispersion than other trees and types of vegetation (Davis, 1969). Environmental reconstruction based upon pollen for the late glacial period (14,500 to 10,000 yr B. P.), has demonstrated the occurrence of grasses for this time period in the Midsouth (H. Delcourt, 1979; Royall *et al.* 1991). However, when viewed on the meso-scale, the occurrence appears insignificant. In the Central Mississippi Alluvial Valley the development of an oak-hickory savannah corresponds with onset of the Hypsithermal Period, 8,000 yr B. P. (Delcourt *et al.* 1997; Delcourt *et al.* n.d.). It is important to remember that this succession took placed during a period of relative geomorphic and climatic stability (Saucier, 1994; Wright, 1983) and increasingly more permanent human settling in the region (Morse & Morse, 1983). In contrast, the late Pleistocene and early Holocene are characterized by a great deal of geomorphological and climatic instability. Catastrophic release of Laurentide melt water began at approximately 16,500 yr B. P. and continued until 9,900 yr B. P. The result of the catastrophic release of meltwater was a braided stream regime for the Mississippi River and a gradual divergence of the river from the Eastern Lowlands (Royal *et al.* 1991). Because of the gradual movement of the braided stream regime from west to east within the valley, relict braided terraces and backswamp deposits of late glacial age are found in the Western Lowlands. These geomorphic changes greatly affected the vegetation of this region. The abandoned terraces provided the disturbance regime for succession of early pioneering

species of grasses. In addition, the presence of a potentially terrain-modifying megafauna (proboscideans and large ground sloths) may have cleared significant patches of land (Owen-Smith, 1987, 1988). The combination of the occurrence of adapted megafauna to open grasslands and geomorphic instability of the large river valleys due to the catastrophic release of glacial meltwater warrant a re-evaluation of the paleoenvironments in relation to the early archaeology of the region. Analysis of the megafauna remains from the Mississippi River Valley and similar regions provides just such an opportunity.

Chapter IX

Discussion

The history of Quaternary vertebrate paleontology of the Central Mississippi Valley is rich, and yet relatively uninvestigated. This has principally been due to the fact that there is no apparent association with humans and the geologic context of the bulk of the fossils. This is bias is not limited to the Mississippi Valley. The radiocarbon records for late Wisconsinan faunas demonstrate a strong bias for those assemblages associated with human activities (Meltzer & Mead, 1985). Reports have been produced for only two *in situ* finds, the full glacial Nonconnah Creek mastodon (Brister *et al.* 1981) and the late glacial valley train deposit containing the stout-legged llama (*Paleollama mirifica*) (Graham, 1990). As previously mentioned, the context of the fossils has led to the misconception that their contribution to vertebrate paleontology and the early archaeology is inconsequential. However, analyses of these gravel bar faunas provide potentially significant paleoecological information. A total of 610 elements have been identified of grassland taxa (bison, horse, mammoth, Harlan's muskox, American lion, Harlan's ground sloth, giant tortoise) and 431 of woodland and forest edge taxa (deer, elk, mastodon, black bear, Jefferson's ground sloth, tapir, long-nosed peccary, beautiful armadillo, turkey) from the Connaway Collection (Figure 6). In contrast to the earlier published paleovegetation record, the bias of open versus woodland or forest edge adapted species in the Connaway Collection lends support for the hypothesis that there were significant areas and periods of time in which grassland was present in the river valley. Paleontological faunas from nearby river valleys, and tributaries of the Mississippi River (Finch *et al.* 1972; Hemmings, 1982; Kaye, 1972), further

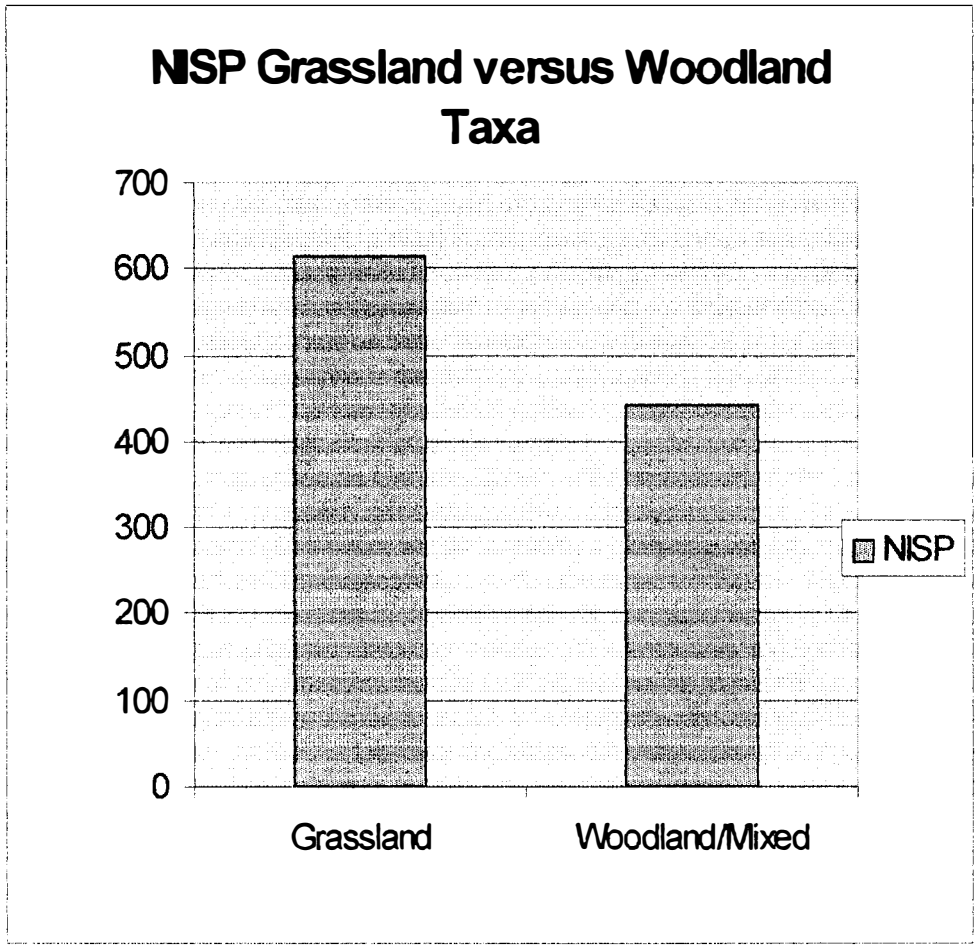

Figure 6. NISP of open grassland adapted vertebrates contrasted with those adapted to woodland/mixed environments from the Connaway Collection.

support this premise. In addition, late Wisconsinan faunas from east and west of the study area contain open grassland adapted micro-vertebrates (Graham *et al.* 1981; Graham & Kay, 1988; Guilday *et al.* 1971; Guilday *et al.* 1978; Hawksley *et al.* 1973; Klippel & Parmalee, 1982*a* ; Lundelius *et al.* 1983; Parmalee *et al.* 1969; Parmalee & Oesch, 1972; Sealander & Heidt, 1990; Semken, 1983, 1984,1988; Schubert, 1997).

As previously noted, meso-scale paleo-vegetation reconstruction demonstrates no permenent presence of grasslands until approximately 8,000 yr B. P., or the onset of the Hypsithermal (Delcourt *et al.* 1997*a*). There is evidence indicating the presence of open areas during the late glacial in the general region (Delcourt *et al.* 1997*b*). Periods of significantly large areas of open grasslands could have been present based upon a micro-scale paleo-environmental domain (Delcourt & Delcourt, 1988). Some of the inconsistency between plant and vertebrate paleoecological record may be due to the probability that pollen responses to climate change may lag up to 200 hundred years in relation to animal responses to environmental perturbation (Davis & Botkin, 1985; Davis, 1986). Although the NISP values reported appear high, the accumulation of the specimens may not have occurred over a vast period of time. It is therefore possible to hypothesize that the grassland adapted animals found in the valley could have lived and died during periods of early succession of grasses on abandoned braided terraces of a gradually eastward moving Mississippi River. It is also reasonable to hypothesize that 100 to 200 years at a time would be more than enough time for the accumulation of the fossils later recovered on late Holocene gravel bars. Guilday (1984) hypothesized that open grassland environments, as evidenced by the presence micro-mammals in the Appalachians, may have been ephemeral. This

postulate may well apply to the grassland adapted large mammals found in the river valleys of the Midsouth.

The dichotomous record of the Mississippi River Valley is somewhat similar to that of the Mammoth Steppe (treeless sub-arctic grassland). Palynological research in the Mammoth Steppe does not provide data that supports the presence of large grassland for the large caecalid mammals (Colinvaux, 1980, 1986; Colinvaux &West, 1984; Cwynar & Ritchie, 1980). However, the overwhelming numbers of steppe adapted mega-mammals do provide unequivocal evidence of large areas of open grasslands for the last glacial period (Guthrie 1982, 1990). A lack of small mammals during the Pleistocene has also been used to argue against large areas of grasslands for the Mammoth Steppe (Colinvaux & West, 1984). Guthrie (1990) argues, that unlike regions south of the ice sheets, small mammals proved not to be good paleoenvironmental indicators. Instead, large mammals were because they were better able to move and obtain nutritive substances in shallow snow. In many regards the fauna of the Mammoth Steppe was an antithesis of those south of the ice sheets. The Mammoth Steppe contained a relatively harmoniously grassland adapted fauna, and the southern faunas are characterized as representing a disharmonious mosaic. Presence of grassland habitats in the Central Mississippi Valley is indicated from the small and large vertebrate paleontological record and the paleovegetation when evaluated with a fine-grained analysis. This may be best exemplified by the gradual rise of ironwood (*Ostrya/Carpinus*) from the late glacial into the early Holocene, 12,000 to 10,000 yr B.P. (Delcourt & Delcourt, 1994). This gradual increase in ironwood over time meant an increase in grasses and shrubs in the Central Mississippi Valley and would have been a natural attraction for Pleistocene

megafauna, and is consistant with the period of initial colonization of North America by aboriginal populations.

The breakup of the late Wisconsin mosaic paleocommunities and the geomorphological instability of the Mississippi River caused by the flow of glacial meltwater the factors influencing the opening of large tracts of grasslands. The openings of these tracts of grassland resulted in colonization by both large and small open prairie adapted mammals. It can therefore be hypothesized that significant areas of open grasslands existed in the major river valleys of the eastern United States. These grasslands may have also enabled the prairie adapted small vertebrate species, such as thirteen-lined ground squirrel and the plains pocket gopher, to migrate eastward to the Midwestern plains during the breakup of the late glacial disharmonious communities. It can be argued that these prairie adapted small mammalian species were already well established in the Plains during the Wisconsinan (Graham *et al.* 1987), and therefore possibly became extirpated in the southeastern United States. However, during the waning of the last glaciation, mammals in various size classes migrated into suitable habitats and avoided extinction or extirpation (Guthrie, 1982, 1984, 1990). In addition, these large openings of grasslands attracted large mammals that may have been the preferred prey of the early fluted- point making human populations. The river valleys of the southeastern United States would have been an ideal migration route for the first people as well. The major river valleys with their abundant animal and lithic resources would have provided routes for invading aboriginal groups in the New World. Travel down the Mississippi River via watercraft has been hypothesized as a potential route to the Gulf of Mexico and eventually Central and South America (Faught, 1996).

This paleoecological interpretation of the large mammals found in the Central Mississippi Valley provides an alternative hypothesis for the Early Paleoindian period of the region (Ruddell, 1998; Ruddell & Davenport, 1999). Early attempts to reconstruct the subsistence and migration strategies of the first people of the eastern woodlands of North America suggests that the big game hunting Clovis adaptation was inappropriate for the southeastern United States. Meltzer (1984, 1988) and Meltzer and Smith (1986) have proposed that the early settlers were generalists based upon the highly diverse faunal and floral communities encountered. No subsistence differences from the Paleoindian period to the Early Archaic period were suggested (Meltzer & Smith, 1986). This model assumes the southeastern region was made up of closed canopy forests. However, as previously noted, the concept of a paleo-community during the late Wisconsinan is not reasonable. This is due to the fact that these past ecological communities were in the process of breaking up as a result of the individualistic responses by both plant and animal species. The timing of the breakup of the disharmonious paleo-communites and initial migration of early human settlers may be key to what resources people utilized. Kelly and Todd (1988) proposed a reliance on a portable bifacial tool kit and a technological based mode of colonization. Their theory further suggests that the early migration into new regions be based upon terrestrial game, but not restricted entirely to megafauna. They suggest that this is necessary until people learn what plant resources were accessible during colonization of new regions. While this scenario has some very attractive and logical applications for Paleoindian adaptations to various environments, it appears to be especially applicable to the Plains environments of the United States. However, it may be inappropriate for the non-glaciated eastern woodlands. In

the eastern river valleys, there are abundant lithic sources of glacially derived and transported chert. The fact that there was a wealth of chert from Crowlys Ridge in the Mississippi River Valley has been suggested as a reason for the early occupations of these regions (Morse & Morse, 1983). The high concentrations of fluted points in these regions have been used to suggest that the river valleys of the eastern United States were staging areas and a leapfrog mode of migration was employed (Anderson, 1991). In other words, in contrast to the environmental deterministic (Meltzer, 1984, 1988; Meltzer & Smith, 1986) and technology-oriented theories (Kelly & Todd 1988), Anderson's theory is place oriented. There are major differences between Anderson's staging areas, Kelly and Todd's technology driven theory, and Meltzer's environmental deterministic explanation. The distinctions lie in the fact that Anderson's theory is better supported by both the archaeological record and by proxy, the vertebrate paleoenvironmental record and upon more detailed examination the paleovegetation and geomorphological record of the southeastern United States. The abundance of chert and the presence of a diverse megafauna provided the early immigrants a wealth of raw materials and a rich subsistence base.

The argument for megafauna adaptation for the eastern forest based upon western Clovis archaeology put forth by Mason (1962) may have come full circle. Research in the eastern United States for the last several decades has attempted to portray the eastern woodlands Paleoindian phenomena as one in contrast with the classic western Clovis adaptation. It has been suggested that the early fluted point cultures of the eastern woodlands were wandering foragers with no structured spatial behavior and therefore, never left much in the way of archaeological evidence such as megafauna kill sites (Meltzer, 1984, 1988; Meltzer & Smith,

1986). David Brose (1978) best summarized this idea in regards to the Paleoindian occupation of the eastern United States by saying it appears that they

"ate nothing and lived as isolated individuals".

Much of the alternative environmental interpretation can be traced back to the influence of the "New Archaeology" approach and the influence of Binford (1980). It must be stated that much of the pioneering ethnoarchaeology done by Binford and others on modern hunter/gatherers relied on data gathered from people living in marginal environments. The late Wisconsinan environments of southeastern United States encountered by the first people to occupy the region were quite the opposite. Instead, it is relevant to note that because of the mosaic character of the late Wisconsinan, the environments were very rich and diverse.

It can also be demonstrated that there is an inherent geoarchaeological bias for the archaeology of this period for all of North America. The vast majority of kill sites that have been found for this period have one environmental constant that clearly defines this geoarchaeological bias. Paleohydrological and geoarchaeological evidence from Clovis-age sites demonstrates that drought conditions existed. Water tables were lowered during this period, with a subsequent rise that corresponded with the Younger Dryas Chronozone and the Folsom Horizon (Haynes, 1991, 1993, 1995). This rise in the water table created the algae rich black mat found at many Paleoindian sites in the Southwest. Haynes (1993) suggests that the formation of the algal black mat is the most reliable stratigraphic marker for the Pleistocene-Holocene boundary. It conformably overlies the Clovis age deposits and has allowed for the preservation of both *in situ* kill sites and natural die off events. The geology of the San Pedro Valley Clovis sites in Arizona is a good example of the geoarchaeological bias also found in the

river valleys of the Midsouth. The Murray Springs Formation lies stratigaphically beneath the Clovis age Lehner Ranch formation and has been dated between 29,000 to 12,000 yr B.P. (Haynes, 1987). A rich and diverse Rancholabrean fauna is contained in the Murray Springs Formation (Lindsey, 1984). However, the depositional environment was not conducive to preservation of archaeological evidence similar to the later Clovis age deposits (Ruddell, 1986). This is the same sort of high erosional environments that characterizes the river valleys of the southeastern United States (Dunnel, 1990). The deflation and subsequent rise of the water table approximately 10,800 years ago provided the ideal taphonomic circumstances for the preservation of Clovis kill sites (Haynes, 1991, 1993, 1995). This is also evident for approximately the same time period for the wet sites in Florida which also provide evidence of a lowering of the water table during the Clovis period (Faught, 1996). The rise in the water table also corresponds with the end of the extinction event (Mead & Meltzer, 1984; Meltzer & Mead, 1983, 1985) at 10,800 yr B. P. and the emergence of the first sub-regional cultural manifestations in the Midsouth (Goodyear, 1982). Ages younger than approximately 10,800 yr B.P., for extinct megafauna have been found to be unreliable and likely too young because of faulty dating methods and lack of properly preserved organic material used to obtain the dates (Haynes, 1993; Stafford, 1990, 1991).

Evidence in the Mississippi Alluvial Valley for the early Paleoindian occupation was concentrated in the Crowleys Ridge area, a rich source of chert. Only later during the Dalton period are sites found significant distances from the alluvial valley (Gillam, 1995; 1996a; 1996b). This was manifested only after the megafauna extinction event and as the emergence of the Dalton culture was taking place. The early occupation by fluted point cultures are instead

mainly found in large alluvial valleys, where actions of the river would more than likely obscure or destroy *in situ* sites similar to those described by Haynes (1991). However, a very diverse megafauna once existed in this valley. Thus, as an alternative or additional hypothesis to the rich chert sources being the sole reason for the early settlement in the Mississippi Alluvial Valley, the presence of a diverse megafauna would have been a prime factor in attracting human settlement. It can therefore be concluded that the earliest people that made their way into the river valleys of the Midsouth found not only rich sources of chert, but also an abundant megafauna. As previously mentioned, geomorphic factors are the likely reason there is still no direct association between human activities and the megafauna (Dunnel, 1990). It is also possible that archaeologists have not been looking in the correct geologic deposits.

As more evidence for the early Paleoindian period of the southeastern United States is amassed (Anderson & Faught, 1998), the theory that Clovis may have originated in the East as opposed to the West (Stanford, 1991) becomes more viable. However, a total of only four unequivocal kill sites have been recorded for the southeastern region of the United States. These include the Little Salt Spring Site, Florida (Clausen *et al.* 1979), Wacissa River, Florida (Webb *et al.* 1984), Coates-Hinds Site in middle Tennessee (Breitburg & Broster, 1995), and on the fringe of what many archaeologists consider the Southeast, the Kimswick site in Missouri (Graham *et al.* 1981). It is important to note that only the Kimmswick site had Clovis points associated with mastodon. The other three are chronologically compatible with Clovis, but not necessarily Clovis in a strict sense. Early Paleoindian manifestations in the Southeast have been routinely described as only isolated fluted point finds and sparse lithic scatters. Because of this, the early groups occupying the

southeastern woodlands have been routinely interpreted as being highly mobile and general foragers. In contrast, the boreal Paleoindian lithic assemblages are described as being efficient and orderly, while those in the woodland environments were indulgent and consumptive (Meltzer, 1984, 1988; Meltzer & Smith, 1986). Western Clovis lithic assemblages are also in stark contrast to those in the East. Western Paleoindian tool kits were efficiently organized, portable, and based upon large bifaces (Frison, 1978,1982; Goodyear, 1979; Haynes, 1980; Kelly & Todd, 1988). The difference between western and northern assemblages to eastern woodland assemblages has led to mistaken impression that the eastern finds represent expedient tools. Alternatively, it has been suggested that the eastern assemblages represent a formal bifacial fluted lanceolate point that when hafted would have allowed deep penetration into large mammals of the now extinct megafauna as well as those smaller taxa comprising an extant faunal assemblage (Morse *et al.* 1996). However, the combined efforts of professional archaeologists in the southeastern region has changed the manner in which the Early Paleoindian Period is viewed. In general, assemblages that compare similarly to other regions of North America in extent and diversity are being studied in the Southeast (Anderson, 1990, 1991, 1995*a*, 1995*b*; Anderson & Sassaman, 1996; Faught, 1996; Faught *et al.* 1994). Although there are obviously a lack of kill sites known in the southeasern United States, it is still my contention that lithic assemblages recovered in the region do indicate a substantial dependence upon the extinct megafauna of the late Pleistocene.

