A Faunal Analysis of the Eleventh Horizon of the Koster Site (11GE4)

Andrea Lee Boon
Indiana University of Pennsylvania

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A FAUNAL ANALYSIS OF THE ELEVENTH HORIZON OF THE KOSTER SITE (11GE4)

A Thesis
Submitted to the School of Graduate Studies and Research
in Partial Fulfillment of the
Requirements for the Degree
Master of Arts

Andrea Lee Boon
Indiana University of Pennsylvania
December 2013
Indiana University of Pennsylvania
School of Graduate Studies and Research
Department of Anthropology

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Illinois State University

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Dean
School of Graduate Studies and Research

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Title: A Faunal Analysis of the Eleventh Horizon of the Koster Site (11GE4)

Author: Andrea Lee Boon

Thesis Chair: Dr. Sarah W. Neusius

Thesis Committee Members: Dr. Phillip Neusius  
Dr. Michael D. Wiant

Faunal analysis is an increasingly utilized archaeological tool. Here, it is applied to a sample of the terminal Early Archaic Horizon Eleven faunal assemblage from the Koster site (11GE4) to determine subsistence strategies, settlement patterns, and challenge previous theories. This study includes previously unanalyzed flotation samples providing a more complete faunal analysis than previously done. This study concludes that the inclusion of flotation samples is an integral part of a faunal analysis, changing the assemblage composition significantly. It also supports the conclusion of a generalized to specialized strategy shift, and suggests that there was a greater and more matured aquatic use than expected. Attempts to determine seasons of occupation (in conjunction with the presence of heavy, immobile artifacts) suggest longer term occupations and the possibility that Koster represents a link between the mobile Early Archaic groups and the shift to sedentism in the Middle Archaic.
ACKNOWLEDGMENTS

I would like to start by thanking my committee members at IUP, Drs. Sarah Neusius and Phil Neusius, who were always there to guide me through this process. A great big thank you to my third committee member, Dr. Michael Wiant, who was a source of great insight, advice and support during my time researching in Illinois.

I would also like to thank Dr. Terrance Martin for the use of his lab and his constant help with my work. A thank you to Dr. Bonnie Styles for her help and support with my research and analyses, as well as a thank you to all of the staff at the Illinois State Museum Research and Collections Center who helped me during my time there.

Another thank you is in order for my classmates, as I may not have made it without their assistance and readiness to listen to my woes. In particular, special thanks to Callista Holmes, Ashley Brown and Amanda Snyder for their unending patience, hours spent commiserating and all the “girls’ nights!”

Thank you to my parents and my sisters for their constant reassurance and faith in me that I relied on so much.

And, most importantly, to my very significant other, David Kroskie, for his complete support, love and help during my research, traveling, tantrums, and crying as another deadline passed thesis unfinished: thank you.
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CHAPTER 1: INTRODUCTION TO KOSTER AND THE EARLY ARCHAIC

Faunal analysis is an increasingly utilized archaeological tool. I have applied this tool to the under-analyzed Koster site (11GE4), in Greene County, Illinois, focusing on the subsistence strategies of the Early Archaic Horizon Eleven, a cultural period designated the Koster phase. The goal of this thesis is to supplement the extant studies of Koster Phase faunal use and examine their results in conjunction with mine to investigate the current conclusions regarding the Early Archaic in the lower Illinois River valley and its transition into the Middle Archaic. Primarily, this thesis will determine what subsistence strategies were used in the Koster phase. Using the theorized subsistence strategies I will look into how these impacted, or were impacted by, the settlement patterns in the Koster phase and whether these patterns are parallel with larger regional subsistence and settlement patterns. Finally, I will consider whether these current results, with a more sufficient sample size, challenge or confirm existing theories about subsistence and settlement in the Early Archaic.

The Midwest Archaic period is not as well understood as later periods, partially due to a scarcity of adequate Archaic faunal remains. Two factors are responsible for the lack of Archaic faunal remains: depositional and taphonomic situations that were not conducive to the preservation of faunal material, and standards of excavation that were not concerned with the recovery of zooarchaeological data (Styles and McMillan 2009). The Koster collections include a rich Archaic faunal assemblage. The fresh-water mussel shells from Horizon Eleven are exceptionally well preserved for their age. This large assemblage has not been thoroughly studied. Sarah Neusius examined a small sample of Horizon Eleven macro-remains but no flotation specimens (Neusius 1982, 1986). Andreas Paloumpis identified a large sample of Horizon Eleven fish remains from flotation but these results have not been analyzed or
published. Horizon Eleven, dated to the terminal Early Archaic period (8800 to 8200 B.P.), was chosen for the incomplete understanding of its nature and the richness of its assemblage to explore the subsistence strategies and diet of the Koster Phase occupants (Brown and Vierra 1983; Styles and McMillan 2009; Wiant et al. 1983, 2009). The fresh data from this study, in conjunction with prior studies, tests the current theories regarding this transitional period at Koster utilizing a zooarchaeological approach to delve into the subjects of subsistence and settlement.