It is possible to hypothesize that the valleys of the eastern United States may have been some of the earliest settlement routes in North America. In addition, they likely provided

migratory routes for the eventual occupation of North America, Central America, and South America. It may have also been a route for sites such as Monte Verde. It is my hypothesis that the gravel bar faunas in the Connaway Collection and similar assemblages provide a means for answering important paleoenvironmental and archaeological questions pertinent to the initial occupation of the Midsouth as well as other regions of the southeastern United States.

Chapter X

Conclusions and Remarks

In the preceding chapters I have attempted to provide a glimpse of the physical phenomena that effected the initial peopling of the Central Mississippi River Valley. It is clear from this discussion that there were many variables that might have influenced colonization of the region. Multiple lines of evidence were analyzed and provided an alternative hypothesis for the subsistence practices of the early fluted-point making cultures. The working hypothesis developed herein is that the initial settlers of the region adapted to hunting large game and continued to do so until the extinction of the megafauna. This line of evidence relates to the overkill theory proposed by Paul Martin (Martin, 1973). Martin's model proposed that the early immigrants to the New World moved in a fast moving front and decimated a naiive, large, slow moving, and low reproducing group of mammals, with the result being extinction in approximately 500 years (Moisman & Martin, 1975). However, an ecological cause for this extinction has also been proposed based upon multiple lines of paleoecological data (Graham & Lundelius, 1984). The Moisman and Martin model (1975) has been highly critisized by demographers who have estimated that it would have been impossible for low density hunter and gatherers to move at the rate of speed modeled in the overkill scenario (Whitely & Dorn, 1993). Due to the fact that the evidence is mounting that humans were in the New World longer than 500 years before the megafaunal extinction, Martin's model is further invalidated. However, the timing and duration of the event may be the only flaw in the model. Indeed, when the Moisman and Martin (1975) is modified by eliminating the concept

of a fast moving front, it has been demonstrated that the extinction event still could have had an important human component (Whittington & Dyke, 1984). The most likely scenario is that the extinction event was a multifaceted event and cannot simply be explained by a single explanation. However, analysis of the last interglacial (Sangamon) demonstrates that the megafauna survived that drastic climate change (Martin, 1984). It is likely that the entrance of humans at a time of dramatic climate change may have been the impetus for the extintion of large mammals on the threshold of extinction.

The late Quaternary environments of the Central Mississippi Valley support this idea. Multiple lines of evidence lead to the conclusion that people concentrated their efforts in the vicinity of the river valley where there was an abundance of chert, and that geomorphic instability created areas of open grasslands that attracted large mammals on which to prey. If only limited or single lines of evidence are followed, different conclusions might be reached. If an archaeologist strictly looks at the lithic assemblages of this region, it might be concluded that these early people were making fluted points fashioned for hafting and used for killing big game not unlike western manifestations of Clovis. However, because of the lack of kill site associations, it has been argued that they were not using them in a similar manner to people in the western United States (Meltzer & Smith, 1986). This has led to the assumption that Paleoindians of southeastern United States are practicing a mode of subsistence similar to that of the early Archaic cultures of the region. Not until the late Paleoindian or Dalton period is there evidence of reliance on a strictly Holocene

fauna. This is also supported by the distribution fluted Clovis type and Dalton points and by my reinterpretation of the paleoecological record of the region. Many archaeologists have used the chronological vegetation maps for the region to conclude that during the late Wisconsinan the area was closed forest. However, as demonstrated in this undertaking, these environments were undergoing rapid changes during the late Wisconsinan. Only until the complex interaction of climate and geomorphology is considered, does an alternative picture arise for the paleoecology of the alluvial valley.

The past environments of the Pleistocene require a multi-level method of investigation. Much of the phenomena that has been observed for this time period might likely have multiple explanations in both time and space. Because of this multiple working hypotheses are deemed appropriate for explaining the complex environments of the late Pleistocene. T. C. Chamberlain (1897) stated it best:

> "There are two fundamental modes of study. The one is an attempt to follow by close imitation the processes of previous thinkers and to acquire the results of their investigations by memorizing. It is a study of a merely secondary, imitative, or acquisitive nature. In the other mode the effort to think independently, or at least individually. It is primary or creative study. The endeavor is to discover new truth or to make a new combination of truth or at least develop by one's own effort an individualized assemblage of truth. The endeavor is to think for one's self, whether the thinking lies wholly in the fields of previous thought or not."

By following multiple lines of evidence, not the generally accepted ideas, a researcher can avoid a bias trap. This simply assumes the possibility that there are multiple causes for empirical evidence. We are often predisposed to be satisfied when we find a logical causal agency for a particular phenomenon. However, I would argue that alternative line of evidence should also be pursued.

The preceding discussion has provided the essence for the research, ideas and suppositions contained in this dissertation. My goal has been to provide an alternative explanation for the early colonization of the Central Mississippi Valley based upon the complex environments aboriginal peoples encountered upon their arrival. The search for western Clovis kill sites might not be a reasonable method of searching for or explaining the Paleoindian occupation in the Midsouth. Environmentally, the region was very dissimilar from many of the sites in the West. Furthermore, there is no evidence that they were chronologically compatible. New research seems to indicate the possibility that the Paleoindian occupation of the eastern United States was earlier than occupation in the western United States.

The vertebrate fauna of the Connaway Collection from the Central Mississippi Valley, along with other lines of evidence, provides an alternative hypothesis for the subsistence practices of the Early Paleoindian Period. This alternative hypothesis is grounded upon a combination of the abundance of open grassland-adapted megafauna in the region of this study and other valleys close to the region. Megafauna is rarely used as a paleoenvironmental indicator, but fine-grained analyses of other lines of evidence indicate its validity for the region in question. In addition to the megafauna

described the presence of key micro-mammals in nearby paleontological sites, a finer detailed examination of the paleovegetation record, and the distribution of fluted points of the area supports my premise. It is therefore my hypothesis that, within the Central Mississippi Valley, the west to east movement of the glacially influenced braided stream regime during the late Wisconsinan produced the opening of areas of disturbance on abandoned terraces in which gramineous vegetation was the primary successional vegetation. The alluvial processes of the river valleys also illustrate the reason for the scarcity of *in situ* kill sites during occupation of fluted point cultures for the same time interval. The faunal elements represented in these assemblages are accordant with the high concentrations of fluted points discovered in these regions and are denotative of a big game hunting strategy. An admixture of rich grassland and mixed woodland adapted megafauna and rich sources of chert in the river valleys of the Midsouth may have attracted the earliest immigrants to the region. It is therefore reasonable to suggest that the rich late Pleistocene megafauna of the region was a major factor for the initial colonization event. Only after the 10,800 yr B. P. extinction episode is there an indication of the rise of sub-regional cultural manifestations and subsistence on a strictly Holocene fauna. This in itself is an excellent example of a cultural change and adaptation during a period of dramatic environmental change. Future research in this region should be concentrated on looking for evidence earlier than this date.

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Appendixes

Appendix A

Photo Plates of Vertebrate Fossils from the Connaway Collection

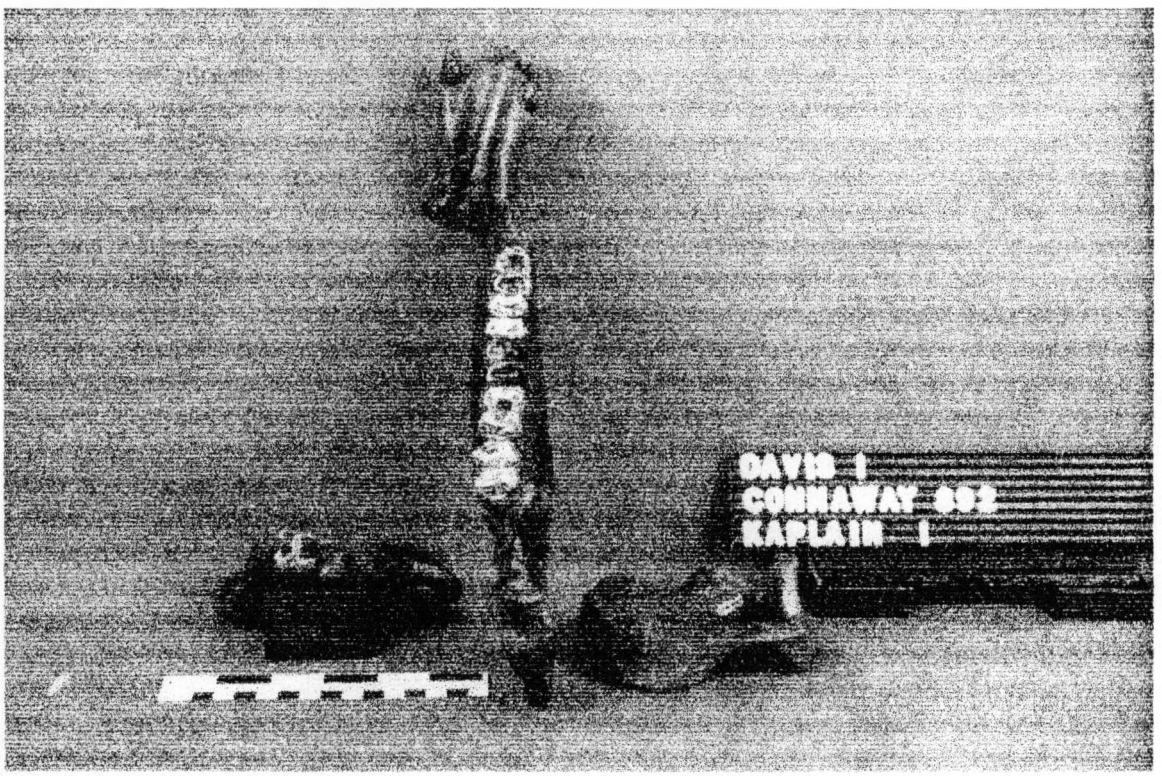

Plate 1. Mandible, partial maxilla and occiput of *Tapirus haysii*. Connaway Collection, Memphis Pink Palace Museum.

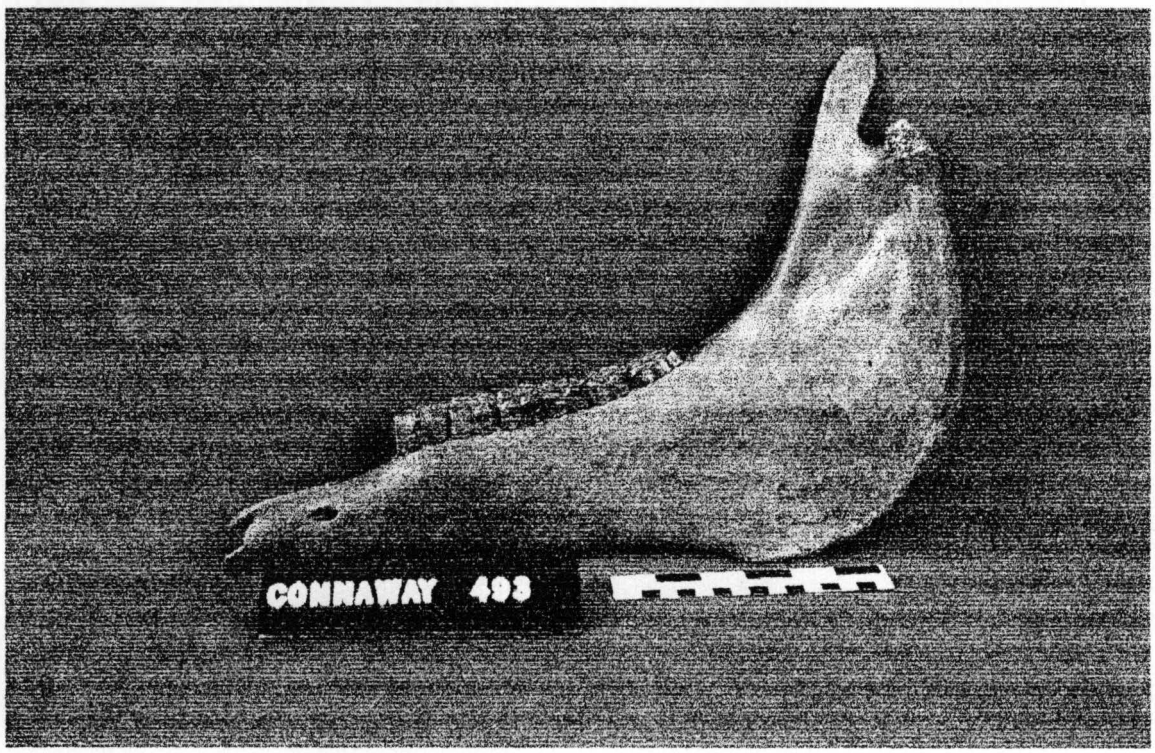

Plate 2. Mandible, *Equus* sp. Connaway Collection, Memphis Pink Palace.

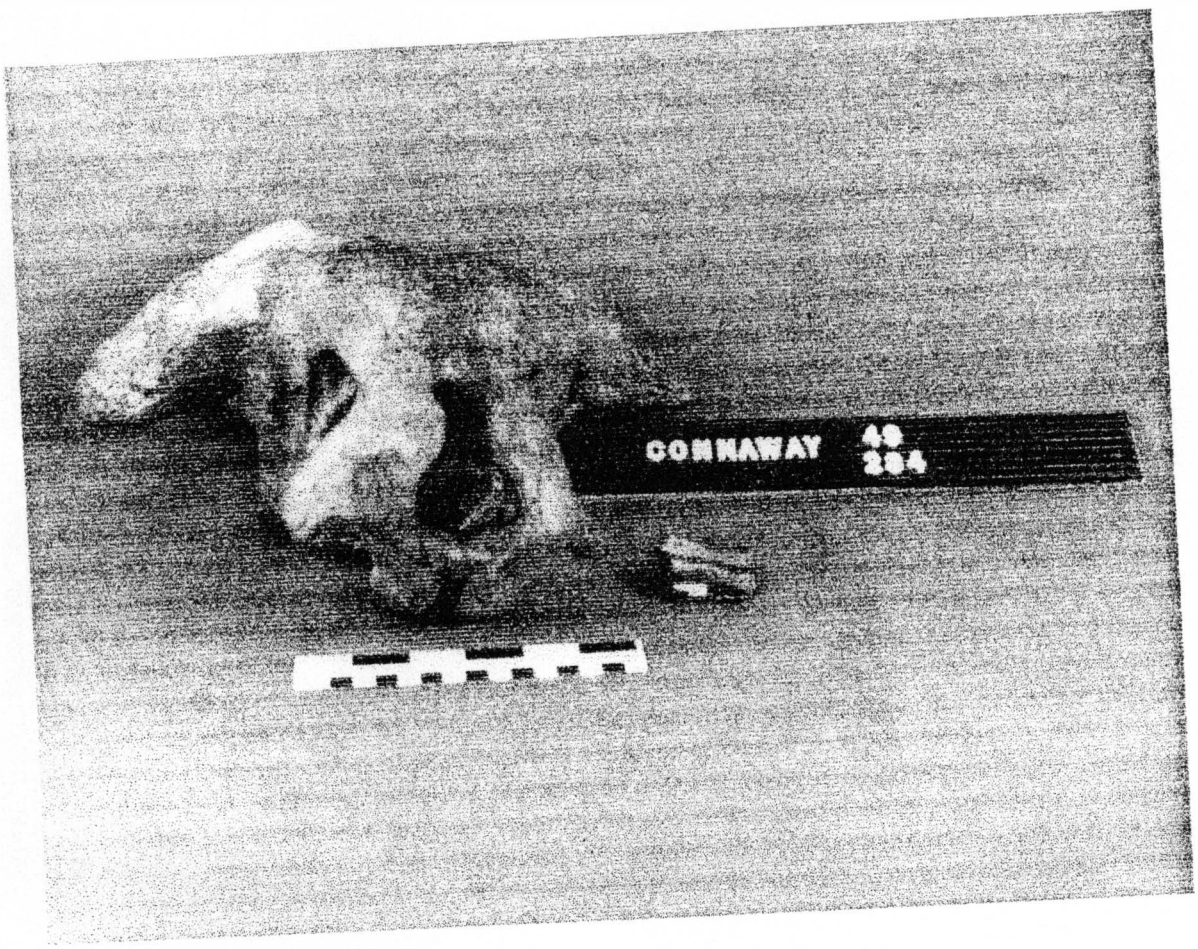

Plate 3. Skull and cheek tooth of *Bootherium bombifrons.* Connaway Collection, Memphis Pink Palace Museum.

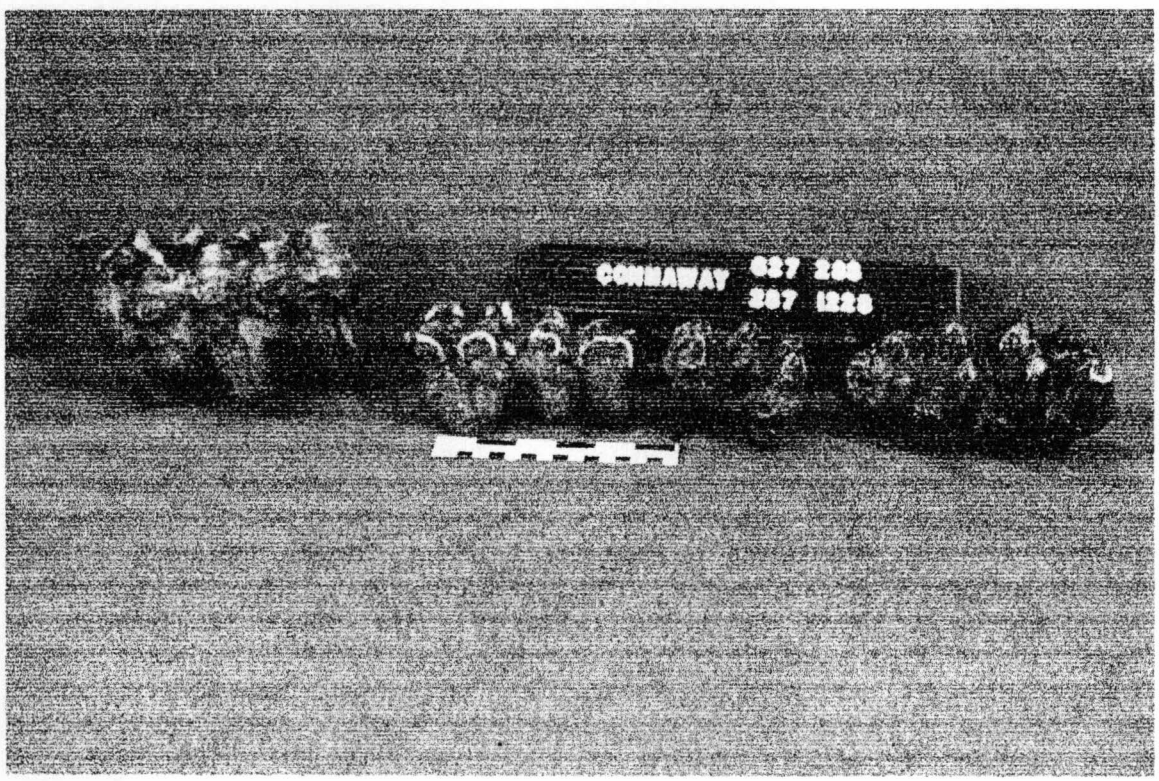

Plate 4. Cheek teeth *Mammut americanum.* Connaway Collection, Memphis Pink Palace Museum.