The archaeological record is deficient in adequate Archaic data in general, particularly for the Early Archaic. Progress with Early Archaic comprehension is slow because it has not been considered a priority period. Interest for the Early Archaic was also delayed in part by the general lack of known Early Archaic deposits in the Midwest. In contrast, the Late Archaic has been considered an Archaic period worthy of investigation as it transitioned into the Early Woodland, a preferred period. Late Archaic, and more recent time periods, site components are more common as they are closer to the ground surface and more accessible, while earlier sites are generally more deeply buried and difficult to access and find. However, in the Illinois River valley the Early to Middle Archaic transition is a significant cultural transition in American Midwestern prehistory (Brown and Vierra 1983; Neusius 1982). The Koster Phase, being in the terminal Early Archaic, is on the cusp of that transition. The Early Archaic inhabitants of the lower Illinois River valley were highly mobile hunter-gatherers who, moving into the terminal Early Archaic and the Middle Archaic periods, shifted towards more permanent base camps utilizing logistical foraging tactics (Binford 1980; Fowler 1959; Wiant et al. 1983). This transition depended on numerous faunal exploitation tactics. Understanding these tactics of the Early Archaic will lead to a better understanding of the transition.
Within American prehistory, the entire Archaic time period is one where archaeologists still have much to understand. Historically thought of as an unexciting and uninformative period in North American prehistory, the Archaic period once went unstudied and mostly ignored. Limited investigations have led to unconfirmed theories and conclusions. Despite advances in the recovery of Archaic materials due to the cultural resources management industry, prior assumptions about the Archaic period still pervade its analysis and understanding. Only in the past few decades has there been an increase of research on Midwest Archaic sites and artifacts (Brown and Vierra 1983; Emerson et al. 2009). Current research is slowly informing archaeologists about the Archaic, but further research is required for more concrete conclusions (Emerson et al. 2009; Wiant et al. 2009).

**Koster Phase**

The Koster site is significant for the following reasons: its long temporal duration and excellent preservation of both inorganic and organic artifacts. Koster is also an open air/bluff base site, not a rockshelter or a cave, making it more distinctive in the region with unique environmental circumstances (Wiant et al. 2009). This relatively rare site type offers data for new and current theories on settlement and subsistence strategies. The lengthy timeline of the site, with the distinctly separate strata, allows a rare view of transitions through time. Individual cultural components were isolated by rapid sterile sediment accumulation. This is particularly important for Koster’s terminal Early Archaic Horizon Eleven as the Middle Archaic horizons have been more thoroughly analyzed, but Horizon Eleven has not (Brown and Vierra 1983; Carlson 1979; Neusius 1982). The exact nature of the Koster phase represented by Horizon
Eleven is uncertain. The changing climate and landscape of the Archaic period resulted in changing cultural patterns. Current consensus is that Horizon Eleven represents repeated seasonal residential camps utilizing a variety of the numerous mammals, fish and bird species available in the region (Brown and Vierra 1983; Wiant et al. 2009). There is evidence for early sedentary developments in the Middle Archaic and archaeologists have argued for a cultural transition that occurred between the Early and Middle Archaic periods (Brown and Vierra 1983; Carlson 1979; Neusius 1982; Wiant et al. 2009). For the transition to be understood, both sides of the shift must be analyzed and as fully known as possible. At this time, for Koster, only the Middle Archaic is at an adequate level of comprehension.
CHAPTER 2: RELATED RESEARCH

The following chapter provides regional and site specific environmental and cultural context, as well as site background, related research and a greater geographical context.

The Lower Illinois River Valley

Physiology

The lower Illinois River Valley (see Figure 1), in west-central Illinois, is characterized by its three dominating features: the Illinois River, its floodplain, and the towering, corridor-like limestone bluffs. The Illinois River begins in northeastern Illinois at the confluence of the Kankakee and Des Plaines Rivers. Currently the river runs along the western edge of the lower valley, splitting and meandering occasionally. A cross section of the lower river valley shows only one anciently abandoned river channel no more than a few hundred feet closer to the eastern bluffs (Butzer 1977:16).

Figure 1. Lower Illinois River valley (Asch et al. 1972).
The bluffs that line the valley and define its border were formed as the ancient Mississippi River carved its path through the Paleozoic limestone bedrock, ultimately carving out the valley (see Figure 2). The limestone bluffs, rising from approximately 44.8 to 69.8 m (147 to 229 ft.) high, run along both sides of the river and make the valley about 4.8 km (3 miles) wide at its broadest point (Styles 1981). These limestone walls open only where tributaries of the Illinois River flow through. Macoupin Creek, a high order tributary, is the closest tributary to the Koster site and flows 1.9 km (1.2 miles) south of the site (Butzer 1977). Other high order tributaries occur along the valley at 12 to 20 km (7.5 to 12.5 miles) intervals. Intermediate tributaries occur at more frequent intervals. There are also numerous low order tributaries (smaller creeks and streams) frequently throughout the valley (Butzer 1977). This includes Koster Creek which runs directly through the Koster site (Neusius 1982).

The Koster site is located on the alluvial and colluvial complex on the eastern bluff-base in the lower Illinois River valley (Asch et al. 1972; Hajic 1990). This slope is comprised of alluvial fans deposited by the Koster watershed and colluvial fan known as the Peyton colluvium (Butzer 1977; Wiant et al 1983). The Peyton colluvium formed as the upland sediment, of late Wisconsin Peoria silt, eroded down into the valley (Butzer 1977, Hajic 1990).

Figure 2 displays the lower Illinois River valley’s four basic environments: aquatic, closed forests, open forests and grassland/prairie. These environments manifest in nine separate resource zones in, and adjacent to, the valley. These zones begin in the center with the Illinois River and its shorelines and spread out east and west from the river. Adjacent to the river are the floodplain forests, after those are the backwater lakes and shorelines followed by the bottomland prairie and talus-slope forest. These inner zones are lined by the limestone bluffs which are topped by the upland forest that merges into the open woodland and finally the upland prairie.
All of these zones are passed through by the final zone: tributary streams and shoreline (Neusius 1982; Zawacki and Hausfater 1969).

![Figure 2. Illinois River valley resource zones (Neusius 1982).](image)

**Flora and Fauna**

Through environmental reconstruction, the Early Archaic period in the lower Illinois River valley can be described as rich in resources (Neusius 1982). The modern Illinois River valley is quite different from its Early Archaic self. Much of the land has been converted for farm use, the forests stripped for open land and lumber and the Illinois River, dammed and polluted, is a weak version of its former self (Neusius 1982; Styles 1981; Wiant et al. 2009). Even records prior to wholesale historic anthropomorphic landscape alterations are not entirely accurate or adequate for describing the river valley in the Early Archaic period as the region underwent several major climate changes before then (Hajic 1981, Neusius 1982; Styles 1981). The best representations of the era come from analyses of geologic, paleobotanical and faunal data from sites dated to that period.

A great variety of flora and fauna would have been found in the deciduous forests, the prairies, and the aquatic environments of the valley. These lists, compiled from prior analyses, are just a representative summary of what resources these zones included. For a complete listing of known flora and fauna see these sources: “Paleoethnobotany of the Koster Site: The Archaic
Horizons (Asch et al. 1972), “Early-Middle Archaic Subsistence Strategies: Changes in Faunal Exploitation at the Koster Site” (Neusius 1982), Faunal Exploitation and Resource Selection: Early Late Woodland Subsistence in the Lower Illinois Valley (Styles 1981), and “Early vegetation of the Lower Illinois River” (Zawacki and Hausfater 1969). The deciduous forests which are found in the floodplain, talus-slope, upland, and open woodland zones contain a variety of nut producing trees as well as trees with other edible portions. Numerous species of berries, fruits and other edible vegetation grew in these deciduous forests as well (Asch et al. 1972; Styles 1981; Zawacki and Hausfater 1969). Table 1 lists many of the flora that could be found in the deciduous forests.

Table 1. Deciduous Forest Flora.

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
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<tbody>
<tr>
<td><strong>Trees</strong></td>
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</tr>
<tr>
<td>Walnut</td>
<td><em>Juglans nigra</em></td>
</tr>
<tr>
<td>Butternut</td>
<td><em>Juglans cinerea</em></td>
</tr>
<tr>
<td>Pecan</td>
<td><em>Carya illinoensis</em></td>
</tr>
<tr>
<td>Hazelnut</td>
<td><em>Corylus Americana</em></td>
</tr>
<tr>
<td>Hickory species</td>
<td><em>Carya spp.</em></td>
</tr>
<tr>
<td>Oak species</td>
<td><em>Quercus spp.</em></td>
</tr>
<tr>
<td>Elm species</td>
<td><em>Ulmus spp.</em></td>
</tr>
<tr>
<td>Sugar Maple</td>
<td><em>Acer saccharum</em></td>
</tr>
<tr>
<td>Dogwood</td>
<td><em>Cornus spp.</em></td>
</tr>
<tr>
<td>Basswood</td>
<td><em>Tilia spp.</em></td>
</tr>
<tr>
<td>Bittersweet</td>
<td><em>Celastrus scandens</em></td>
</tr>
<tr>
<td>Honey Locust</td>
<td><em>Gleditsia triacanthos</em></td>
</tr>
<tr>
<td>Box Elder</td>
<td><em>Acer nigundo</em></td>
</tr>
<tr>
<td><strong>Berries, Fruits, etc</strong></td>
<td></td>
</tr>
<tr>
<td>Hackberry</td>
<td><em>Celtis spp.</em></td>
</tr>
<tr>
<td>Red Mulberry</td>
<td><em>Moros rubra</em></td>
</tr>
<tr>
<td>Hawthorn</td>
<td><em>Crataegus spp.</em></td>
</tr>
<tr>
<td>Grape</td>
<td><em>Vitis spp.</em></td>
</tr>
<tr>
<td>Persimmon</td>
<td><em>Diospyros spp.</em></td>
</tr>
<tr>
<td>Greenbrier</td>
<td><em>Smilax spp.</em></td>
</tr>
<tr>
<td>Smooth Sumac</td>
<td><em>Rhus glabra</em></td>
</tr>
<tr>
<td>Hog Peanut</td>
<td><em>Amphicarpa bracteata</em></td>
</tr>
</tbody>
</table>
The rich diversity of trees and plants supported a diverse group of mammals, birds, reptiles and amphibians, a concise list of which is in Table 2. Mammals include a few predators and a variety of small and medium-sized prey mammals. The white-tailed deer (*Odocoileus virginianus*) is the largest prey animal known in the region. The occurrence of elk (*Cervus Canadensis*) in this area is unclear due to a limited number of specimens positively identified as such, as well as the difficulty of differentiating elk from white-tailed deer among fragmentary specimens. Bird species are less numerous, the few identified being the wild turkey (*Meleagris*).