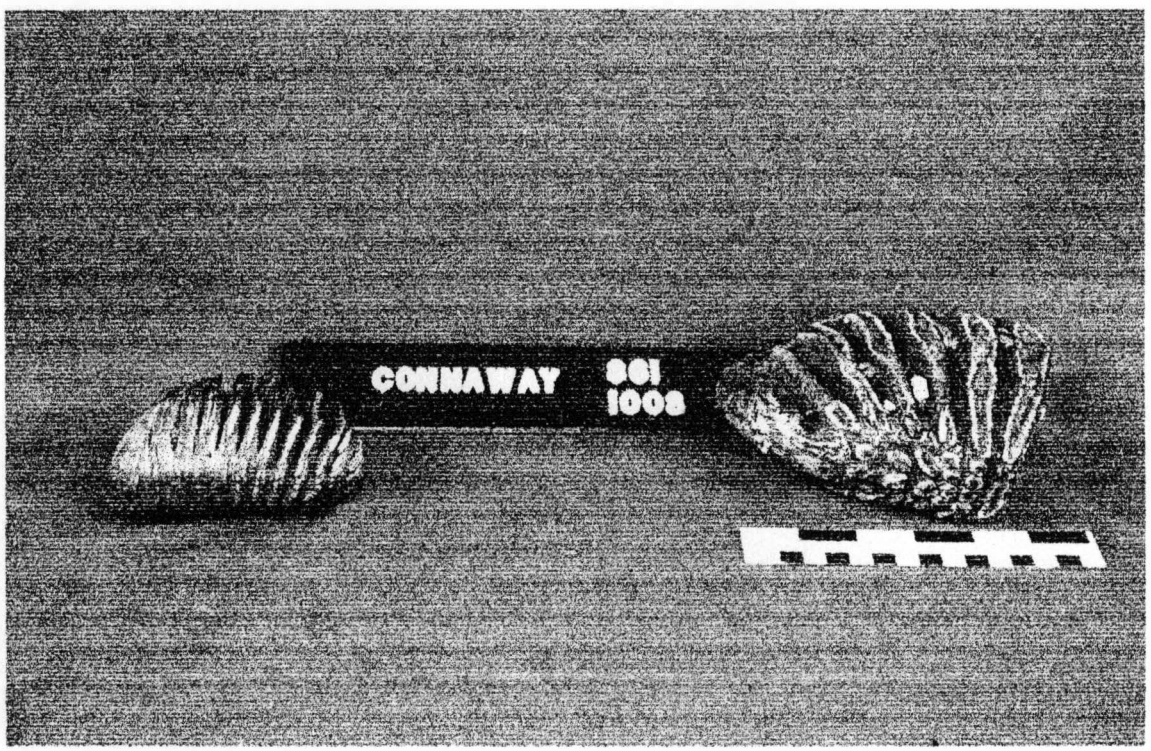

Plate 5. Cheek teeth *Mammuthus columbi*. Connaway Collection, Memphis Pink Palace Museum.

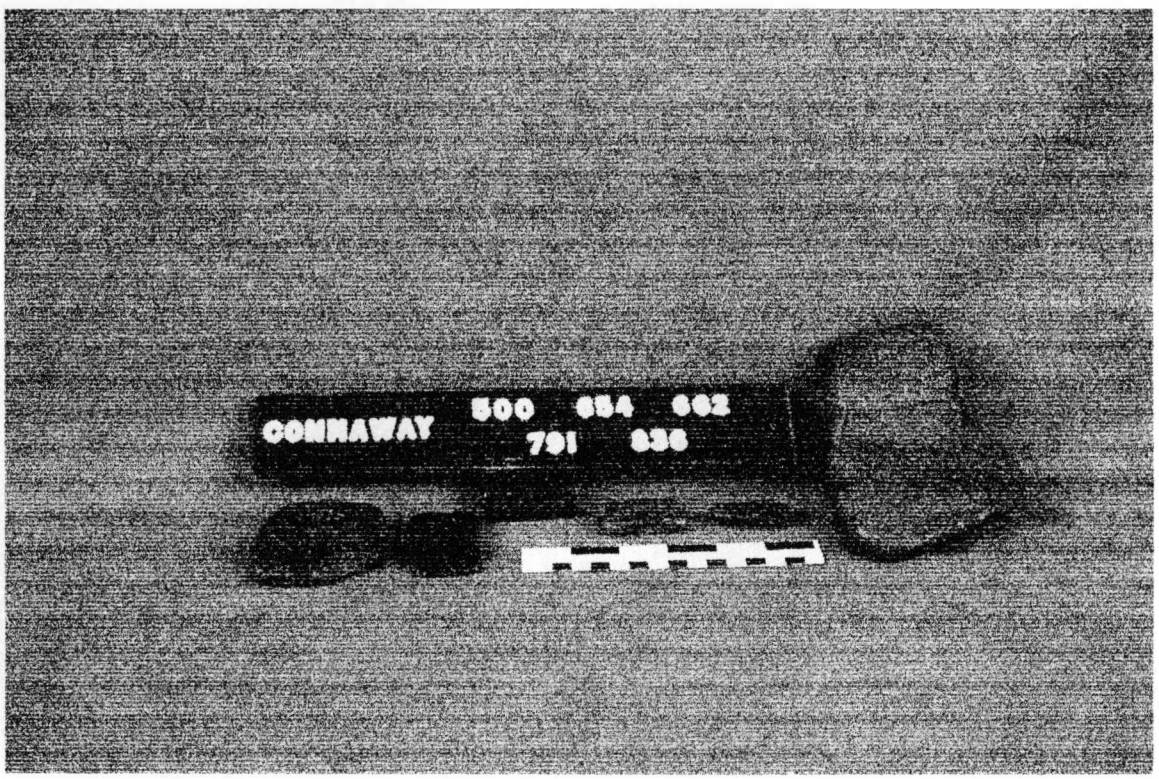

Plate 6. Plastron and carapace fragments of *Chrysemys* sp. and *Geochelone crassiscutata*. Connaway Collection, Memphis Pink Palace Museum.

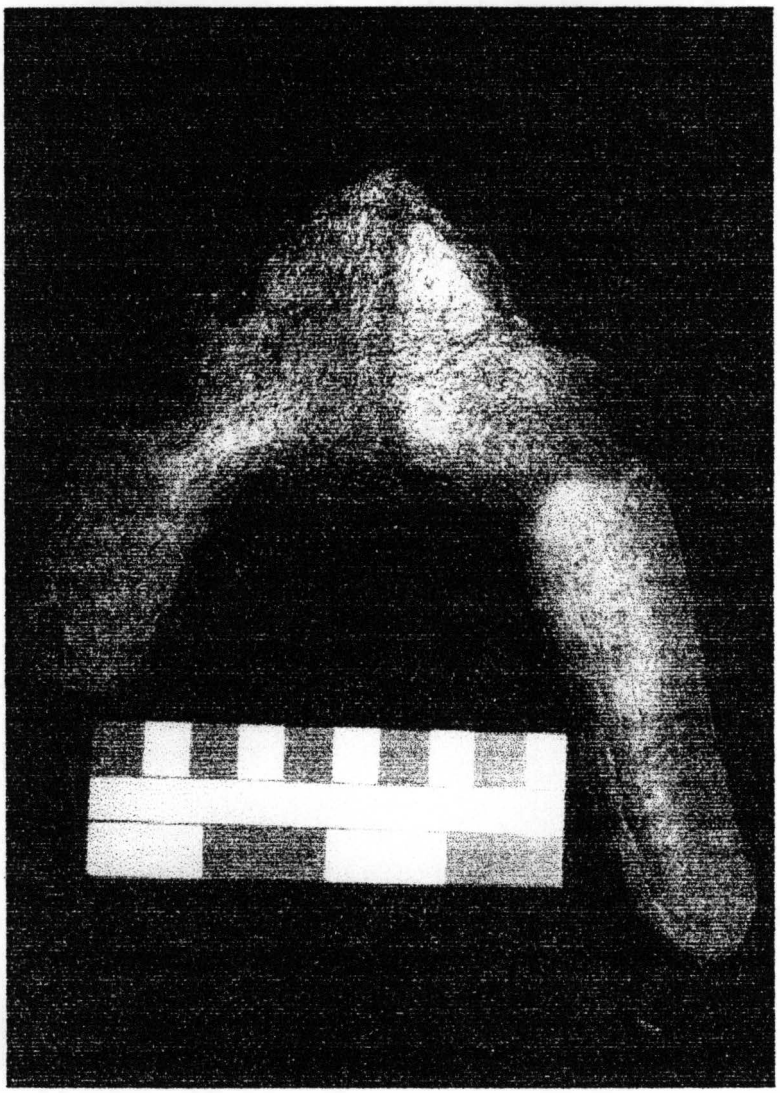

Plate 7. Partial cranium and antler bases, cf. *Rangifer* sp. indet. Connaway Collection, Memphis Pink Palace Museum.

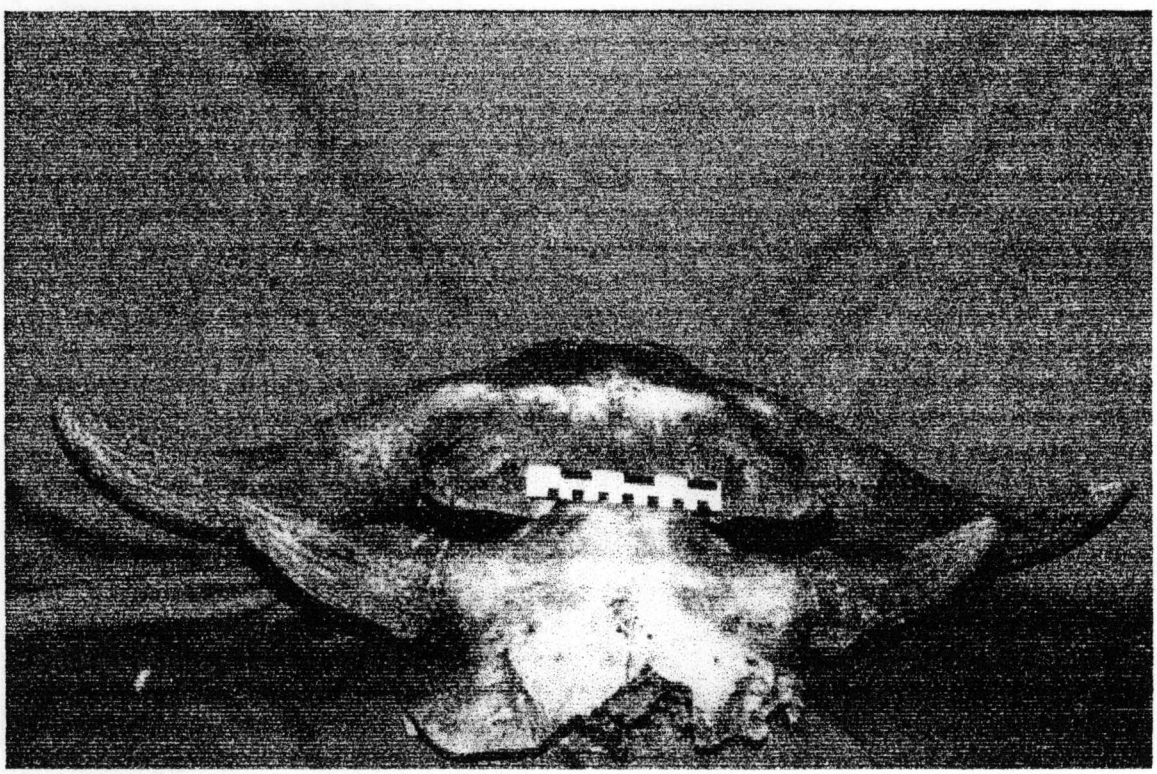

Plate 8. Skulls and horn cores, *Bison bison bison* male (foreground) and *Bison bison antiquus* male (background). Connaway Collection, Memphis Pink Palace Museum.

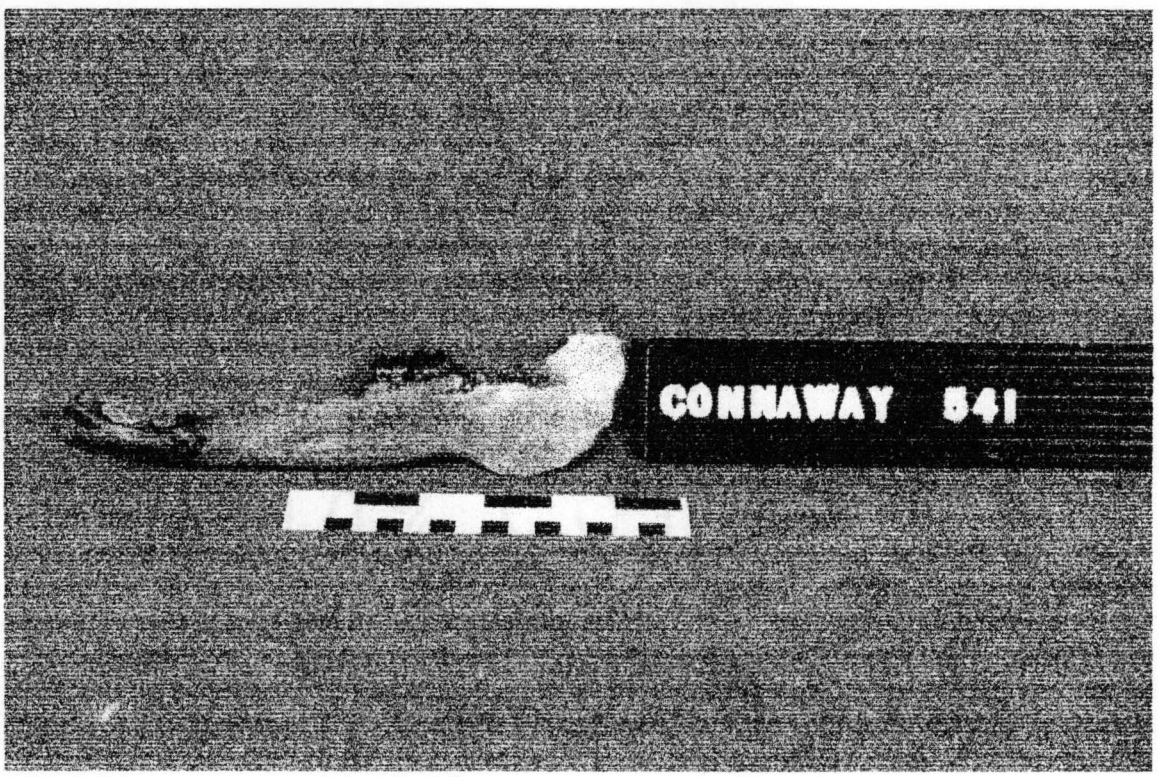

Plate 9. Mandible, *Myohylus fossilis*. Connaway Collection, Memphis pink Palace Museum.

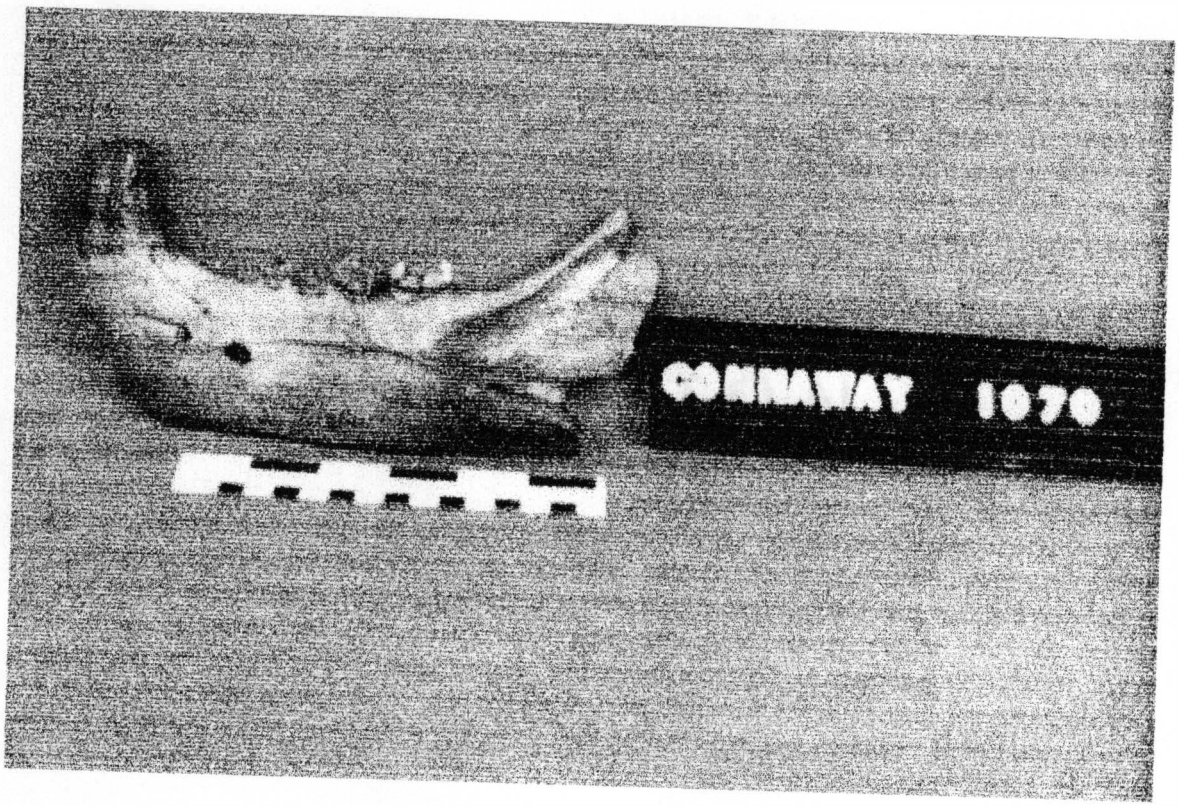

Plate 10. Mandible, *Panthera leo atrox.* Connaway Collection, Memphis pink Palace Museum.

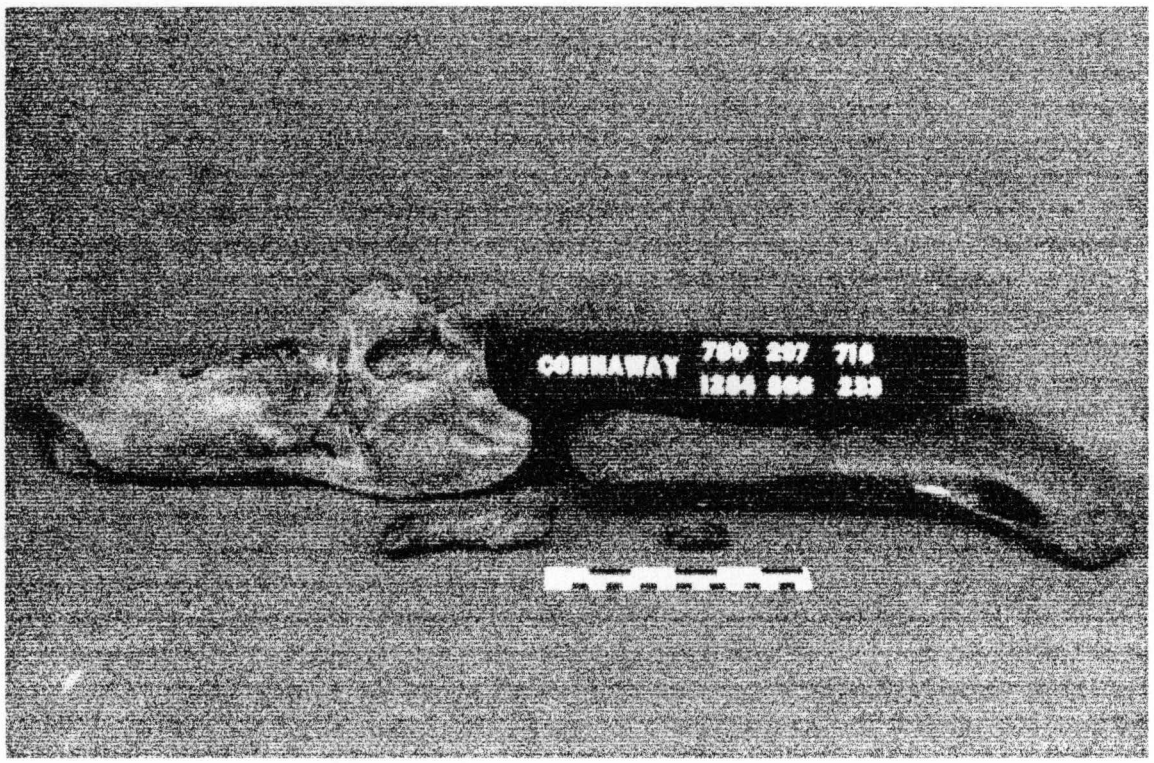

Plate 11. Mandible *Paramylodon harleni*, metacarpal, cheek tooth, and humerus, *Megalonyx jeffersonii*. Connaway Collection, Memphis Pink Palace Museum.

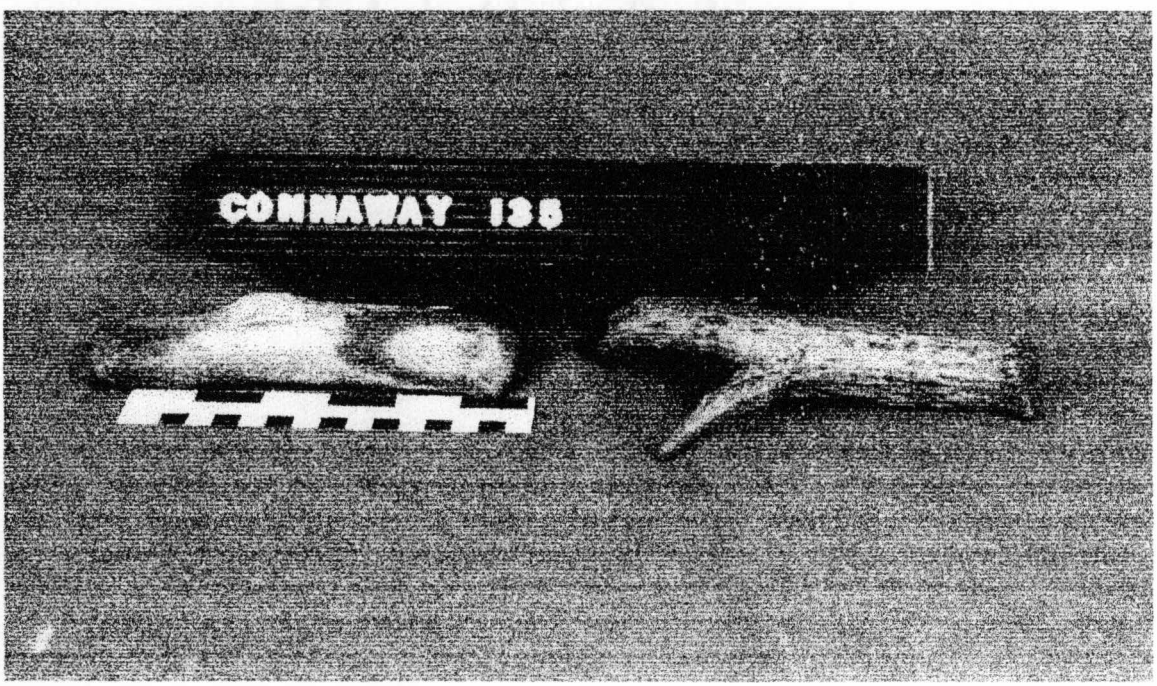

Plate 12. Comparison of modified antler (left) to unmodified antler, *Odocoileus virginianus*. Connaway Collection, Memphis Pink Palace Museum.

Appendix B
Identified Specimens from the Connaway Collection

Taxa	Element	Number	Appearance
Alligator mississippiensis	Dermal scute	1995.40.336	Fossil
Alligator mississippiensis	Femur fragment	1995.23.82	Fossil
Aplodinotus grunniens	Maxilla fragment	1995.7.179	Fossil
Aplodinotus grunniens	Vertebra centra	1995.40.335	Fossil
Apalone sp.	Plastron fragment	1995.38.33	Fossil
Apalone sp.	Plastron fragment	1995.23.152	Fossil
Apalone sp.	Plastron fragment	1995.7.695	Fossil
Apalone sp.	Plastron fragment	1995.22.80	Fossil
Apalone sp.	Plastron fragment	1995.7.201	Fossil
Apalone spinifera	Carapace fragment	141	Fossil
Apalone spinifera	Carapace fragment	109	Fossil
Arctodus sp.	Proximal femur	1995.22.10	Fossil
Arctodus sp.	Distal humerus	1995.7.808	Fossil
Ardea herodius	Tibiotarsus	1995.23.196	Fossil
Attractosteus spatula	Vertebra centra	101	Fossil
B. b. occidentalis	Horn core tip	1995.31.20	Fossil
B. b. occidentalis	Horn core	1995.7.1181	Fossil
B. b. occidentalis	Skull w/horn core	1995.7.1092	Fossil
B. b. antiquus	Horn core	1995.40.129	Fossil
B. b. antiquus	Horn core	1995.7.1083	Fossil
B. b. antiquus	Horn core	1995.7.116	Fossil
B. b. antiquus	Horn core w/ partial skull	1995.7.247	Fossil
B. b. antiquus	Horn core w/ skull frag	1995.31.5	Fossil
B. b. antiquus	Horn core	1995.23.122	Fossil
B. b. antiquus	Skull frag w/ horn core	1995.23.110	Fossil
B. b. antiquus	Skull frag w/horn core	1995.40.130	Fossil
B. b. antiquus	Skull frag w/horn core	1995.7.518	Fossil
B. b. antiquus	Skull w/ horn cores	1995.22.1	Fossil
B. b. antiquus	Horn core	1995.7.1180	Fossil
Bison bison bison	Horn core w/ skull frag	1995.7.1151	Recent
Bison bison bison	Skull w/horn cores	1995.7.1032	Recent
Bison bison bison	Skull w/horn core	1995.7.650	Recent
Bison bison bison	Skull w/horn cores	1995.23.120	Recent
Bison latifrons	Distal humerus	1995.15.1	Fossil
Bison latifrons	Distal radius	1995.23.1	Fossil
Bison latifrons	Horn core	1995.24.1	Fossil
Bison latifrons	Horn core	1995.7.1054	Fossil
Bison latifrons	Horn core	1221	Fossil
Bison latifrons	Horn core tip	1995.7.946	
Bison latifrons	Metatarsal	205	
Bison sp.	Femur	1995.31.7	Fossil

Bison sp.	Lumbar Vertebra	1995.38.34	Fossil
Bison sp.	Mandible	1995.31.24	Fossil
Bison sp.	Metatarsal	1995.31.6	Fossil
Bison sp.	Metatarsal	1995.36.11	Fossil
Bison sp.	Radius	1995.38.11	Fossil
Bison sp.	Ramus of Mandible	1995.31.23	Fossil
Bison sp.	Tibia	1995.38.10	Fossil
Bison sp.	Astragalus	1995.7.431	Fossil
Bison sp.	Atlas	1995.30.16	Fossil
Bison sp.	Atlas	1995.40.131	Fossil
Bison sp.	Atlas	1995.7.112	Fossil
Bison sp.	Atlas	1995.7.226	Fossil
Bison sp.	Atlas	1995.7.637	Fossil
Bison sp.	Atlas	1995.7.902	Fossil
Bison sp.	Atlas	1995.7.778	Fossil
Bison sp.	Atlas	1995.7.115	Fossil
Bison sp.	Atlas	1995.7.711	Fossil
Bison sp.	Atlas	1995.7.820	Fossil
Bison sp.	Axis	1995.40.185	Fossil
Bison sp.	Calcaneum	1995.7.771	Fossil
Bison sp.	Calcaneum	1995.7.892	Fossil
Bison sp.	Calcaneum	1995.7.927	Fossil
Bison sp.	Cervical vertebrae	1995.40.151	Fossil
Bison sp.	Cheek tooth frag	1995.22.38	Fossil
Bison sp.	Cheek tooth frag	1995.22.39	Fossil
Bison sp.	Cheek tooth frag	1995.22.40	Fossil
Bison sp.	Cheek tooth frag	1995.22.41	Fossil
Bison sp.	Cheek tooth frag	1995.22.42	Fossil
Bison sp.	Cheek tooth frag	1995.22.43	Fossil
Bison sp.	Cheek tooth frag	1995.22.44	Fossil
Bison sp.	Cheek tooth frag	1995.22.45	Fossil
Bison sp.	Cheek tooth frag	1995.23.60	Fossil
Bison sp.	Cheek tooth frag	1995.38.4	Fossil
Bison sp.	Cheek tooth frag	1995.38.5	Fossil
Bison sp.	Cheek tooth frag	1995.40.307	Fossil
Bison sp.	Cheek tooth frag	1995.7.252	Fossil
Bison sp.	Cheek tooth frag	1995.7.275	Fossil
Bison sp.	Distal calcaneus	1995.7.936	Fossil
Bison sp.	Distal femur	1995.7.1184	Fossil
Bison sp.	Distal humerus	1995.7.1013	Fossil
Bison sp.	Distal humerus	1995.7.1037	Fossil
Bison sp.	Distal humerus	1995.7.739	Fossil
Bison sp.	Distal humerus	1995.7.794	Fossil
Bison sp.	Distal humerus	1995.7.884	Fossil
Bison sp.	Distal humerus	1995.7.911	Fossil
Bison sp.	Distal humerus	1995.23.134	Fossil
Bison sp.	Distal humerus	1995.30.1	Fossil
Bison sp.	Distal humerus	1995.7.1090	Fossil

Bison sp.	Distal metacarpal	1995.7.488	Fossil
Bison sp.	Distal metacarpal	1995.7.882	Fossil
Bison sp.	Distal metacarpal	1995.7.981	Fossil
Bison sp.	Distal metapodial	1995.7.912	Fossil
Bison sp.	Distal Metatarsal	1995.7.413	Fossil
Bison sp.	Distal Metatarsal	1995.23.38	Fossil
Bison sp.	Distal radio/ulna	1995.7.1198	Fossil
Bison sp.	Distal radius	1995.45.35	Fossil
Bison sp.	Distal radius	1995.7.259	Fossil
Bison sp.	Distal radius epiphysis	1995.7.819	Fossil
Bison sp.	Distal radius	1995.7.1038	Fossil
Bison sp.	Distal scapula	1995.7.1185	Fossil
Bison sp.	Femur	1995.22.5	Fossil
Bison sp.	Femur	1995.38.7	Fossil
Bison sp.	Femur	1995.40.2	Fossil
Bison sp.	Horn core fragment	1995.7.721	Fossil
Bison sp.	Horn core fragment	1995.7.806	Fossil
Bison sp.	Horn core fragment	1995.7.807	Fossil
Bison sp.	Horn core fragment	1995.7.813	Fossil
Bison sp.	Horn core fragment	1995.38.9	Fossil
Bison sp.	Humerus	1995.40.1	Fossil
Bison sp.	Cervical vert	22	Fossil
Bison sp.	Lower cheek tooth	1995.7.106	Fossil
Bison sp.	Lower cheek tooth	1995.7.22	Fossil
Bison sp.	Lower cheek tooth	1995.7.233	Fossil
Bison sp.	Lower cheek tooth	1995.7.455	Fossil
Bison sp.	Lower cheek tooth	1995.7.549	Fossil
Bison sp.	Lower cheek tooth	1995.7.580	Fossil
Bison sp.	Lower M/3	1995.7.433	Fossil
Bison sp.	Lower M/3	1995.7.649	Fossil
Bison sp.	Lower M/3	1995.7.869	Fossil
Bison sp.	Lower M/3	1995.7.915	Fossil
Bison sp.	Lower M/3	1995.7.934	Fossil
Bison sp.	Lower M/3	1995.7.109	Fossil
Bison sp.	Lower M3	1995.7.701	Fossil
Bison sp.	Lower M/3	1995.7.245	Fossil
Bison sp.	Lower molar	1995.37.6	Fossil
Bison sp.	Lower molar	1995.40.294	Fossil
Bison sp.	Lower molar	1995.40.298	Fossil
Bison sp.	Lower molar	1995.40.301	Fossil
Bison sp.	Lower molar	1995.7.1026	Fossil
Bison sp.	Lower molar	1995.7.104	Fossil
Bison sp.	Lower molar frag	1995.45.16	Fossil
Bison sp.	Lower molar M/3	1995.7.105	Fossil
Bison sp.	Lower premolar	1995.40.88	Fossil
Bison sp.	Lower premolar	1995.7.228	Fossil
Bison sp.	Lumbar vertebra	1995.40.154	Fossil
Bison sp.	Lumbar vertebra	1995.25.1	Fossil

Bison sp.	Lumbar vertebra	1995.23.192	Fossil
Bison sp.	Mandible	1995.15.2	Fossil
Bison sp.	Mandible	1995.37.7	Fossil
Bison sp.	Mandible	1995.38.1	Fossil
Bison sp.	Mandible	1995.38.2	Fossil
Bison sp.	Mandible	1995.7.141	Fossil
Bison sp.	Mandible	1995.7.142	Fossil
Bison sp.	Mandible	1995.7.143	Fossil
Bison sp.	Mandible	1995.7.236	Fossil
Bison sp.	Mandible	1995.7.237	Fossil
Bison sp.	Mandible	1995.7.238	Fossil
Bison sp.	Mandible	1995.7.240	Fossil
Bison sp.	Mandible	1995.7.248	Fossil
Bison sp.	Mandible	1995.7.249	Fossil
Bison sp.	Mandible	1995.7.4	Fossil
Bison sp.	Mandible	1995.7.445	Fossil
Bison sp.	Mandible	1995.7.479	Fossil
Bison sp.	Mandible	1995.7.507	Fossil
Bison sp.	Mandible	1995.7.78	Fossil
Bison sp.	Mandible	1995.7.79	Fossil
Bison sp.	Mandible	1995.40.127	Fossil
Bison sp.	Mandible	1995.22.59	Fossil
Bison sp.	Mandible	1995.40.194	Fossil
Bison sp.	Mandible	1995.40.319	Fossil
Bison sp.	Mandible	1995.7.118	Fossil
Bison sp.	Mandible	1995.7.633	Fossil
Bison sp.	Mandible	1995.7.638	Fossil
Bison sp.	Mandible	1995.7.653	Fossil
Bison sp.	Mandible	1995.7.658	Fossil
Bison sp.	Mandible	1995.7.687	Fossil
Bison sp.	Mandible	1995.7.723	Fossil
Bison sp.	Mandible	1995.7.793	Fossil
Bison sp.	Mandible w/M/1-2	1995.7.662	Fossil
Bison sp.	Mandible w/M/2	1995.7.661	Fossil
Bison sp.	Maxilla	1995.40.297	Fossil
Bison sp.	Maxilla	1995.7.598	Fossil
Bison sp.	Metacarpal	1995.23.11	Fossil
Bison sp.	Metacarpal	1995.23.2	Fossil
Bison sp.	Metacarpal	1995.40.139	Fossil
Bison sp.	Metacarpal	1995.40.160	Fossil
Bison sp.	Metacarpal	1995.45.18	Fossil
Bison sp.	Metacarpal	1995.7.474	Fossil
Bison sp.	Metacarpal	1995.7.600	Fossil
Bison sp.	Metacarpal	1995.7.625	Fossil
Bison sp.	Metacarpal	1995.7.674	Fossil
Bison sp.	Metapodial fragment	1995.40.136	Fossil
Bison sp.	Metapodial fragment	1995.7.918	Fossil
Bison sp.	Metatarsal	1995.23.10	Fossil

Bison sp.	Metatarsal	1995.7.332	Fossil
Bison sp.	Nueral spine	1995.7.748	Fossil
Bison sp.	Innominate fragment	1995.29.4	Fossil
Bison sp.	Innominate fragment	1995.40.193	Fossil
Bison sp.	Innominate fragment	1995.40.66	Fossil
Bison sp.	Innominate fragment	1995.7.666	Fossil
Bison sp.	Phalanx	1995.23.27	Fossil
Bison sp.	Phalanx	1995.7.1155	Fossil
Bison sp.	Phalanx	1995.7.212	Fossil
Bison sp.	Phalanx	1995.7.646	Fossil
Bison sp.	Phalanx	1995.7.979	Fossil
Bison sp.	Proximal ulna	1995.7.9	Fossil
Bison sp.	Proximal femur	1995.7.725	Fossil
Bison sp.	Proximal humerus	1995.7.1030	Fossil
Bison sp.	Proximal humerus	1995.7.117	Fossil
Bison sp.	Proximal metacarpal	1995.23.33	Fossil
Bison sp.	Proximal metatarsal	1995.23.53	Fossil
Bison sp.	Proximal metapodial	1995.7.536	Fossil
Bison sp.	Proximal radius	1995.23.12	Fossil
Bison sp.	Proximal radius	1995.23.52	Fossil
Bison sp.	Proximal radius	1995.23.64	Fossil
Bison sp.	Proximal radius	1995.29.1	Fossil
Bison sp.	Proximal radius	1995.40.108	Fossil
Bison sp.	Proximal radius	1995.7.1203	Fossil
Bison sp.	Proximal radius	1995.7.156	Fossil
Bison sp.	Proximal radius	1995.7.715	Fossil
Bison sp.	Proximal radius	1995.7.82	Fossil
Bison sp.	Proximal radius	1995.7.910	Fossil
Bison sp.	Proximal scapula	1995.7.1200	Fossil
Bison sp.	Proximal tibia	1995.23.51	Fossil
Bison sp.	Proximal tibia	1995.45.28	Fossil
Bison sp.	Proximal tibia	1995.8.27	Fossil
Bison sp.	Proximal ulna	1995.23.10	Fossil
Bison sp.	Proximal ulna	1995.40.72	Fossil
Bison sp.	Proximal ulna	1995.7.1017	Fossil
Bison sp.	Proximal ulna	1995.7.1033	Fossil
Bison sp.	Proximal ulna	1995.7.1193	Fossil
Bison sp.	Proximal Ulna	1995.7.887	Fossil
Bison sp.	Radio/ulna	1995.45.23	Fossil
Bison sp.	Radius	1995.7.1157	Fossil
Bison sp.	Radius	1995.7.197	Fossil
Bison sp.	radius frag	1995.7.159	Fossil
Bison sp.	Rib	1995.7.110	Fossil
Bison sp.	Sacrum fragment	1995.40.134	Fossil
Bison sp.	Sacrum fragment	1995.7.716	Fossil
Bison sp.	Sacrum fragment	1995.7.812	Fossil
Bison sp.	Scapula	1995.7.737	Fossil
Bison sp.	Scapula fragment	1995.23.20	Fossil