<table>
<thead>
<tr>
<th>Common name</th>
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<tr>
<td><strong>Mammals</strong></td>
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<tr>
<td>Opossum</td>
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<tr>
<td>Black Bear</td>
<td><em>Ursus americanus</em></td>
</tr>
<tr>
<td>Raccoon</td>
<td><em>Procyon lotor</em></td>
</tr>
<tr>
<td>Striped Skunk</td>
<td><em>Mephitis mephitis</em></td>
</tr>
<tr>
<td>American Badger</td>
<td><em>Taxidea taxus</em></td>
</tr>
<tr>
<td>Foxes</td>
<td><em>Urocyon spp.</em></td>
</tr>
<tr>
<td>Wolves</td>
<td><em>Canis spp.</em></td>
</tr>
<tr>
<td>Cougar</td>
<td><em>Felis concolor</em></td>
</tr>
<tr>
<td>Bobcat</td>
<td><em>Lynx rufus</em></td>
</tr>
<tr>
<td>Woodchuck</td>
<td><em>Marmota monax</em></td>
</tr>
<tr>
<td>Squirrels (Tree &amp; Ground)</td>
<td><em>Sciuridae spp.</em></td>
</tr>
<tr>
<td>Plains Pocket Gopher</td>
<td><em>Geomys bursarius</em></td>
</tr>
<tr>
<td>Eastern Cottontail</td>
<td><em>Sylvilagus floridanus</em></td>
</tr>
<tr>
<td>White-tailed Deer</td>
<td><em>Odocoileus virginianus</em></td>
</tr>
<tr>
<td>Elk</td>
<td><em>Cervus canadensis</em></td>
</tr>
<tr>
<td><strong>Birds</strong></td>
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</tr>
<tr>
<td>Wild Turkey</td>
<td><em>Meleagris gallopavo</em></td>
</tr>
<tr>
<td>Passenger Pigeon</td>
<td><em>Ectopistes migratorius</em></td>
</tr>
<tr>
<td>Bobwhite</td>
<td><em>Colinus virginianus</em></td>
</tr>
<tr>
<td><strong>Reptile</strong></td>
<td></td>
</tr>
<tr>
<td>Common Box Turtle</td>
<td><em>Terrapene carolina</em></td>
</tr>
</tbody>
</table>
gallopavo), passenger pigeon (*Ectopistes migratorius*) and bobwhite (*Colinus virginianus*). The only reptile or amphibian Styles assigns to the forest zones is the common box turtle (*Terrapene carolina*) (Neusius 1982; Styles 1981).

The nearby bottomland prairie and the farther upland prairies offered less variety in the way of edible, yet crucial, flora and fauna. The former zone consisted of no food-producing trees and few edible plants. Upland prairies offered little more (Asch et al. 1972; Styles 1981; Zawacki and Hausfater 1969). The edible flora are listed in Table 3.

<table>
<thead>
<tr>
<th>Common name</th>
<th>Scientific name</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bottomland Prairie</strong></td>
<td></td>
</tr>
<tr>
<td>Duck Potato</td>
<td><em>Sagittaria latifolia</em></td>
</tr>
<tr>
<td>Nutgrass</td>
<td><em>Cyperus rotundus</em></td>
</tr>
<tr>
<td>Sedge</td>
<td><em>Cyperaceae spp.</em></td>
</tr>
<tr>
<td>Amaranth</td>
<td><em>Amaranthus spp.</em></td>
</tr>
<tr>
<td>Marshelder</td>
<td><em>Iva annua</em></td>
</tr>
<tr>
<td>Giant Ragweed</td>
<td><em>Ambrosia trifida</em></td>
</tr>
<tr>
<td><strong>Upland Prairie</strong></td>
<td></td>
</tr>
<tr>
<td>Strawberry</td>
<td><em>Fragaria vesca</em></td>
</tr>
<tr>
<td>Sumac</td>
<td><em>Rhus glabra</em></td>
</tr>
<tr>
<td>Prairie Clover</td>
<td><em>Dalea spp.</em></td>
</tr>
<tr>
<td>Lovegrass</td>
<td><em>Eragrastis spp.</em></td>
</tr>
<tr>
<td>Oxalis species</td>
<td><em>Oxalis spp.</em></td>
</tr>
</tbody>
</table>

Table 4 lists the minimal fauna that could be found in the prairies. White-tailed deer would have been found at the margins of these open grasslands and the deciduous forests. The occurrence of elk and bison in this region and zone is unclear. Elk uncertainty was discussed above while the appearance of bison is also doubted due to a lack of specimens. There is the
possibility of their occurrence in the upland prairies but to what extent is unknown (Neusius 1982; Styles 1981).

The aquatic environments, the river, lakes and streams, in contrast to the prairies, were more productive and rich in terms of food resources. The floral resources are included in Table 5 (Asch et al. 1972; Styles 1981; Zawazki and Hausfater 1969).

Table 4. Prairie Fauna.