Bison sp.	Skull fragment	1995.37.13	Fossil
Bison sp.	Skull fragment	1995.38.8	Fossil
Bison sp.	Skull fragment	1995.40.179	Fossil
Bison sp.	Skull fragment	1995.40.64	Fossil
Bison sp.	Skull fragment	1995.7.1121	Fossil
Bison sp.	Skull fragment	1995.7.1186	Fossil
Bison sp.	Skull fragment	1995.7.231	Fossil
Bison sp.	Skull fragment	1995.7.281	Fossil
Bison sp.	Skull fragment	1995.7.586	Fossil
Bison sp.	Skull fragment	1995.7.935	Fossil
Bison sp.	Skull fragment	1995.7.523	Fossil
Bison sp.	Skull fragment	1995.40.158	Fossil
Bison sp.	Skull fragment w/horn core	1995.7.475	Fossil
Bison sp.	Skull fragment w/horn core	1995.7.519	Fossil
Bison sp.	Skull fragment w/horn core	1995.7.520	Fossil
Bison sp.	Skull fragment w/horn core	1995.7.522	Fossil
Bison sp.	Terminal phalanx	1995.7.872	Fossil
Bison sp.	Thoracic vertebra	1995.23.109	Fossil
Bison sp.	Thoracic vertebra	1995.38.32	Fossil
Bison sp.	Thoracic vertebra	1995.38.39	Fossil
Bison sp.	Thoracic vertebra	1995.40.153	Fossil
Bison sp.	Thoracic vertebra	1995.40.155	Fossil
Bison sp.	Thoracic vertebra	1995.7.1089	Fossil
Bison sp.	Thoracic vertebra	1995.7.113	Fossil
Bison sp.	Thoracic vertebra	1995.7.114	Fossil
Bison sp.	Thoracic vertebra	1995.7.1144	Fossil
Bison sp.	Thoracic vertebra	1995.7.503	Fossil
Bison sp.	Thoracic vertebra	1995.7.583	Fossil
Bison sp.	Thoracic vertebra	1995.7.430	Fossil
Bison sp.	Thoracic vertebra	1995.7.262	Fossil
Bison sp.	Thoracic vertebra	1995.7.263	Fossil
Bison sp.	Thoracic vertebra spine	1995.38.64	Fossil
Bison sp.	Thoracic vertebra spine	1995.7.447	Fossil
Bison sp.	Tibia	1995.23.117	Fossil
Bison sp.	Tibia	1995.23.97	Fossil
Bison sp.	Tibia	1995.36.4	Fossil
Bison sp.	Tibia	1995.7.1209	Fossil
Bison sp.	Tibia	1995.7.407	Fossil
Bison sp.	Tooth	1995.7.214	Fossil
Bison sp.	Ulna fragment	1995.7.253	Fossil
Bison sp.	Upper cheek tooth	1995.7.441	Fossil
Bison sp.	Upper tooth fragment	1995.40.303	Fossil
Bison sp.	Upper tooth fragment	1995.40.304	Fossil
Bison sp.	Upper tooth fragment	1995.40.311	Fossil
Bison sp.	Upper molar	1995.37.14	Fossil
Bison sp.	Upper molar	1995.40.288	Fossil
Bison sp.	Upper molar	1995.40.290	Fossil
Bison sp.	Upper molar	1995.40.292	Fossil

Bison sp.	Upper molar	1995.40.299	Fossil
Bison sp.	Upper molar	1995.40.317	Fossil
Bison sp.	Upper molar	1995.40.318	Fossil
Bison sp.	Upper molar	1995.45.37	Fossil
Bison sp.	Upper molar	1995.7.108	Fossil
Bison sp.	Upper molar	1995.7.48	Fossil
Bison sp.	Upper molar	1995.7.929	Fossil
Bison sp.	Vertebra fragment	1955.7.1020	Fossil
Bison sp.	Vertebra fragment	1995.23.111	Fossil
Bison sp.	Vertebra fragment	1995.23.16	Fossil
Bison sp.	Vertebra fragment	1995.23.17	Fossil
Bison sp.	Vertebra fragment	1995.23.3	Fossil
Bison sp.	Vertebra fragment	1995.23.4	Fossil
Bison sp.	Vertebra fragment	1995.45.27	Fossil
Bison sp.	Vertebra fragment	1995.7.1008	Fossil
Bison sp.	Vertebra fragment	1995.7.1019	Fossil
Bison sp.	Vertebra fragment	1995.7.315	Fossil
Bison sp.	Vertebra fragment	1995.7.91	Fossil
Bison sp.	Vertebra fragment	1995.26.2	Fossil
Bison sp.	Vertebra fragment	1995.7.663	Fossil
Bison sp.	Vertebra fragment	1995.7.928	Fossil
Bison sp.	Vertebra spine	1995.22.6	Fossil
Bison sp.	Astragalus	1995.7.904	Fossil
Bison sp.	Distal Metacarpal	1995.7.35	Fossil
Bison sp.	Lower cheek tooth	1995.7.38	Fossil
Bison sp.	Lower cheek tooth	1995.7.39	Fossil
Bison sp.	Lower cheek tooth	1995.7.36	Fossil
Bison sp.	Lower cheek tooth	1995.7.37	Fossil
Bison sp.	Radius	1995.7.428	Fossil
Bison sp.	Upper cheek tooth	1995.7.420	Fossil
Bison sp.	Proximal tibia	1995.7.497	Fossil
Bootherium bombifrons	Axis	1995.7.209	Fossil
Bootherium bombifrons	Cervical vertebra	1995.7.367	Fossil
Bootherium bombifrons	Horn core	1995.7.961	Fossil
Bootherium bombifrons	lower M1/M2	1995.7.46	Fossil
Bootherium bombifrons	Skull w/ horn cores	1995.22.8	Fossil
Bootherium bombifrons	Skull w/ horn cores	1995.23.121	Fossil
Bootherium bombifrons	Vertebra	1995.22.2	Fossil
Bootherium bombifrons	Vertebra	1995.22.50	Fossil
Bootherium bombifrons	Vertebra	1995.45.32	Fossil
Bootherium bombifrons	Vertebra	1995.45.38	Fossil
Bootherium bombifrons	Vertebra	1995.45.3	Fossil
Bootherium bombifrons	Metatarsal	1995.7.269	Fossil
Bootherium bombifrons	Skull	45	Fossil
Bootherium bombifrons	Thoracic vertebra	49	Fossil
Bootherium bombifrons	Thoracic vertebra	53	Fossil
Bootherium bombifrons	Thoracic vertebra	60	Fossil
Bootherium bombifrons	Thoracic vertebra	65	Fossil

Bootherium bombifrons	Thoracic vertebra	69	Fossil
Bootherium bombifrons	Molar	71	Fossil
Bos taurus	Astragalus	1995.38.14	Recent
Bos taurus	Astragalus	1995.22.66	Recent
Bos taurus	Astragalus	1995.7.68	Recent
Bos taurus	Axis	1995.23.96	Recent
Bos taurus	Axis	1995.7.74	Recent
Bos taurus	Calcaneum	1995.40.12	Recent
Bos taurus	Cheek tooth fragment	1995.22.47	Recent
Bos taurus	Cheek tooth fragment	1995.22.48	Recent
Bos taurus	Cheek tooth fragment	1995.22.49	Recent
Bos taurus	Cheek tooth fragment	1995.38.6	Recent
Bos taurus	Distal femur	1995.23.91	Recent
Bos taurus	Distal humerus	1995.7.335	Recent
Bos taurus	Distal humerus	1995.7.733	Recent
Bos taurus	Distal Radius	1995.36.7	Recent
Bos taurus	Distal radius	1995.23.89	Recent
Bos taurus	Distal tibia	1995.23.26	Recent
Bos taurus	Distal tibia	1995.26.3	Recent
Bos taurus	Humerus	1995.26.4	Recent
Bos taurus	Humerus	1995.45.43	Recent
Bos taurus	Humerus	1995.7.1116	Recent
Bos taurus	Humerus fragment	1995.23.115	Recent
Bos taurus	Humerus fragment	1995.40.43	Recent
Bos taurus	Humerus fragment	1995.23.73	Recent
Bos taurus	Humerus fragment	1995.23.74	Recent
Bos taurus	Humerus fragment	1995.23.75	Recent
Bos taurus	Humerus fragment	1995.23.76	Recent
Bos taurus	Humerus fragment	1995.23.77	Recent
Bos taurus	Lower M/3	1995.7.786	Recent
Bos taurus	Lower molar	1995.45.7	Recent
Bos taurus	Lower molar	1995.7.963	Recent
Bos taurus	Mandible	23	Recent
Bos taurus	Mandible	1995.15.14	Recent
Bos taurus	Mandible	1995.22.75	Recent
Bos taurus	Mandible	1995.23.35	Recent
Bos taurus	Mandible	1995.23.94	Recent
Bos taurus	Mandible	1995.7.414	Recent
Bos taurus	Mandible fragment	1995.22.57	Recent
Bos taurus	Mandible fragment	1995.45.40	Recent
Bos taurus	Maxilla	1995.38.3	Recent
Bos taurus	Metacapal	1995.23.63	Recent
Bos taurus	Metacarpal	1995.23.39	Recent
Bos taurus	Metacarpal	1995.45.44	Recent
Bos taurus	Metacarpal	29	Recent
Bos taurus	Metatarsal	1995.22.71	Recent
Bos taurus	Metatarsal	1995.22.72	Recent
Bos taurus	Metatarsal	1995.23.88	Recent

Bos taurus	Metatarsal	1995.8.22	Recent
Bos taurus	Molar tooth	28	Recent
Bos taurus	Innominate fragment	1995.23.78	Recent
Bos taurus	Proximal humerus	1995.23.101	Recent
Bos taurus	Proximal Radius	1995.40.15	Recent
Bos taurus	Proximal ulna	1995.7.333	Recent
Bos taurus	Radio/ulna	1995.23.117	Recent
Bos taurus	Radio/ulna	1995.45.24	Recent
Bos taurus	Radius	16	Recent
Bos taurus	Radius	1995.7.336	Recent
Bos taurus	Radius	1995.7.261	Recent
Bos taurus	Scapula fragment	1995.23.79	Recent
Bos taurus	Scapula fragment	1995.23.97	Recent
Bos taurus	Scapula fragment	1995.40.109	Recent
Bos taurus	Skull	1995.23.90	Recent
Bos taurus	Thoracic vertebra	1995.7.408	Recent
Bos taurus	Tibia	1995.7.337	Recent
Bos taurus	Tibia fragment	1995.40.11	Recent
Bos taurus	Upper molar	1995.23.45	Recent
Bos taurus	Upper molar frag	1995.7.877	Recent
Bos taurus	Vertebra fragment	1995.23.87	Recent
Branta canadensis	Humerus	1995.23.178	Fossil
Canis familiaris	Mandible	1995.8.13	Recent
Canis sp.	Distal humerus	1995.22.84	Recent
Canis sp.	Distal humerus	1995.8.15	Recent
Canis sp.	Mandible	1995.7.667	Recent
Canis sp.	Radius frag	1995.23.193	Recent
Castor canadensis	Femur	1995.7.176	Recent
Castor canadensis	Lower molar	1995.7.1102	Recent
Castorides ohioensis	Cheek tooth fragment	1995.37.2	Fossil
Castorides ohioensis	Incisor	1995.7.1059	Fossil
Castorides ohioensis	Incisor	1995.7.647	Fossil
Cervalces scotti	Metatarsal	1995.7.899	Fossil
Cervus canadensis	Antler	1995.38.15	Fossil
Cervus canadensis	Antler fragment	1995.7.577	Fossil
Cervus canadensis	Antler fragment	1995.7.73	Fossil
Cervus canadensis	Antler fragment	1995.7.890	Fossil
Cervus canadensis	Distal metatarsal	1995.7.351	Fossil
Cervus canadensis	Metacarpal	1995.23.35	Recent
Cervus canadensis	Metapodial fragment	1995.40.219	Recent
Cervus canadensis	Pelvis fragment	1995.23.49	Fossil
Cervus canadensis	Proximal femur	1995.7.840	Recent
Cervus canadensis	Proximal scapula	1995.22.69	Recent
Chelydra serpintina	Scapula fragment	189	Fossil
Chrysemys sp.	Plastron fragment	1995.40.332	Recent
Chrysemys sp.	Plastron fragment	1995.40.333	Recent
Chrysemys sp.	Plastron fragment	1995.40.334	Recent
Chrysemys sp.	Plastron segment	9	Recent

Chrysemys sp.	Plueral	1995.7.30	Recent
Chrysemys sp.	Carapace fragment	1029	Recent
Chrysemys sp.	Carapace fragment	1006	Fossil
Dasypus bellus	Humerus	1995.40.325	Fossil
Dasypus bellus	Skull fragment	88	Fossil
Dasypus bellus	Femur	97	Fossil
Equus sp.	Astragalus	1995.7.611	Fossil
Equus sp.	Axis	1995.7.132	Fossil
Equus sp.	Axis fragment	1995.7.415	Fossil
Equus sp.	Calcaneum	21	Fossil
Equus sp.	Calcaneum	1995.7.587	Fossil
Equus sp.	Cheek tooth fragment	1995.22.11	Fossil
Equus sp.	Cheek tooth fragment	1995.22.12	Fossil
Equus sp.	Cheek tooth fragment	1995.22.13	Fossil
Equus sp.	Cheek tooth fragment	1995.22.14	Fossil
Equus sp.	Cheek tooth fragment	1995.22.15	Fossil
Equus sp.	Cheek tooth fragment	1995.22.16	Fossil
Equus sp.	Cheek tooth fragment	1995.22.17	Fossil
Equus sp.	Cheek tooth fragment	1995.22.18	Fossil
Equus sp.	Cheek tooth fragment	1995.22.19	Fossil
Equus sp.	Cheek tooth fragment	1995.22.20	Fossil
Equus sp.	Cheek tooth fragment	1995.22.21	Fossil
Equus sp.	Cheek tooth fragment	1995.22.22	Fossil
Equus sp.	Cheek tooth fragment	1995.22.23	Fossil
Equus sp.	Cheek tooth fragment	1995.22.24	Fossil
Equus sp.	Cheek tooth fragment	1995.22.25	Fossil
Equus sp.	Cheek tooth fragment	1995.22.26	Fossil
Equus sp.	Cheek tooth fragment	1995.22.27	Fossil
Equus sp.	Cheek tooth fragment	1995.22.28	Fossil
Equus sp.	Cheek tooth fragment	1995.22.29	Fossil
Equus sp.	Cheek tooth fragment	1995.22.30	Fossil
Equus sp.	Cheek tooth fragment	1995.22.31	Fossil
Equus sp.	Cheek tooth fragment	1995.22.32	Fossil
Equus sp.	Cheek tooth fragment	1995.22.33	Fossil
Equus sp.	Cheek tooth fragment	1995.22.34	Fossil
Equus sp.	Cheek tooth fragment	1995.22.35	Fossil
Equus sp.	Cheek tooth fragment	1995.22.36	Fossil
Equus sp.	Cheek tooth fragment	1995.22.37	Fossil
Equus sp.	Cheek tooth fragment	1995.23.105	Fossil
Equus sp.	Cheek tooth fragment	1995.23.106	Fossil
Equus sp.	Cheek tooth fragment	1995.23.107	Fossil
Equus sp.	Cheek tooth fragment	1995.23.78	Fossil
Equus sp.	Cheek tooth fragment	1995.38.29	Fossil
Equus sp.	Cheek tooth fragment	1995.38.30	Fossil
Equus sp.	Cheek tooth fragment	1995.38.31	Fossil
Equus sp.	Cheek tooth fragment	1995.40.275	Fossil
Equus sp.	Cheek tooth fragment	1995.40.277	Fossil
Equus sp.	Cheek tooth fragment	1995.40.278	Fossil

Equus sp.	Cheek tooth fragment	1995.40.281	Fossil
Equus sp.	Cheek tooth fragment	1995.40.308	Fossil
Equus sp.	Cheek tooth fragment	1995.40.316	Fossil
Equus sp.	Cheek tooth fragment	1995.40.320	Fossil
Equus sp.	Cheek tooth fragment	1995.45.13	Fossil
Equus sp.	Cheek tooth fragment	1995.7.1074	Fossil
Equus sp.	Cheek tooth fragment	1995.23.127	Fossil
Equus sp.	Distal femur	1995.7.627	Fossil
Equus sp.	Distal metacarpal	1995.23.13	Fossil
Equus sp.	Distal metatarsal	1995.23.14	Fossil
Equus sp.	Distal metatarsal	1995.7.980	Fossil
Equus sp.	Distal radius frag	1995.7.588	Fossil
Equus sp.	Distal scapula	1995.7.217	Fossil
Equus sp.	Distal scapula	1995.7.77	Fossil
Equus sp.	Distal scapula	1995.7.84	Fossil
Equus sp.	Distal tibia	1995.40.125	Recent
Equus sp.	Distal tibia	1995.45.21	Fossil
Equus sp.	Distal tibia	1995.40.115	Fossil
Equus sp.	Lower cheek tooth	1995.7.26	Fossil
Equus sp.	Lower cheek tooth	1995.7.27	Fossil
Equus sp.	Lower cheek tooth	1995.7.355	Fossil
Equus sp.	Lower cheek tooth	1995.7.417	Fossil
Equus sp.	Lower cheek tooth	1995.7.508	Fossil
Equus sp.	Lower cheek tooth	1995.7.509	Fossil
Equus sp.	Lower cheek tooth	1995.7.510	Fossil
Equus sp.	Lower cheek tooth	1995.7.511	Fossil
Equus sp.	Lower cheek tooth	1995.7.581	Fossil
Equus sp.	Lower cheek tooth	1995.7.632	Fossil
Equus sp.	Lower cheek tooth	1995.31.11	Fossil
Equus sp.	Lower cheek tooth	1995.23.148	Fossil
Equus sp.	Lower cheek tooth	1995.23.149	Fossil
Equus sp.	Lower cheek tooth	1995.23.150	Fossil
Equus sp.	Lower cheek tooth	1995.23.151	Fossil
Equus sp.	Lower cheek tooth	1995.40.295	Fossil
Equus sp.	Lower cheek tooth	1995.40.296	Fossil
Equus sp.	Lower cheek tooth	1995.40.300	Fossil
Equus sp.	Lower cheek tooth	1995.40.302	Fossil
Equus sp.	Lower cheek tooth	1995.40.305	Fossil
Equus sp.	Lower cheek tooth	1995.40.306	Fossil
Equus sp.	Lower cheek tooth	1995.40.312	Fossil
Equus sp.	Lower cheek tooth	1995.7.1099	Fossil
Equus sp.	Lower cheek tooth	1995.7.696	Fossil
Equus sp.	Lower cheek tooth	1995.23.119	Fossil
Equus sp.	Lower cheek tooth	1995.23.125	Fossil
Equus sp.	Lower cheek tooth	1995.23.147	Fossil
Equus sp.	Lower moalr	1995.7.469	Fossil
Equus sp.	Lower molar	1995.40.282	Fossil
Equus sp.	Lower molar	1995.40.287	Fossil

Equus sp.	Lower molar	1995.7.1025	Fossil
Equus sp.	Lower molar	1995.7.1104	Fossil
Equus sp.	Lower molar	1995.7.274	Fossil
Equus sp.	Lower molar	1995.7.319	Fossil
Equus sp.	Lower molar	1995.7.962	Fossil
Equus sp.	Lower molar	1995.7.973	Fossil
Equus sp.	Lower molar	1995.7.974	Fossil
Equus sp.	Lower molar	1995.7.976	Fossil
Equus sp.	Lower molar	1995.7.977	Fossil
Equus sp.	Lower molar	1995.23.25	Fossil
Equus sp.	Lower molar	1995.7.375	Fossil
Equus sp.	Lower molar	1995.7.416	Recent
Equus sp.	Lower P/2	1995.7.634	Fossil
Equus sp.	Lower premolar	199.7.45	Fossil
Equus sp.	Lower premolar	1995.23.26	Fossil
Equus sp.	Lower premolar	1995.31.4	Fossil
Equus sp.	Lower premolar	1995.32.3	Fossil
Equus sp.	Lower premolar	1995.37.11	Fossil
Equus sp.	Lower premolar	1995.37.8	Fossil
Equus sp.	Lower premolar	1995.40.293	Fossil
Equus sp.	Lower premolar	1995.7.1103	Fossil
Equus sp.	Lower premolar	1995.7.24	Fossil
Equus sp.	Lower premolar	1995.7.25	Fossil
Equus sp.	Lower premolar	1995.7.7726	Fossil
Equus sp.	Lower premolar	1995.7.802	Fossil
Equus sp.	Lower premolar	1995.7.803	Fossil
Equus sp.	Lower premolar	1995.7.878	Fossil
Equus sp.	Lower premolar	8	Fossil
Equus sp.	Lumbar vertebra	1995.7.386	Fossil
Equus sp.	Mandible	1995.40.128	Fossil
Equus sp.	Mandible	1995.45.6	Fossil
Equus sp.	Mandible	1995.7.239	Fossil
Equus sp.	Mandible	1995.7.273	Fossil
Equus sp.	Mandible	1995.7.40	Fossil
Equus sp.	Mandible	1995.7.339	Fossil
Equus sp.	mandible	1995.7.1	Fossil
Equus sp.	Mandible fragment	1995.23.180	Fossil
Equus sp.	Mandible fragment	1995.40.159	Fossil
Equus sp.	Mandible fragment	1995.40.259	Fossil
Equus sp.	Mandible fragment	1995.7.280	Fossil
Equus sp.	Mandible fragment	1995.7.377	Fossil
Equus sp.	Mandible w/2 molars	1995.7.870	Fossil
Equus sp.	Metacarpal	1995.38.49	Fossil
Equus sp.	Metacarpal	1995.45.4	Fossil
Equus sp.	Metapodial fragment	1995.22.89	Fossil
Equus sp.	Metapodial fragment	1995.40.10	Fossil
Equus sp.	Metapodial fragment	1995.7.491	Fossil
Equus sp.	Metapodial fragment	1995.7.564	Fossil