<table>
<thead>
<tr>
<th>Common name</th>
<th>Scientific name</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mammals</strong></td>
<td></td>
</tr>
<tr>
<td>American Badger</td>
<td><em>Taxidea taxus</em></td>
</tr>
<tr>
<td>Bison</td>
<td><em>Bison bison</em></td>
</tr>
<tr>
<td>Coyote</td>
<td><em>Canis latrans</em></td>
</tr>
<tr>
<td>White-tailed Deer</td>
<td><em>Odocoileus virginianus</em></td>
</tr>
<tr>
<td>Elk</td>
<td><em>Cevus elaphus canadensis</em></td>
</tr>
<tr>
<td>Ground Squirrels</td>
<td><em>Sciuridae spp.</em></td>
</tr>
<tr>
<td>Plains Pocket Gopher</td>
<td><em>Geomys bursarius</em></td>
</tr>
<tr>
<td><strong>Birds</strong></td>
<td></td>
</tr>
<tr>
<td>Sandhill Crane</td>
<td><em>Grus canadensis</em></td>
</tr>
<tr>
<td>Bobwhite</td>
<td><em>Colinus virginianus</em></td>
</tr>
<tr>
<td><strong>Reptiles</strong></td>
<td></td>
</tr>
<tr>
<td>Blanding’s Turtle</td>
<td><em>Emys blandingii</em></td>
</tr>
<tr>
<td>Ornate box Turtle</td>
<td><em>Terrapene ornata ornata</em></td>
</tr>
</tbody>
</table>

In contrast to the forests, the aquatic environments produced fewer mammals but far more birds, reptiles and amphibians, as seen in Table 6. Of the mammals, only four species are found in and around the aquatic zones. There are a great number of waterfowl including numerous diving and dabbling ducks and mergansers in addition to those listed below. A small number of possible specimens have implied the occurrence of the whistling and trumpeter swans. The bullfrog (*R. catesbeiana*) and several turtle species, excluding only the common and ornate box turtles, were found in these zones as well.
### Table 5. Aquatic Flora.

<table>
<thead>
<tr>
<th>Common name</th>
<th>Scientific name</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Trees</strong></td>
<td></td>
</tr>
<tr>
<td>Silver Maple</td>
<td><em>Acer saccharinum</em></td>
</tr>
<tr>
<td>Green Ash</td>
<td><em>Fraxinus pennsylvanica</em></td>
</tr>
<tr>
<td><strong>Berries, Fruits, etc.</strong></td>
<td></td>
</tr>
<tr>
<td>Grapes</td>
<td><em>Vitis</em> spp.</td>
</tr>
<tr>
<td>Duck Potato</td>
<td><em>Sagittaria latifolia</em></td>
</tr>
<tr>
<td>Nutrgrass</td>
<td><em>Cyperus rotundus</em></td>
</tr>
<tr>
<td>Sedge</td>
<td><em>Cyperaceae</em> spp.</td>
</tr>
<tr>
<td>American Lotus</td>
<td><em>Nelumbo lutea</em></td>
</tr>
<tr>
<td>Nettles</td>
<td><em>Urtica</em> spp.</td>
</tr>
<tr>
<td>Goosefoot</td>
<td><em>Chenopodium</em> spp.</td>
</tr>
<tr>
<td>Marchcress</td>
<td><em>Rorippa</em> spp</td>
</tr>
<tr>
<td>Amaranth</td>
<td><em>Amaranthus</em> spp.</td>
</tr>
<tr>
<td>Marshelder</td>
<td><em>Iva annua</em></td>
</tr>
<tr>
<td>Giant Ragweed</td>
<td><em>Ambrosia trifida</em></td>
</tr>
</tbody>
</table>

### Table 6. Aquatic Fauna.

<table>
<thead>
<tr>
<th>Common name</th>
<th>Scientific name</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mammals</strong></td>
<td></td>
</tr>
<tr>
<td>Mink</td>
<td><em>Neovison vison</em></td>
</tr>
<tr>
<td>River Otter</td>
<td><em>Lutra candensis</em></td>
</tr>
<tr>
<td>Beaver</td>
<td><em>Castor canadensis</em></td>
</tr>
<tr>
<td>Muskrat</td>
<td><em>Ondatra zibethicus</em></td>
</tr>
<tr>
<td><strong>Birds</strong></td>
<td></td>
</tr>
<tr>
<td>Canada Goose</td>
<td><em>Branta canadensis</em></td>
</tr>
<tr>
<td>Snow Goose</td>
<td><em>Chen caerulescens</em></td>
</tr>
<tr>
<td>Herons and Egrets</td>
<td><em>Ardeidae</em> spp.</td>
</tr>
<tr>
<td>Cranes</td>
<td><em>Gruidae</em> spp.</td>
</tr>
<tr>
<td>Coots</td>
<td><em>Fulica</em> spp</td>
</tr>
<tr>
<td>Loons</td>
<td><em>Gavia</em> spp</td>
</tr>
<tr>
<td>Whistling Swan</td>
<td><em>Cygnus columbianus</em></td>
</tr>
<tr>
<td>Trumpeter Swan</td>
<td><em>Cygnus buccinator</em></td>
</tr>
</tbody>
</table>
Naturally, the aquatic environments are the only zones that produced fish and fresh-water mussel species. The important characteristics of these species, however, are which aquatic habitat they reside in. The exploitation of different aquatic habitats is an important question in the history of the Archaic Period in the lower Illinois River valley. The habitats include the Illinois River, various tributaries, other local streams, and backwater lakes. Geophysical analyses suggest that backwater lakes were scarce in the Early Archaic (Hill 1975; Styles 1986). They did not proliferate until the Middle Archaic when the seasonal flooding and subsiding of the river caused large amounts of river water, and the fauna it contained, to be trapped in depressions on the landscape on a larger scale. In the Middle Archaic, these productive lakes were vital to the inhabitants of the valley. The lakes’ faunal resources were many and easily attained (Asch et al 1979; Styles and McMillan 2009; Wiant et al 2009). The fish and fresh-water mussels available from all three aquatic zones include, but are not limited to, those listed in Table 7. Mussels also included multiple species from the genera *Fusconaia, Quadrula, Pleurobema, Elliptio, Lasmigona, Anodonta, Actinonaias, and Lampsilis*.

**Climate Change**

The Archaic period spans several thousand years. During this time there were environmental as well as cultural changes. During the Early Archaic the climate was warmer than that of the preceding Pleistocene and deciduous forests spread across the region replacing the previous mosaic of forest types. These forests fostered high populations of a variety of tree squirrel species as well as other forest fauna. White-tailed deer populations were low due to the fact that they prefer open forests and forest edges and the current forests were closed and dense (Neusius 1986; Styles and McMillan 2009). The Early Archaic period ended just as the Hypsithermal Interval began.
Table 7. Fish and Mussel Species.

<table>
<thead>
<tr>
<th>Common name</th>
<th>Scientific name</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fish</strong></td>
<td></td>
</tr>
<tr>
<td>Gar</td>
<td><em>Lepisosteus spp.</em></td>
</tr>
<tr>
<td>Bowfin</td>
<td><em>Amia calva</em></td>
</tr>
<tr>
<td>Gizzard Shad</td>
<td><em>Dorosoma cepedianum</em></td>
</tr>
<tr>
<td>Pike</td>
<td><em>Esox Lucius</em></td>
</tr>
<tr>
<td>Buffalo</td>
<td><em>Ictiobus spp.</em></td>
</tr>
<tr>
<td>Suckers</td>
<td><em>Catostomidae spp.</em></td>
</tr>
<tr>
<td>Catfish</td>
<td><em>Ictaluridae spp.</em></td>
</tr>
<tr>
<td>Bass and Sunfish</td>
<td><em>Centrarchidae spp</em></td>
</tr>
<tr>
<td>Walleye</td>
<td><em>Sander vitreus</em></td>
</tr>
<tr>
<td>Drum</td>
<td><em>Aplodonotus grunniens</em></td>
</tr>
<tr>
<td><strong>Fresh-water Mussels</strong></td>
<td></td>
</tr>
<tr>
<td>Washboard</td>
<td><em>Megalonaias nervosa</em></td>
</tr>
<tr>
<td>Three-ridge</td>
<td><em>Amblema plicata</em></td>
</tr>
<tr>
<td>Pistol-grip</td>
<td><em>Tritogonia verrucosa</em></td>
</tr>
<tr>
<td>Warty-backs</td>
<td><em>Obliquaria reflexa</em></td>
</tr>
<tr>
<td>Creeper</td>
<td><em>Strophitis undulatus</em></td>
</tr>
</tbody>
</table>

The Hypsithermal Interval was a warming trend from 8900 to 3200 B.P. (Grimm and Jacobson 2004; Hajic 1990; McElrath et al. 2009). Previously, the Hypsithermal was thought to be a unimodal trend while more recent studies describe it as two periods of aridity followed by alleviation. The first period is defined as occurring from 8900 to 7600 B.P. and the second from 5400 B.P. to 3200 B.P. (Grimm and Jacobson 2004; Nelson et al. 2006; Webb et al. 1983). During these periods the deciduous forests of the Early Archaic thinned, opened and, to some extent, gave way to burgeoning prairie and grasslands in the uplands (Asch et al 1972; Styles and McMillan 2009). Asch et al postulate that in the lower Illinois River valley the landscape protected the forests to some degree and hindered the spread of prairie grasslands. The Illinois River and its tributaries provided the necessary moisture to maintain a deciduous forest even in
the arid Hypsithermal climate and the high rising bluffs shaded and cooled the forests (Asch et al. 1972; Brown and Vierra 1983). This may have caused a decrease in the tree squirrel and other forest fauna populations as their forest habitat changed and was reduced in size. The loosely protected forests in the valley were less dense than before with forest edges that likely favored the white-tailed deer population and encouraged a rise in deer numbers (Neusius 1986; Styles and McMillan 2009).

Culture

The Archaic is defined in terms of hunting, gathering, fishing and is lacking in agriculture and ceramics. From the beginning, characterizing the Archaic periods and their regional cultural chronologies has been difficult to establish. Much of the chronologies have been based solely on the lithic technologies and their, sometimes tenuous, association to a time and group, even with the expansion of site databases to include floodplain sites. No chronology or cultural history for the lower Illinois River valley is solid or without its faults at this time (McElrath et al 2009). Defining the Archaic has proven to be difficult and is still an ongoing venture. Using the latest radiocarbon dating techniques, models, and data from long duration sites, such as Koster, the following section is as complete a cultural understanding of the Archaic in the Lower Illinois River valley as we have to date.