Equus sp.	Metapodial fragment	1995.7.885	Fossil
Equus sp.	Metatarsal	1995.22.73	Fossil
Equus sp.	Metatarsal	1995.23.95	Fossil
Equus sp.	Metatarsal	1995.40.71	Fossil
Equus sp.	Metatarsal	1995.7.1067	Fossil
Equus sp.	Metatarsal	1995.7.267	Fossil
Equus sp.	Metatarsal	1995.7.268	Fossil
Equus sp.	Metatarsal	1995.7.334	Fossil
Equus sp.	Metatarsal	1995.40.107	Fossil
Equus sp.	Molar frag	1995.7.107	Fossil
Equus sp.	Phalanx	18	Fossil
Equus sp.	Phalanx	1995.7.111	Fossil
Equus sp.	Phalanx	1995.7.163	Fossil
Equus sp.	Phalanx	1995.7.270	Fossil
Equus sp.	Phalanx	1995.7.324	Fossil
Equus sp.	Phalanx	1995.7.732	Fossil
Equus sp.	Premolar P/3	1995.7.432	Fossil
Equus sp.	Prox Metapodial	1995.7.898	Fossil
Equus sp.	Proximal metacarpal	1995.40.145	Fossil
Equus sp.	Proximal metapodial	1995.40.245	Fossil
Equus sp.	Proximal metatarsal	1995.23.80	Fossil
Equus sp.	Proximal metatarsal	1995.7.1096	Fossil
Equus sp.	Proximal metatarsal	1995.7.490	Fossil
Equus sp.	Proximal radius	1995.7.382	Fossil
Equus sp.	Proximal radius	1995.7.671	Fossil
Equus sp.	Proximal scapula	1995.22.70	Fossil
Equus sp.	Proximal scapula	1995.7.570	Fossil
Equus sp.	Proximal tibia	1995.40.161	Fossil
Equus sp.	Proximal tibia	1995.40.21	Fossil
Equus sp.	Proximal tibia	1995.40.53	Fossil
Equus sp.	Radio/ulna	1995.22.74	Fossil
Equus sp.	Radio/ulna	1995.8.17	Fossil
Equus sp.	Radioulna	1995.29.2	Fossil
Equus sp.	Radio-ulna	1995.36.12	Fossil
Equus sp.	Radio-ulna	1995.38.12	Fossil
Equus sp.	Radius	1995.7.80	Fossil
Equus sp.	Scapula	1995.7.2	Fossil
Equus sp.	Thoracic vertebra	1995.7.612	Fossil
Equus sp.	Thoracic vertebra	1995.23.114	Fossil
Equus sp.	Thoracic vertebra	1995.36.6	Fossil
Equus sp.	Thoracic vertebra	1995.7.1114	Fossil
Equus sp.	Thoracic vertebra	1995.7.591	Fossil
Equus sp.	Thoracic vertebra	1995.7.400	Fossil
Equus sp.	Tibia	1995.23.154	Fossil
Equus sp.	Tibia	1995.40.101	Fossil
Equus sp.	Tibia	1995.40.103	Fossil
Equus sp.	Tibia	1995.40.126	Fossil
Equus sp.	Tibia	1995.7.81	Fossil

Equus sp.	Tibia	1995.23.116	Fossil
Equus sp.	Tooth fragment	1995.7.139	Fossil
Equus sp.	Tooth fragment	1995.7.198	Fossil
Equus sp.	Ulna	1995.7.617	Fossil
Equus sp.	Upper cheek tooth	1995.7.102	Fossil
Equus sp.	Upper cheek tooth	1995.7.103	Fossil
Equus sp.	Upper cheek tooth	1995.31.12	Fossil
Equus sp.	Upper cheek tooth	1995.32.4	Fossil
Equus sp.	Upper cheek tooth	1995.40.274	Fossil
Equus sp.	Upper cheek tooth	1995.7.418	Fossil
Equus sp.	Upper cheek tooth	1995.7.419	Fossil
Equus sp.	Upper cheek tooth	1995.7.548	Fossil
Equus sp.	Upper cheek tooth	1995.23.142	Fossil
Equus sp.	Upper cheek tooth	1995.40.310	Fossil
Equus sp.	Upper cheek tooth	1995.40.313	Fossil
Equus sp.	Upper cheek tooth	1995.7.434	Fossil
Equus sp.	Upper M1	1995.7.599	Fossil
Equus sp.	Upper M1/	1995.7.23	Fossil
Equus sp.	Upper M3	1995.7.943	Fossil
Equus sp.	Upper molar	1995.23.141	Fossil
Equus sp.	Upper molar	1995.37.3	Fossil
Equus sp.	Upper molar	1995.40.276	Fossil
Equus sp.	Upper molar	1995.40.279	Fossil
Equus sp.	Upper molar	1995.40.283	Fossil
Equus sp.	Upper molar	1995.40.285	Fossil
Equus sp.	Upper molar	1995.40.286	Fossil
Equus sp.	Upper molar	1995.45.14	Fossil
Equus sp.	Upper molar	1995.45.15	Fossil
Equus sp.	Upper molar	1995.45.8	Fossil
Equus sp.	Upper molar	1995.45.9	Fossil
Equus sp.	Upper molar	1995.7.101	Fossil
Equus sp.	Upper molar	1995.7.1024	Fossil
Equus sp.	Upper molar	1995.7.1075	Fossil
Equus sp.	Upper molar	1995.7.1076	Fossil
Equus sp.	Upper molar	1995.7.148	Fossil
Equus sp.	Upper molar	1995.7.227	Fossil
Equus sp.	Upper molar	1995.7.356	Fossil
Equus sp.	Upper molar	1995.7.376	Fossil
Equus sp.	Upper molar	1995.7.409	Fossil
Equus sp.	Upper molar	1995.7.688	Fossil
Equus sp.	Upper molar	1995.7.698	Fossil
Equus sp.	Upper molar	1995.7.971	Fossil
Equus sp.	Upper molar	1995.7.972	Fossil
Equus sp.	Upper molar	1995.7.975	Fossil
Equus sp.	Upper molar	1995.7.880	Fossil
Equus sp.	Upper molar	1995.7.881	Fossil
Equus sp.	Upper molar frag	1995.7.442	Fossil
Equus sp.	Upper molar M/1	1995.7.235	Fossil

Equus sp.	Upper P/2	1995.7.589	Fossil
Equus sp.	Upper premolar	1995.40.280	Fossil
Equus sp.	Upper premolar	1995.40.284	Fossil
Equus sp.	Vertebrae	1995.22.67	Fossil
Equus sp.	Vertebra	1995.7.1006	Fossil
Equus sp.	Vertebra	1995.7.264	Fossil
Equus sp.	Vertebra	1995.7.502	Fossil
Equus sp.	Vertebra	1995.7.613	Fossil
Equus sp.	Vertebra	1995.7.87	Fossil
Equus sp.	Vertebra	1995.7.232	Fossil
Equus sp.	Vertebra	1995.7.505	Fossil
Geochelone crassiscutata	Carapace fragment	1995.23.179	Fossil
Geochelone crassiscutata	Carapace fragment	1995.7.1140	Fossil
Geochelone crassiscutata	Carapace fragment	1995.7.1159	Fossil
Geochelone crassiscutata	Carapace fragment	1995.7.1188	Fossil
Geochelone crassiscutata	Carapace fragment	1995.7.1202	Fossil
Geochelone crassiscutata	Carapace fragment	1995.8.24	Fossil
Geochelone crassiscutata	Plastron fragment	1995.7.913	Fossil
Geochelone crassiscutata	Plastron fragment	1995.8.25	Fossil
Geochelone crassiscutata	Scapula	1995.7.1137	Fossil
Geochelone crassiscutata	Scapula fragment	1995.7.1158	Fossil
Geochelone crassiscutata	Carapace fragment	1995.7.621	Fossil
Geochelone crassiscutata	Carapace fragment	1995.7.636	Fossil
Geochelone crassiscutata	Carapace fragment	1995.7.677	Fossil
Geochelone crassiscutata	Plastron fragment	1995.7.801	Fossil
Geochelone crassiscutata	Plastron fragment	1995.7.722	Fossil
Geochelone crassiscutata	Carapace fragment	1995.7.343	Fossil
Lepisosteus sp.	Skull frag	1995.40.181	Fossil
Lepisosteus sp.	Centra frag	1995.40.96	Fossil
Macroclemys temmincki	Scapula frag	305	Fossil
Mammut americanum	Carpal/tarsal	1995.7.873	Fossil
Mammut americanum	Distal fibula	1995.7.399	Fossil
Mammut americanum	Distal radius	1995.7.1207	Fossil
Mammut americanum	Distal radius	1995.7.767	Fossil
Mammut americanum	Mandible frag	1995.7.1072	Fossil
Mammut americanum	Molar	1995.7.366	Fossil
Mammut americanum	Molar	1995.7.477	Fossil
Mammut americanum	Molar	1995.7.818	Fossil
Mammut americanum	Molar frag	1995.38.36	Fossil
Mammut americanum	Nueral spine	1995.7.1201	Fossil
Mammut americanum	Innominate fragment	1995.7.277	Fossil
Mammut americanum	Innominate fragment	1995.7.385	Fossil
Mammut americanum	Proximal radius	1995.7.1183	Fossil
Mammut americanum	Proximal radius	1995.7.1197	Fossil
Mammut americanum	Proximal tibia	1995.22.4	Fossil
Mammut americanum	Proximal ulna	1995.7.1206	Fossil
Mammut americanum	Skull fragment	1995.37.1	Fossil
Mammut americanum	Skull fragment	1995.7.1205	Fossil

Mammut americanum	Skull fragment	1995.7.796	Fossil
Mammut americanum	Tibia	1995.7.251	Fossil
Mammut americanum	Tibia fragment	1995.7.133	Fossil
Mammut americanum	Tibia fragment	1995.7.138	Fossil
Mammut americanum	Tooth	1995.7.1031	Fossil
Mammut americanum	Tooth	1995.7.590	Fossil
Mammut americanum	Tooth	1995.7.614	Fossil
Mammut americanum	Tooth fragment	1995.40.322	Fossil
Mammut americanum	Tooth fragment	1995.40.323	Fossil
Mammut americanum	Tooth fragment	1995.40.47	Fossil
Mammut americanum	Tooth fragment	1995.40.75	Fossil
Mammut americanum	Tooth fragment	1995.40.81	Fossil
Mammut americanum	Tooth fragment	1995.45.1	Fossil
Mammut americanum	Tooth fragment	1995.7.1044	Fossil
Mammut americanum	Tooth fragment	1995.7.135	Fossil
Mammut americanum	Tooth fragment	1995.7.136	Fossil
Mammut americanum	Tooth fragment	1995.7.137	Fossil
Mammut americanum	Tooth frag	1995.7.307	Fossil
Mammut americanum	Tooth root	1995.7.421	Fossil
Mammut americanum	Tooth root	1995.7.905	Fossil
Mammut americanum	Tusk fragment	1995.7.250	Fossil
Mammut americanum	Tusk tip	1995.7.357	Fossil
Mammut americanum	Vertebra spine	1995.23.115	Fossil
Mammut americanum	Vertebra spine	1995.7.223	Fossil
Mammuthus sp.	Molar frag	1995.23.74	Fossil
Mammuthus sp.	Calcaneus	1995.23.108	Fossil
Mammuthus sp.	Humerus	1995.22.9	Fossil
Mammuthus sp.	Molar tooth frag	1995.45.10	Fossil
Mammuthus sp.	Molar tooth frag	1995.45.11	Fossil
Mammuthus sp.	Molar tooth frag	1995.45.12	Fossil
Mammuthus sp.	Proximal humerus	1995.23.118	Fossil
Mammuthus sp.	Tooth frag	1995.15.15	Fossil
Mammuthus columbi	Molar	1995.38.37	Fossil
Mammuthus columbi	Molar	112	Fossil
Marmota monax	Tibia	1995.23.99	Recent
Megalonyx jeffersoni	Femur	1995.22.3	Fossil
Megalonyx jeffersoni	Femur	1995.45.29	Fossil
Megalonyx jeffersoni	Proximal humerus	1995.45.20	Fossil
Megalonyx jeffersoni	Proximal humerus	1995.45.53	Fossil
Megalonyx jeffersoni	Sacrum fragment	1995.45.30	Fossil
Megalonyx jeffersonii	5th metacarpal	1995.7.398	Fossil
Megalonyx jeffersonii	Cheek tooth fragment	1995.7.683	Fossil
Megalonyx jeffersonii	Distal humerus	1995.7.85	Fossil
Megalonyx jeffersonii	Distal humerus	1995.23.119	Fossil
Megalonyx jeffersonii	Distal scapula	1995.7.90	Fossil
Megalonyx jeffersonii	Femur	1995.7.86	Fossil
Megalonyx jeffersonii	Humerus	1995.7.720	Fossil
Megalonyx jeffersonii	Metacarpal/falsiform	1995.7.193	Fossil

Megalonyx jeffersonii	Skull	1995.7.845	Fossil
Megalonyx jeffersonii	Skull fragment	1995.7.284	Fossil
Megalonyx jeffersonii	Thoracic Vertebra	1995.7.100	Fossil
Megalonyx jeffersonii	Thoracic Vertebra		Fossil
Megaloyx jeffersonii	Vert frag		Fossil
Megolonyx jeffersonii	Atlas frag		Fossil
Megolonyx jeffersonii	Humerus		Fossil
Megolonyx jeffersonii	Humerus frag		Fossil
Melagris gallapavo	Tarsometatarsus	1995.8.9	Recent
Nothrotheriops sp.	Skull/rostrum missing	1995.7.999	Fossil
Odocoileus sp.	Antler	1995.7.1060	Fossil
Odocoileus sp.	Antler	1995.23.112	Fossil
Odocoileus sp.	Antler	1995.38.17	Fossil
Odocoileus sp.	Antler	1995.38.18	Recent
Odocoileus sp.	Antler base	1995.7.121	Fossil
Odocoileus sp.	Antler base	1995.7.83	Fossil
Odocoileus sp.	Antler base	1995.7.284	Fossil
Odocoileus sp.	Antler base	1995.7.100	Fossil
Odocoileus sp.	Antler base	1995.40.271	Fossil
Odocoileus sp.	Antler fragment	1995.22.53	Fossil
Odocoileus sp.	Antler fragment	1995.22.55	Fossil
Odocoileus sp.	Antler fragment	1995.22.56	Fossil
Odocoileus sp.	Antler fragment	1995.22.63	Fossil
Odocoileus sp.	Antler fragment	1995.22.64	Fossil
Odocoileus sp.	Antler fragment	1995.23.113	Fossil
Odocoileus sp.	Antler fragment	1995.23.113	Fossil
Odocoileus sp.	Antler fragment	1995.23.114	Fossil
Odocoileus sp.	Antler fragment	1995.23.132	Fossil
Odocoileus sp.	Antler fragment	1995.23.162	Fossil
Odocoileus sp.	Antler fragment	1995.23.77	Fossil
Odocoileus sp.	Antler fragment	1995.23.80	Fossil
Odocoileus sp.	Antler fragment	1995.23.81	Fossil
Odocoileus sp.	Antler fragment	1995.23.81	Fossil
Odocoileus sp.	Antler fragment	1995.23.82	Fossil
Odocoileus sp.	Antler fragment	1995.23.83	Fossil
Odocoileus sp.	Antler fragment	1995.23.83	Fossil
Odocoileus sp.	Antler fragment	1995.23.84	Fossil
Odocoileus sp.	Antler fragment	1995.23.85	Fossil
Odocoileus sp.	Antler fragment	1995.23.87	Fossil
Odocoileus sp.	Antler fragment	1995.30.6	Fossil
Odocoileus sp.	Antler fragment	1995.40.117	Fossil
Odocoileus sp.	Antler fragment	1995.40.118	Fossil
Odocoileus sp.	Antler fragment	1995.40.119	Fossil
Odocoileus sp.	Antler fragment	1995.40.120	Fossil
Odocoileus sp.	Antler fragment	1995.40.190	Fossil
Odocoileus sp.	Antler fragment	1995.40.44	Fossil
Odocoileus sp.	Antler fragment	1995.40.77	Fossil
Odocoileus sp.	Antler fragment	1995.40.80	Fossil

Odocoileus sp.	Antler fragment	1995.7.1023	Fossil
Odocoileus sp.	Antler fragment	1995.7.1040	Fossil
Odocoileus sp.	Antler fragment	1995.7.1041	Fossil
Odocoileus sp.	Antler fragment	1995.7.1047	Fossil
Odocoileus sp.	Antler fragment	1995.7.118	Fossil
Odocoileus sp.	Antler fragment	1995.7.120	Fossil
Odocoileus sp.	Antler fragment	1995.7.122	Fossil
Odocoileus sp.	Antler fragment	1995.7.123	Recent
Odocoileus sp.	Antler fragment	1995.7.124	Fossil
Odocoileus sp.	Antler fragment	1995.7.124	Fossil
Odocoileus sp.	Antler fragment	1995.7.125	Fossil
Odocoileus sp.	Antler fragment	1995.7.126	Fossil
Odocoileus sp.	Antler fragment	1995.7.127	Fossil
Odocoileus sp.	Antler fragment	1995.7.130	Fossil
Odocoileus sp.	Antler fragment	1995.7.145	Fossil
Odocoileus sp.	Antler fragment	1995.7.215	Fossil
Odocoileus sp.	Antler fragment	1995.7.222	Fossil
Odocoileus sp.	Antler fragment	1995.7.241	Fossil
Odocoileus sp.	Antler fragment	1995.7.242	Fossil
Odocoileus sp.	Antler fragment	1995.7.243	Recent
Odocoileus sp.	Antler fragment	1995.7.246	Fossil
Odocoileus sp.	Antler fragment	1995.7.283	Recent
Odocoileus sp.	Antler fragment	1995.7.329	Fossil
Odocoileus sp.	Antler fragment	1995.7.33	Fossil
Odocoileus sp.	Antler fragment	1995.7.353	Fossil
Odocoileus sp.	Antler fragment	1995.7.384	Fossil
Odocoileus sp.	Antler fragment	1995.7.402	Fossil
Odocoileus sp.	Antler fragment	1995.7.410	Recent
Odocoileus sp.	Antler fragment	1995.7.411	Fossil
Odocoileus sp.	Antler fragment	1995.7.412	Fossil
Odocoileus sp.	Antler fragment	1995.7.426	Fossil
Odocoileus sp.	Antler fragment	1995.7.439	Fossil
Odocoileus sp.	Antler fragment	1995.7.457	Fossil
Odocoileus sp.	Antler fragment	1995.7.481	Fossil
Odocoileus sp.	Antler fragment	1995.7.5	Fossil
Odocoileus sp.	Antler fragment	1995.7.515	Fossil
Odocoileus sp.	Antler fragment	1995.7.516	Fossil
Odocoileus sp.	Antler fragment	1995.7.517	Fossil
Odocoileus sp.	Antler fragment	1995.7.550	Fossil
Odocoileus sp.	Antler fragment	1995.7.551	Fossil
Odocoileus sp.	Antler fragment	1995.7.552	Fossil
Odocoileus sp.	Antler fragment	1995.7.553	Fossil
Odocoileus sp.	Antler fragment	1995.7.554	Fossil
Odocoileus sp.	Antler fragment	1995.7.555	Fossil
Odocoileus sp.	Antler fragment	1995.7.585	Fossil
Odocoileus sp.	Antler fragment	1995.7.619	Fossil
Odocoileus sp.	Antler fragment	1995.7.622	Fossil
Odocoileus sp.	Antler fragment	1995.7.628	Fossil