The Early Archaic in the lower Illinois River valley dates from 9600-8200 B.P. (Wiant et al. 2009). This region and period is represented by numerous identified sites. The majority of which are upland, because, as mentioned earlier, early floodplain sites are probably deeply buried and inaccessible. Floodplain site identifications were also made difficult by the mistaken idea that the Illinois River floodplain was 10,000 years old (Rubey 1952). Koster (river valley margin), Napoleon Hollow (Illinois River floodplain), Titus (tributary stream valley margin),
Twin Ditch (Illinois River floodplain), and Campbell Hollow (tributary stream floodplain) are a few of the floodplain sites with Early Archaic components. Before these floodplain sites were identified all known Early Archaic sites were on the upland landscape which skewed theories about Early Archaic settlement patterns. The identification of these floodplain sites challenged the prior ideas regarding upland settlement patterns and new theories were formed (Wiant et al. 2009).

Within the lower Illinois River valley, groups of Early Archaic peoples now are thought to have made a living utilizing residential mobility and generalized subsistence strategies based on small mammals, the majority of which were tree squirrels (Neusius 1986; Styles et al. 1983; Wiant et al. 2009). Birds were also harvested from the environment, terrestrial types more so than waterfowl in the Early Archaic. This avian subsistence pattern would be reversed in the later Archaic causing waterfowl to appear more frequently in the Middle and Late Archaic assemblages (Styles 1982; Styles and McMillan 2009). Fish were, of course, utilized by all groups in the valley in all periods. Early Archaic assemblages show that fish were harvested but with a small average body size. This suggests the use of indiscriminate fishing techniques such as netting, trapping and poisoning (Styles 1982; Styles and McMillan 2009). Fish utilization, and all aquatic resources in general, greatly increased into the Middle Archaic and even more so in the later Middle Archaic (Neusius 1981; Styles and McMillan 2009).

The great variety of faunal use in the valley during the terminal Early Archaic period is paralleled by the abundant variety of chipped-stone tools and projectile points within these sites. The Twin Ditch site yielded the oldest Early Archaic radiocarbon dates as well as appearances of the oldest notched points: Hardin Barbed, St. Charles and Thebes. The Napoleon Hollow site, which included a Twin Ditch phase component, had the previously named points, minus Thebes,
plus Agate Basin and Dalton points (Wiant et al. 2009). The Koster Phase stone tool technologies are detailed in the following section.

**Koster Phase**

The previous section outlined the environmental and cultural setting in which the Koster Phase is found. Though the Koster site is the only representation of the Koster Phase, analyses and studies have allowed a limited interpretation of the culture. The following is a summary of the Koster Phase culture as best currently understood. Horizon Eleven points include the Graham Cave, Kirk and Stilwell II mostly made from local Burlington chert. Analyses of the lithic artifacts suggest reworking which, in turn, suggests movement to areas lacking useful chert sources (Wiant et al. 2009; Wiant and Hassen 1984). Smaller LeCroy points were also recovered. Their narrow stem width is evidence that they were hafted to a shaft with a small diameter. In this period a thinner shaft likely meant the early use of the atlatl. The chipped-stone tool assemblage is more diverse than just projectile points. It also includes scrapers, gouges and gravers (Brown and Vierra 1983; Wiant et al. 2009). There was a mature ground-stone technology in place in the Early Archaic in the lower Illinois River valley, perhaps nowhere more so than at Koster. Of the eleven types of ground-stone tools identified in the valley, nine types were recovered from Horizon Eleven represented by seventy total ground-stone artifacts. The very presence of these subsistence tools provides insight to my research goal regarding settlement understanding. The diversity and quantity of ground-stone tools at Koster shows an investment of time into the production of these tools. The investment into these tools, and therefore the site, is another indication of a longer settlement rather than a short residential
mobility or frequent revisiting of the site (Binford 1978; Wiant et al. 2009). The Koster phase is typically described as being characterized by small, mobile groups, much like the other cultures in the Midwest at the time. These groups moved together in residential mobility, meaning the entire group moved from location to location. In contrast, logistical mobility refers to situations in which the majority of the group remained at a base camp while a few moved to other locations abundant with a particular resource to be obtained and brought back to the base camp (Binford 1980; Carlson 1979). The evidence of longer settlement makes Horizon Eleven significant to the understanding of settlement patterns of the Early Archaic in the lower Illinois River valley and to the Early to Middle Archaic transition as evidence of early steps toward sedentism. A study is currently ongoing to discern the three-dimensional archaeological record and better understand the details of site taphonomy (Vogel and Leady 2012). This study will help to sort and distinguish between the possible multiple occupations of Horizon Eleven and aid in understanding the settlement pattern.