Odocoileus sp.	Antler fragment	1995.7.629	Fossil
Odocoileus sp.	Antler fragment	1995.7.643	Fossil
Odocoileus sp.	Antler fragment	1995.7.685	Fossil
Odocoileus sp.	Antler fragment	1995.7.689	Fossil
Odocoileus sp.	Antler fragment	1995.7.697	Fossil
Odocoileus sp.	Antler fragment	1995.7.71	Fossil
Odocoileus sp.	Antler fragment	1995.7.718	Recent
Odocoileus sp.	Antler fragment	1995.7.72	Recent
Odocoileus sp.	Antler fragment	1995.7.730	Fossil
Odocoileus sp.	Antler fragment	1995.7.738	Fossil
Odocoileus sp.	Antler fragment	1995.7.780	Fossil
Odocoileus sp.	Antler fragment	1995.7.804	Fossil
Odocoileus sp.	Antler fragment	1995.7.834	Fossil
Odocoileus sp.	Antler fragment	1995.7.844	Fossil
Odocoileus sp.	Antler fragment	1995.7.861	Fossil
Odocoileus sp.	Antler fragment	1995.7.865	Fossil
Odocoileus sp.	Antler fragment	1995.7.866	Fossil
Odocoileus sp.	Antler fragment	1995.7.876	Fossil
Odocoileus sp.	Antler fragment	1995.7.889	Recent
Odocoileus sp.	Antler fragment	1995.7.900	Fossil
Odocoileus sp.	Antler fragment	1995.7.940	Fossil
Odocoileus sp.	Antler fragment	1995.7.958	Fossil
Odocoileus sp.	Antler fragment	1995.7.965	Fossil
Odocoileus sp.	Antler fragment	1995.7.966	Fossil
Odocoileus sp.	Antler fragment	1995.7.993	Fossil
Odocoileus sp.	Antler fragment	1995.7.994	Fossil
Odocoileus sp.	Antler fragment	1995.7.995	Fossil
Odocoileus sp.	Antler fragment	1995.7.996	Fossil
Odocoileus sp.	Antler fragment	1995.7.528	Recent
Odocoileus sp.	Antler tine	1995.23.136	Fossil
Odocoileus sp.	Antler tine	1995.23.73	Fossil
Odocoileus sp.	Antler tine	1995.40.246	Fossil
Odocoileus sp.	Antler tine	1995.7.328	Fossil
Odocoileus sp.	Antler tine	1995.8.32	Fossil
Odocoileus sp.	Antler w/ skull	1995.38.19	Fossil
Odocoileus sp.	Atlas	1995.25.3	Fossil
Odocoileus sp.	Atlas	1995.7.326	Fossil
Odocoileus sp.	Axis	1995.22.65	Fossil
Odocoileus sp.	Axis	1995.40.92	Fossil
Odocoileus sp.	Calcaneum	1995.40.247	Fossil
Odocoileus sp.	Calcaneum	1995.7.6	Fossil
Odocoileus sp.	Calcaneum	1995.7.700	Fossil
Odocoileus sp.	Calcaneum	1995.30.18	Fossil
Odocoileus sp.	Calcaneum	1995.31.15	Fossil
Odocoileus sp.	Calcaneum	1995.38.23	Fossil
Odocoileus sp.	Calcaneum	1995.40.249	Fossil
Odocoileus sp.	Calcaneum	1995.7.1123	Fossil
Odocoileus sp.	Cervical vertebra	1995.8.23	Fossil

Odocoileus sp.	Cervical vertebra	195.7.863	Fossil
Odocoileus sp.	Distal femur	1995.40.22	Fossil
Odocoileus sp.	Distal femur	1995.23.64	Recent
Odocoileus sp.	Distal femur	1995.40.31	Fossil
Odocoileus sp.	Distal femur	1995.40.58	Fossil
Odocoileus sp.	Distal femur	1995.7.1011	Fossil
Odocoileus sp.	Distal femur	1995.7.1171	Fossil
Odocoileus sp.	Distal femur	1995.7.154	Fossil
Odocoileus sp.	Distal femur	1995.7.557	Fossil
Odocoileus sp.	Distal femur	1995.7.673	Fossil
Odocoileus sp.	Distal femur	1995.7.69	Fossil
Odocoileus sp.	Distal femur	1995.7.735	Fossil
Odocoileus sp.	Distal femur	1995.7.1147	Fossil
Odocoileus sp.	Distal humerus	1995.7.155	Fossil
Odocoileus sp.	Distal humerus	1995.22.88	Fossil
Odocoileus sp.	Distal humerus	1995.23.70	Fossil
Odocoileus sp.	Distal humerus	1995.40.165	Fossil
Odocoileus sp.	Distal humerus	1995.40.39	Fossil
Odocoileus sp.	Distal humerus	1995.7.213	Fossil
Odocoileus sp.	Distal humerus	1995.7.358	Fossil
Odocoileus sp.	Distal humerus	1995.7.753	Fossil
Odocoileus sp.	Distal humerus	1995.7.755	Fossil
Odocoileus sp.	Distal humerus	1995.7.857	Fossil
Odocoileus sp.	Distal humerus	1995.7.983	Fossil
Odocoileus sp.	Distal humerus	1995.23.109	Fossil
Odocoileus sp.	Distal humerus	1995.23.110	Fossil
Odocoileus sp.	Distal humerus	1995.23.65	Fossil
Odocoileus sp.	Distal humerus	1995.7.538	Fossil
Odocoileus sp.	Distal humerus	1995.7.556	Fossil
Odocoileus sp.	Distal metapodial	1995.7.1161	Fossil
Odocoileus sp.	Distal metatarsal	1995.7.211	Fossil
Odocoileus sp.	Distal metatarsal	4	Fossil
Odocoileus sp.	Distal metatarsal	1995.23.39	Fossil
Odocoileus sp.	Distal metatarsal	1995.23.43	Recent
Odocoileus sp.	Distal radius	1995.30.4	Fossil
Odocoileus sp.	Distal radius	1995.40.37	Fossil
Odocoileus sp.	Distal radius	1995.7.32	Fossil
Odocoileus sp.	Distal radius	1995.8.3	Fossil
Odocoileus sp.	Distal radius	1995.8.4	Fossil
Odocoileus sp.	Distal scapula	1995.7.1136	Fossil
Odocoileus sp.	Distal scapula	1995.7.465	Fossil
Odocoileus sp.	Distal tibia	1995.22.94	Fossil
Odocoileus sp.	Distal tibia	1995.23.104	Fossil
Odocoileus sp.	Distal tibia	1995.40.86	Fossil
Odocoileus sp.	Distal tibia	1995.7.57	Fossil
Odocoileus sp.	Distal tibia	1995.7.670	Fossil
Odocoileus sp.	Distal tibia	1995.8.16	Fossil
Odocoileus sp.	Distal metatarsal	1995.7.466	Fossil

Odocoileus sp.	Humerus	1995.23.94	Fossil
Odocoileus sp.	Humerus	1995.37.12	Fossil
Odocoileus sp.	Humerus	1995.38.22	Fossil
Odocoileus sp.	Humerus	1995.40.42	Fossil
Odocoileus sp.	Humerus	1995.7.8	
Odocoileus sp.	Humerus	1995.30.7	Fossil
Odocoileus sp.	Humerus	1995.7.1172	Fossil
Odocoileus sp.	Humerus	1995.7.368	Fossil
Odocoileus sp.	Humerus	14	Fossil
Odocoileus sp.	Illium fragment	1995.7.799	Fossil
Odocoileus sp.	Lower molar	1995.7.117	Fossil
Odocoileus sp.	Lumbar vertebra	1995.7.210	Fossil
Odocoileus sp.	Lumbar vertebra	1995.7.471	Fossil
Odocoileus sp.	Mandible	1995.15.13	Fossil
Odocoileus sp.	Mandible	1995.22.77	Fossil
Odocoileus sp.	Mandible	1995.23.98	Recent
Odocoileus sp.	Mandible	1995.29.3	Fossil
Odocoileus sp.	Mandible	1995.38.27	Fossil
Odocoileus sp.	Mandible	1995.40.321	Fossil
Odocoileus sp.	Mandible	1995.7.206	Fossil
Odocoileus sp.	Mandible	1995.8.5	Fossil
Odocoileus sp.	Mandible	1995.7.1112	Fossil
Odocoileus sp.	Mandible	1995.23.123	Fossil
Odocoileus sp.	Mandible	1995.23.111	Fossil
Odocoileus sp.	Mandible	1995.23.68	Fossil
Odocoileus sp.	Mandible	1995.7.28	Recent
Odocoileus sp.	Mandible	1995.7.901	Fossil
Odocoileus sp.	Metacarpal	1995.22.83	Fossil
Odocoileus sp.	Metacarpal	1995.7.129	Fossil
Odocoileus sp.	Metacarpal	1995.23.44	Fossil
Odocoileus sp.	Metacarpal	1995.23.159	Fossil
Odocoileus sp.	Metacarpal	1995.7.304	Fossil
Odocoileus sp.	Metacarpal	1995.7.544	Fossil
Odocoileus sp.	Metacarpal	1995.7.782	Fossil
Odocoileus sp.	Metacarpal	1995.7.829	Fossil
Odocoileus sp.	Metacarpal	1995.7.867	Fossil
Odocoileus sp.	Metatarsal	1995.23.184	Recent
Odocoileus sp.	Metatarsal	1995.7.1113	Fossil
Odocoileus sp.	Metatarsal	1995.7.146	Fossil
Odocoileus sp.	Metatarsal	1995.7.175	Fossil
Odocoileus sp.	Metatarsal	1995.7.195	Recent
Odocoileus sp.	Metatarsal	1995.7.446	Fossil
Odocoileus sp.	Metatarsal	195.7.693	Fossil
Odocoileus sp.	Innominate	1995.7.11	Fossil
Odocoileus sp.	Innominate	1995.7.359	Fossil
Odocoileus sp.	Innominate	1995.15.12	Fossil
Odocoileus sp.	Innominate	1995.40.163	Fossil
Odocoileus sp.	Innominate	1995.7.1064	Fossil

Odocoileus sp.	Innominate	1995.7.190	Recent
Odocoileus sp.	Innominate	1995.7.833	Fossil
Odocoileus sp.	Proximal radius	15	Fossil
Odocoileus sp.	Proximal radius	1995.7.10	Fossil
Odocoileus sp.	Proximal tibia	1995.7.271	Fossil
Odocoileus sp.	Proximal femur	1995.23.12	Fossil
Odocoileus sp.	Proximal femur	1995.40.182	Fossil
Odocoileus sp.	Proximal femur	1995.7.144	Fossil
Odocoileus sp.	Proximal femur	1995.7.760	Fossil
Odocoileus sp.	Proximal femur	1995.7.96	Fossil
Odocoileus sp.	Proximal humerus	1995.15.8	Fossil
Odocoileus sp.	Proximal humerus	1995.23.183	Fossil
Odocoileus sp.	Proximal metapodial	1995.23.24	Fossil
Odocoileus sp.	Proximal metapodial	1995.7.13	Fossil
Odocoileus sp.	Proximal radius	1995.7.1088	Fossil
Odocoileus sp.	Proximal radius	1995.7.1170	Fossil
Odocoileus sp.	Proximal radius	1995.7.205	Fossil
Odocoileus sp.	Proximal adius	1995.7.448	Recent
Odocoileus sp.	Proximal radius	1995.8.14	Fossil
Odocoileus sp.	Proximal scapula	1995.7.1101	Recent
Odocoileus sp.	Proximal scapula	1995.7.907	Fossil
Odocoileus sp.	Proximal scapula	1995.15.5	Fossil
Odocoileus sp.	Proximal tibia	1995.40.142	Fossil
Odocoileus sp.	Proximal tibia	1995.40.87	Fossil
Odocoileus sp.	Proximal tibia	1995.7.906	Fossil
Odocoileus sp.	Proximal ulna	1995.40.95	Fossil
Odocoileus sp.	Proximal ulna	1995.7.229	Fossil
Odocoileus sp.	Proximal ulna	1995.7.467	Fossil
Odocoileus sp.	Proximal ulna	1995.7.777	Fossil
Odocoileus sp.	Radius	1995.23.15	Fossil
Odocoileus sp.	Radius	1995.38.21	Fossil
Odocoileus sp.	Radius	1995.40.7	Fossil
Odocoileus sp.	Radius	1995.7.1173	Fossil
Odocoileus sp.	Radius	1995.7.331	Fossil
Odocoileus sp.	Radius	1995.7.429	Fossil
Odocoileus sp.	Radius	1995.7.55	Fossil
Odocoileus sp.	Radius	1995.40.104	Fossil
Odocoileus sp.	Radius	1995.7.306	Recent
Odocoileus sp.	Radius	1995.23.46	Fossil
Odocoileus sp.	Radius	1995.7.1105	Fossil
Odocoileus sp.	Sacrum	1995.7.699	Fossil
Odocoileus sp.	Sacrum	1995.7.709	Fossil
Odocoileus sp.	Scapula fragment	1995.23.86	Fossil
Odocoileus sp.	Scapula fragment	1995.30.11	Fossil
Odocoileus sp.	Scapula fragment	1995.38.25	Fossil
Odocoileus sp.	Scapula fragment	1995.38.26	Fossil
Odocoileus sp.	Scapula fragment	1995.40.167	Fossil
Odocoileus sp.	Scapula fragment	1995.7.191	Fossil

Odocoileus sp.	Scapula fragment	1995.7.486	Fossil
Odocoileus sp.	Scapula fragment	1995.7.59	Recent
Odocoileus sp.	Scapula fragment	1995.7.924	Recent
Odocoileus sp.	Skull	1995.7.128	Fossil
Odocoileus sp.	Skull	1995.7.147	Fossil
Odocoileus sp.	Skull cap	1995.22.76	Fossil
Odocoileus sp.	Skull cap	1995.7.1135	Fossil
Odocoileus sp.	Skull cap	1995.7.1179	Fossil
Odocoileus sp.	Skull cap	1995.7.41	Fossil
Odocoileus sp.	Skull cap	1995.7.706	Fossil
Odocoileus sp.	Skull cap	1995.7.88	Fossil
Odocoileus sp.	Skull cap w/ antler buds	1995.7.305	Fossil
Odocoileus sp.	Skull fragment	1995.7.463	Fossil
Odocoileus sp.	Skullcap w/antler buds	1995.7.664	Fossil
Odocoileus sp.	Cervical vertebra	3	Fossil
Odocoileus sp.	Cervical vertebra	17	Fossil
Odocoileus sp.	Thoracic vertebra	1995.7.470	Recent
Odocoileus sp.	Thoracic vertebra	1995.8.20	Fossil
Odocoileus sp.	Thoracic vertebra	1995.8.26	Fossil
Odocoileus sp.	Tibia	1995.23.96	Fossil
Odocoileus sp.	Tibia	1995.38.20	Fossil
Odocoileus sp.	Tibia	1995.40.175	Fossil
Odocoileus sp.	Tibia	1995.40.55	Fossil
Odocoileus sp.	Tibia	1995.40.70	Fossil
Odocoileus sp.	Tibia	1995.7.856	Fossil
Odocoileus sp.	Tibia	7	Fossil
Odocoileus sp.	Ulna	1995.38.24	Fossil
Odocoileus sp.	Vertebra	1995.7.150	Fossil
Odocoileus sp.	Vertebra	1995.7.272	Fossil
Odocoileus sp.	Vertebra	1995.7.440	Fossil
Odocoileus sp.	Vertebra	1995.7.472	Fossil
Odocoileus sp.	Vertebra	1995.40.156	Recent
Odocoileus sp.	Vertebra	1995.40.157	Recent
Odocoileus sp.	Vertebra	1995.7.691	Recent
Odocoileus sp.	Vertebra	1995.7.692	Recent
Odocoileus sp.	Vertebra	1995.7.759	Recent
Odocoileus sp.	Vertebra	20	Recent
Odocoileus sp.	Vertebra	1995.38.28	Fossil
Odocoileus virginianus	Antler	1995.7.119	Fossil
Odocoileus virginianus	Antler	1995.7.42	Fossil
Odocoileus virginianus	Antler fragment	1995.7.401	Fossil
Odocoileus virginianus	Antler fragment	1995.7.449	Fossil
Ovis aries	Skull fragment	1995.22.85	Recent
Panthera leo atrox	Carnassial	1995.40.331	Fossil
Panthera leo atrox	Distal humerus	1995.7.1119	Fossil
Panthera leo atrox	Mandible	1070	Fossil
Paramylodon harleni	Axis	1995.40.132	Fossil
Paramylodon harleni	Distal femur	1995.7.450	Fossil

Paramylodon harleni	Innominate	1995.7.821	Fossil
Paramylodon harleni	Innominate	1995.7.451	Fossil
Paramylodon harleni	Proximal femur	1995.23.19	Fossil
Paramylodon harleni	Terminal phalanx	1995.40.324	Fossil
Pylodictis olivaris	supraethmoid	1995.40.180	Fossil
Rangifer sp.	Antler	1995.38.16	Fossil
Rangifer sp.	Antler tine	1995.40.122	Fossil
Rangifer sp.	Skull cap w/antler buds	1995.8.2	Fossil
Rangifer sp.	Modified antler	WiseLamb73	Fossil
Sus scrofa	Mandible	1995.22.46	Recent
Sus scrofa	Mandible	1995.30.24	Recent
Sus scrofa	Mandible	1995.7.566	Recent
Sus scrofa	inominate fragment	1995.7.584	Recent
Sus scrofa	Tusk fragment	1995.7.841	Recent
Sylvilagus sp.	Proximal femur	1995.8.8	Recent
Tapirus haysii	Mandible	1995.31.1	Fossil
Tapirus haysii	Mandible	1995.37.10	Fossil
Tapirus haysii	Mandible	1995.7.257	Fossil
Tapirus haysii	Mandible	1995.7.258	Fossil
Tapirus haysii	Mandible fragment	1995.40.328	Fossil
Tapirus haysii	Mandible fragment	1995.40.329	Fossil
Tapirus haysii	Mandible fragment	1995.7.1115	Fossil
Tapirus haysii	Mandible w/teeth	1995.7.923	Fossil
Tapirus sp.	Distal tibia	1995.7.535	Fossil
Tapirus veroensis	Mandible	1995.40.217	Fossil
Terrapene sp	Carapace fragment	809	Fossil
Terrapene sp.	Plastron fragment	129	Fossil
Ursus americanus	Distal clavicle	1995.7.527	Recent
Ursus americanus	Distal humerus	19	Recent
Ursus americanus	Distal humerus	1995.8.18	Recent
Ursus americanus	Humerus	848	Recent
Ursus americanus	Mandible	1995.22.7	Fossil
Ursus americanus	Mandible	1995.7.666	Recent
Ursus americanus	Innominate	88	Recent
Ursus americanus	Innominate fragment	30	Recent
Ursus americanus	Innominate fragment	1995.8.29	Recent
Ursus americanus	Proximal calcaneus	1995.7.984	Recent
Ursus americanus	Proximal ulna	1995.40.29	Fossil

Appendix C
Relative percentages of NISP of the Connaway Collection

Taxon	NISP	Percentage
Lepisosteus sp.	2	0.18
Atractosteus spatula	1	0.09
Pylodictis olivaris	1	0.09
Aplodinotus grunniens	2	0.18
Alligator mississippiensis	2	0.18
Chelydra serpentina	2	0.18
Macroclemys temmincki	1	0.09
Chrysemys sp.	7	0.10
Terrepene sp.	2	0.18
Geochelone crassiscutata	17	1.54
Apalone spinifera	9	0.81
Meleagris gallopavo	1	0.09
Ardea herodius	1	0.09
Branta canadensis	1	0.09
Dasypus bellus	3	0.27
Megalonyx jeffersonii	21	1.91
Nothrotheriops sp.	1	0.09
Paramylodon harleni	8	0.72
Lutra canadensis	1	0.09
Canis sp.	5	0.45
Arctodus sp.	2	0.18
Ursus americanus	11	1.00
Panthera leo atrox	3	0.27
Marmota monax	1	0.09
Castoroides ohioensis	6	0.54
Castor canadensis	2	0.18
Sylvilagus sp.	1	0.09
Equus sp.	245	22.3
Tapirus haysii	11	1.00
Tapirus veroensis	1	0.09
Myohylus fossilis	1	0.09
Sus scrofa	5	0.45
Odocoileus virginianus	4	0.36
Odocoileus sp.	322	29.3
Rangifer sp.	4	0.36
Cervalces cf. *scotti*	1	0.09
Cervus elephas	10	0.91
Ovis aires	1	0.09
Bootherium bombifrons	19	1.73
Bison latifrons	7	0.63
Bison bison antiquus	11	1.00
Bison bison occidentalis	3	0.27
Bison bison bison	4	0.36
Bison sp.	274	24.9

Appendix C (Continued)
Relative percentages of NISP of the Connaway Collection

Taxon	NISP	Percentage
Mammut americanum	49	4.46
Mammuthus sp.	12	1.09
Total	1098	100.00

Appendix D
AMS Laboratory Assay

SR-5159, MUSEUM # Wise/Lamb #73 JOB-4 Site: Wise/Lamb #73

Sample Type: ANTLER
MUSEUM
Rangifer tarandus

Project: PINK PALACE

Submitter: RONALD C.
BRISTER

Strat Depth:

Estimated Age:

Fraction Modern: 0.4079 ± 0.0028

Fraction Dated: XAD-GELATIN(KOH-COLLAGEN)

14C AGE: = 7,200 ± 60 yr. BP (CAMS-58184)

[GRPT-4319]

Received from LLNL: 27-AUG-99

Appendix E
PALEOVEGETATION MAPS (Adapted from Delcourt & Delcourt, 1997*b*)

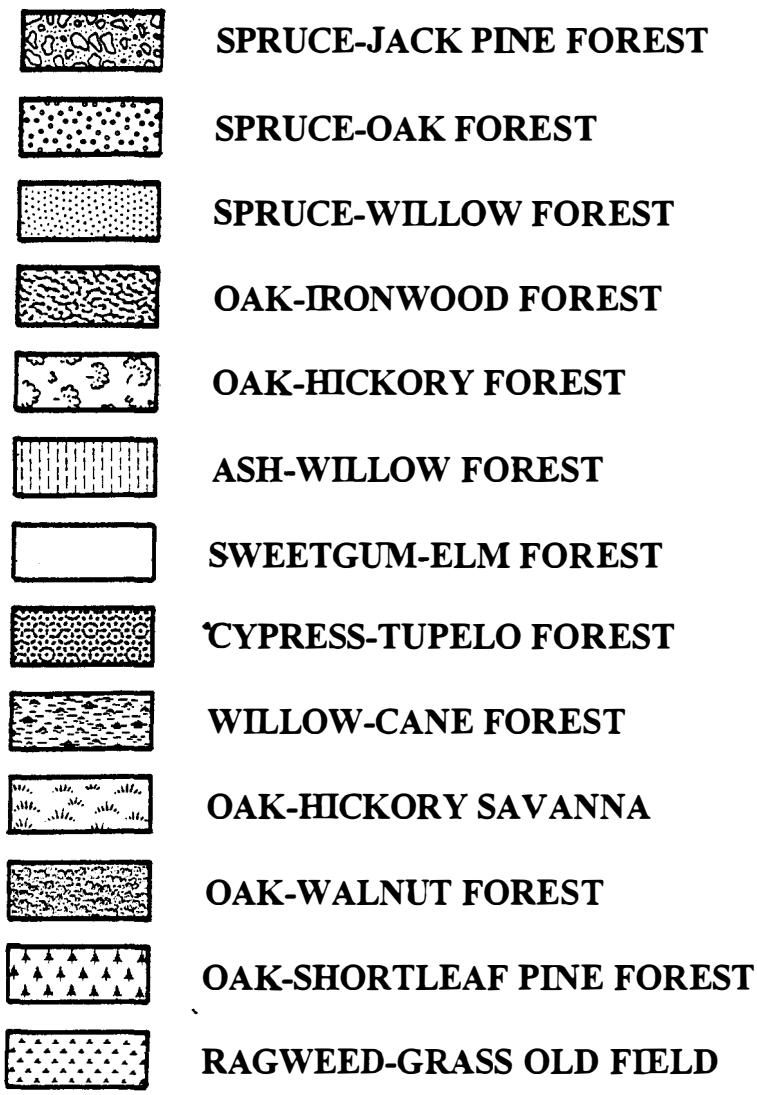

Figure 7. Key to Vegetation Types

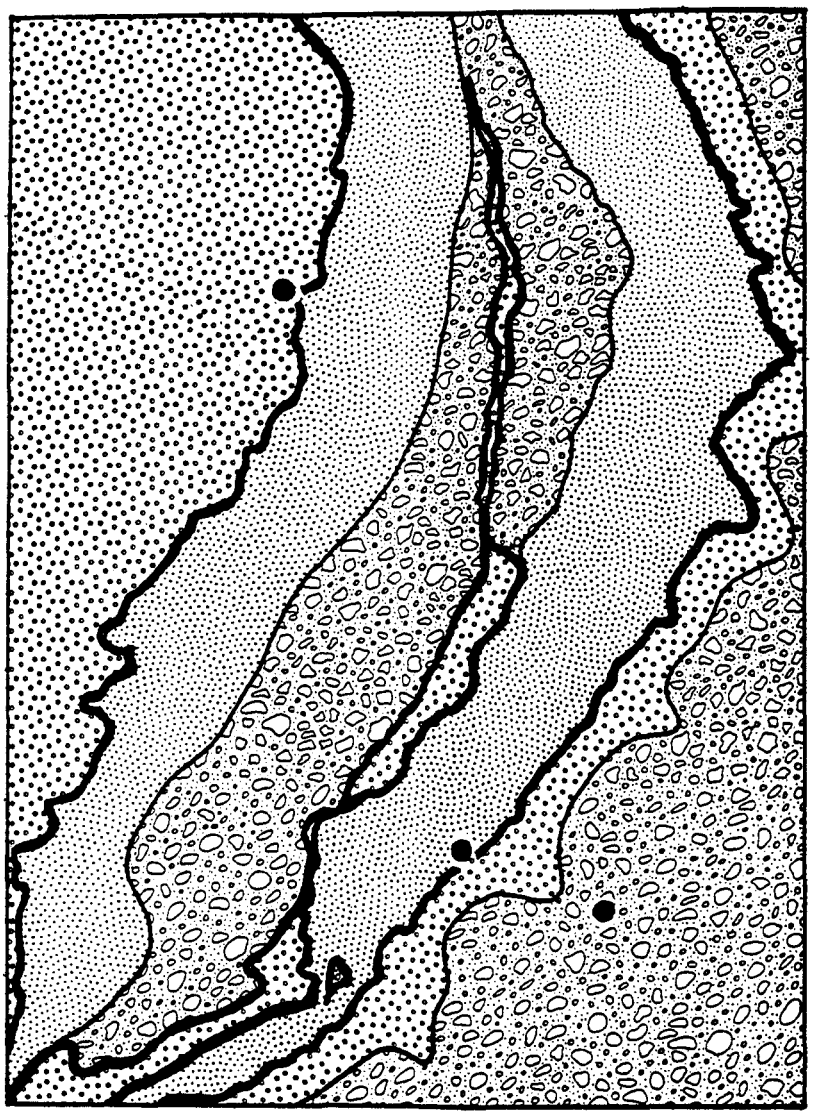

Figure 8. Paleoenvironmental map for 18,000 yr B.P.

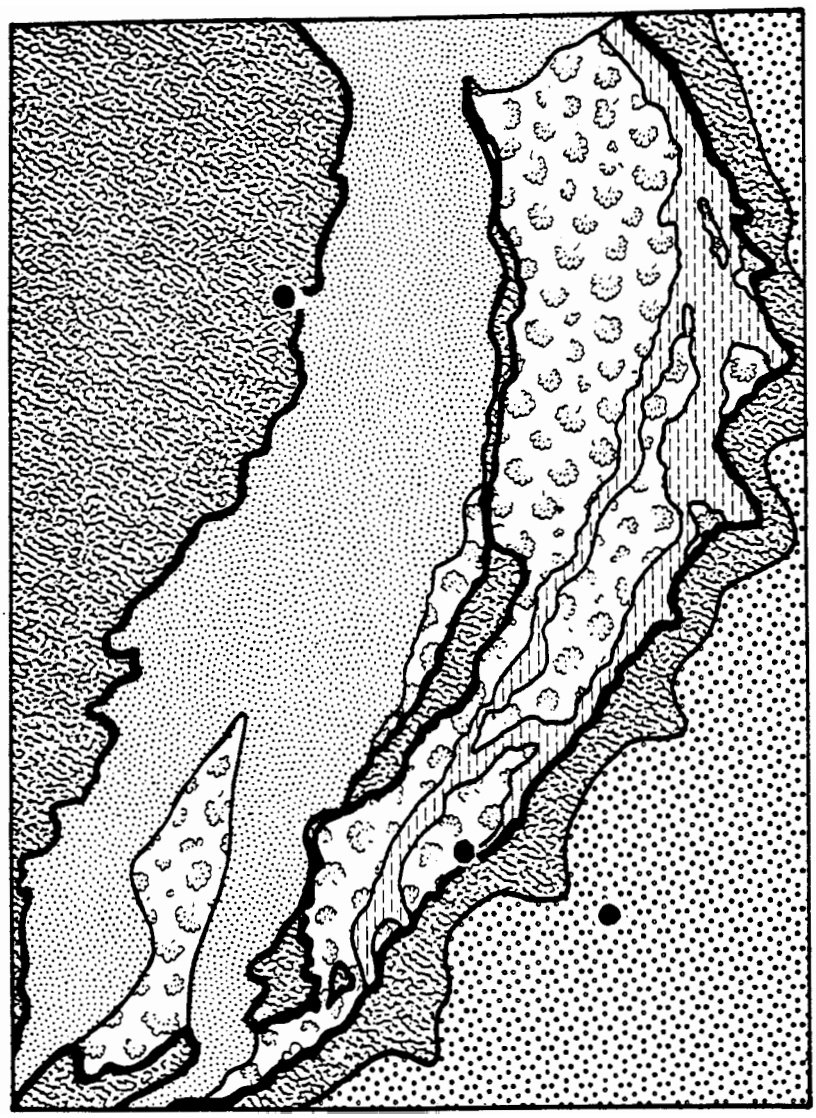

Figure 9. Paleoenvironmental map for 14,000 yr B.P.

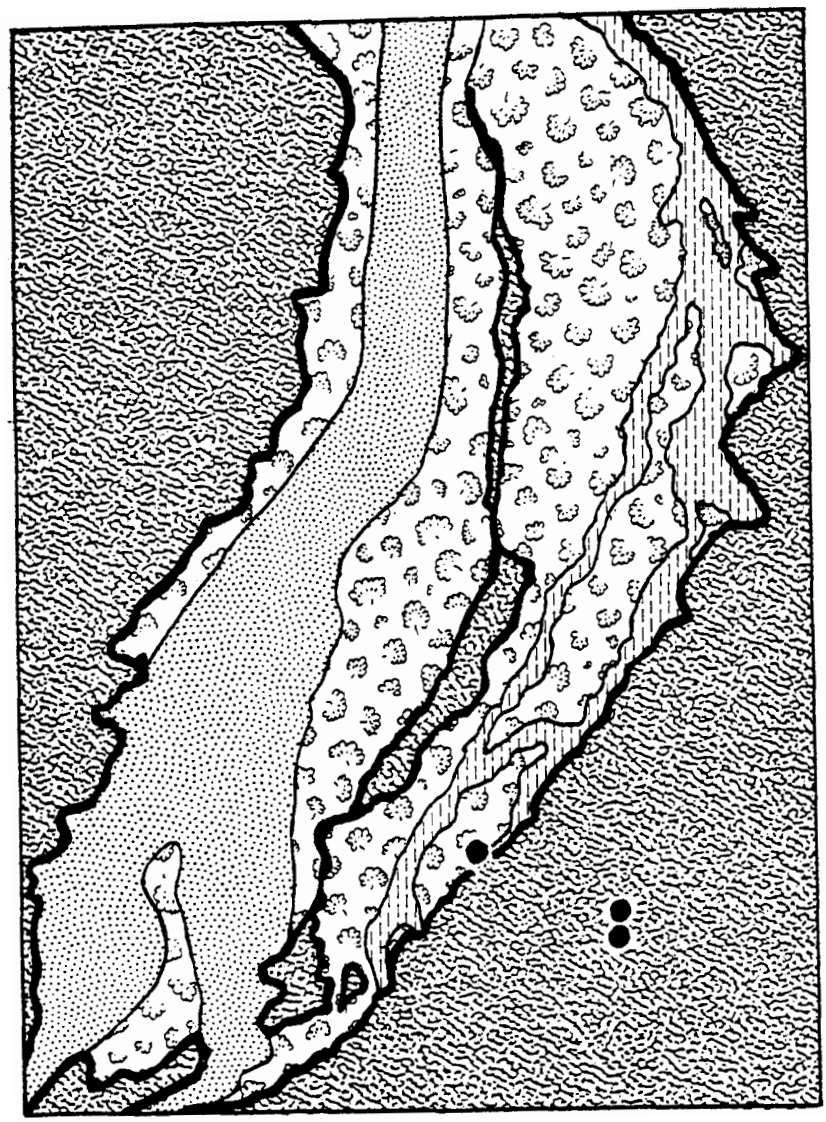

Figure 10. Paleoenvironmental map for 12,000 yr B.P.

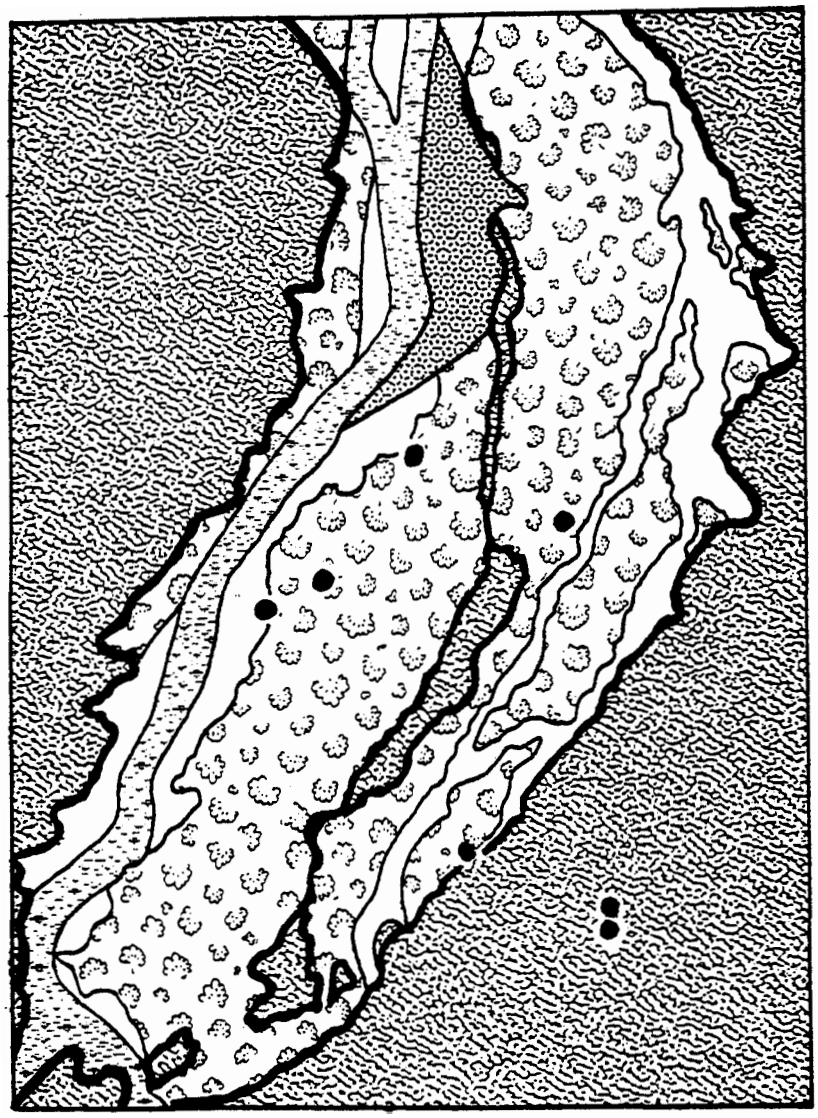

Figure 11. Paleoenvironmental map for 10,000 yr B.P.

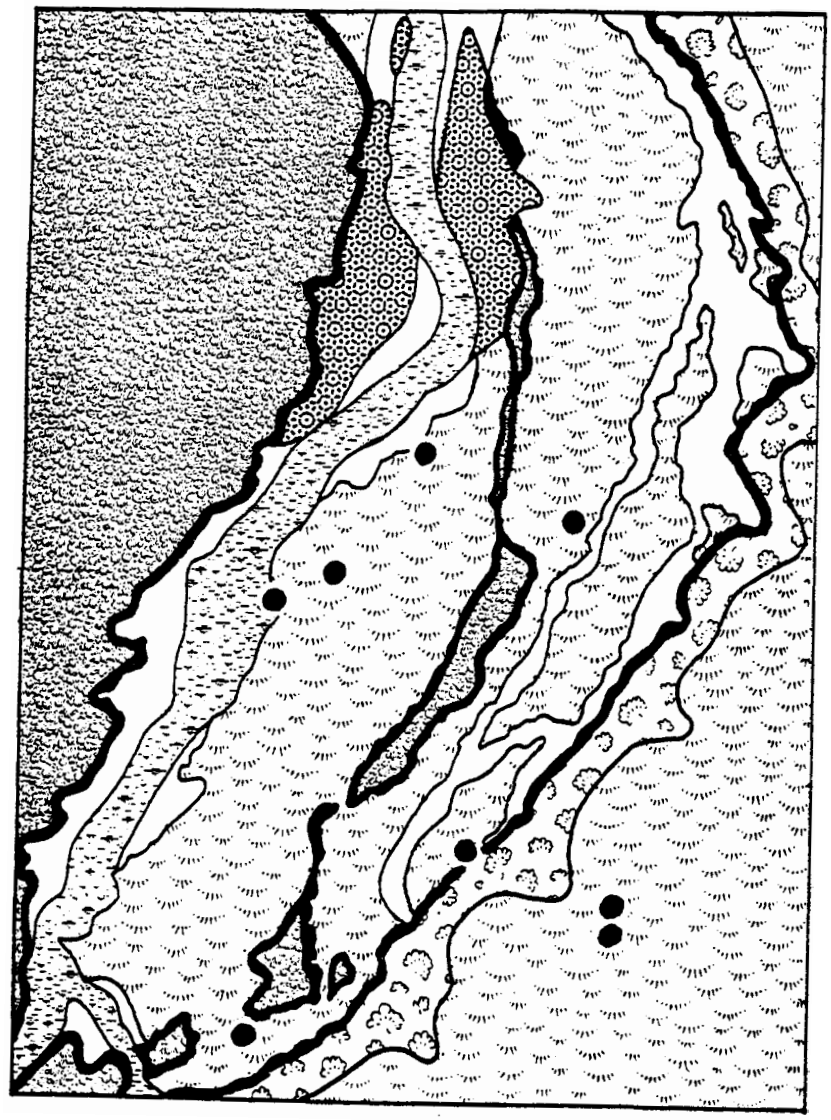

Figure 12. Paleoenvironmental map for 8000 yr B. P.

VITA

Michael W. Ruddell was born in Phoenix, Arizona on March 15, 1955. He attended public schools in the Phoenix Public School System and graduated from Camelback High School in 1974. He attended Phoenix College and received an Associate of Arts degree in 1976. He then attended the University of Arizona in Tucson, Arizona and earned a Bachelor of Arts in Anthropology in 1978. After working in the field of archaeology and other miscellaneous occupations in 1986, he began working on a graduate degree at Northern Arizona University in Flagstaff, Arizona. He received a Master of Science in Quaternary Studies in 1992. While working in the Medical Field, he decided to pursue a doctorate in Zooarchaeology at the University of Tennessee, Knoxville in 1994. The doctoral degree was received.

He is presently employed at Pellissippi State Technical Community College as the lead adjunct instructor of anthropology.