The presence of human graves is another distinction of Horizon 11. There were nine human graves across the site including five adults and four infants (Wright 1987). The adults, buried in flexed positions in deep, straight-walled pits, consisted of two females and one male. One grave was identified as a probable male and the remaining grave’s gender was indeterminate. Several of the remains had indications of possible physical disabilities (Milner et al. 2009:116). Only one, the probable male, was buried with a grave good. This one artifact was a drilled antler cylinder with two modified antler or bone pieces inserted within, its purpose or meaning is unknown. A few of the adult graves were capped with limestone slabs. The infant graves were shallow and they were possibly buried on their left sides (Wright 1987). The graves were generally found in one area, adjacent to the camp with two graves overlapping the living
area, though it has not been declared a cemetery as the burials lack any discernible pattern (Milner et al. 2009:116). The number, placement, and variety of the graves add further evidence to a long term or repeated occupation of Horizon Eleven (Milner et al. 2009:116; Wiant et al. 2009). Three canine graves were also excavated from Horizon Eleven. A fourth canine grave was excavated but its ambiguous stratigraphic placement makes its’ Horizon Eleven provenience questionable. All four graves however, were reliably identified as domesticated dogs. These are the earliest known, deliberate dog burials in North America (Morey and Wiant 1992). These are intriguing burials not only for their content but the preparation that went into the graves and the condition of the skeletons. The graves do not include any directly associated burial goods. A metate and mano, however, were found near grave F2256’s indistinct boundaries (Figure 3). While the artifacts cannot be attributed as grave goods, it is posited they were present at the time of the burial. The skeletons were whole, mostly articulated (minor disarticulation is attributed to taphonomic processes) and had no indications of butchering: burning, cutting or skinning. The lack of any human modification whatsoever indicates that a level of care and affection was given to these dogs (Morey and Wiant 1992; Wiant et al. 2009).

Figure 3. Koster dog burial F2256 (Courtesy Del Baston and Michael Wiant).
Koster Site

The Koster investigation began in 1968 when Stuart Struever, a professor at Northwestern University in Illinois, followed the advice of local farmer, Theodore Koster, and dug several test units on his farm in Greene County in west-central Illinois (see Figure 1). At the time Struever was studying the role of plant cultivation in Middle and early Late Woodland cultures on the surface and was testing potential sites to investigate further. The test units at Koster revealed not only Middle and early late Woodland materials but a stratified multi-component Archaic Period sequence of occupation soon thereafter. Koster began one of the largest excavations in North America at the time.

Koster is one of the most important archaeological sites in North America. The site spans the time periods from the Early Archaic to the Late Woodland periods; it is renowned for the remarkable integrity of its stratified deposits as well as for amazing preservation of materials (Emerson et al. 2009; Houart 1971; Neusius 1982). Koster has added a considerable wealth of information to the Midwestern, and even more broadly North American, prehistoric archaeological record. From what has been analyzed, Koster has led to new and insightful interpretations about prehistory in general and specifically about Midwestern Archaic hunter and gatherer lifeways (Brown and Vierra 1983; Emerson et al. 2009; Houart 1971). In general, in Eastern north America, Woodland deposits have been studied in greater depth and detail than Archaic deposits. Koster is among the few known sites where the Archaic deposits include substantial quantities of artifacts pertaining to many facets of Midwestern prehistoric life.
Excavation

The Koster project was revolutionary in the way that Struever structured the excavation and analyses. Koster became the center of a multidisciplinary research program with affiliated laboratories and facilities set up in the nearby Kampsville, 11 km (6.8 miles) to the northwest. Involved in the project were paleoethnobotanists, zooarchaeologists, geologists and other natural scientists that coordinated in studying the various components of the Koster site. The processing and analyses of these raw materials were performed concurrently with the dig at the various facilities at Kampsville, a previously unheard of practice. Along with innovative excavation practices, Struever also instituted the use of compiling data in a digital format with a computer lab (Wiant and Neusius 2007:86-93; Struever and Holton 1979). The pioneering practices resulted in recovery of artifacts and data on an unprecedented level, allowing for more immediate analysis and research on what was also an unprecedented level. The surface of the Koster site excavation encompassed about 12,200 m$^2$ (40,000 ft.$^2$); at the deepest point, more than 9 m (30 ft.) deep, the excavation totaled 460 m$^2$ (1,512 ft.$^2$) in surface area (Figure 4). Excavations were performed in a variety of ways. Although levels above Horizon Eleven were excavated in bulk by shovel in 7.6 cm (3 in) thick levels and screened, Horizon Eleven was excavated by trowel in 5 cm (2 in) levels and the sediment was not screened. Because the previous levels’ soil was screened and then floated, larger specimens were picked out of the screens leaving only the minute specimens to the flotation. As this was not the case with Horizon Eleven, Horizon Eleven flotation samples contain larger, as well as more, specimens than the previous horizons and such differences should be noted when comparing inter-horizon flotation samples.
The majority of units in Horizon Eleven were excavated in the non-screened, 5 cm (2 in) level method in large quadrants within 1.8 m by 1.8 m (6 ft. by 6 ft.) units (Figure 6). Others were excavated in sixteen mini-blocks set within the units. In both of these excavation types any object found 2.54 cm (1 in) or larger was plotted on a two-dimensional graph. Three transects were excavated across Horizon Eleven by trowel as well, in which every object larger than .6 cm (.25 in) was plotted with three-dimensional provenience information. Horizon Eleven excavation strategies were developed by Gail Houart Anderson (personal communication Sarah Neusius). Flotation samples, another innovative practice at the time, were taken from the northeast quadrant of every unit (Struever 1968).

Koster Literature

Koster has been the subject of a great deal of research, analysis, and publication due to its remarkable cultural record. The studies are mostly on the Middle Archaic through Woodland
periods, however. Horizon Eleven (and the possibly earlier Horizon 12) still awaits the same fervor of research and analysis.

New studies, such as this thesis, are being completed from the original data as well as producing new data. The first studies were the yearly reports published on the excavation, the data gathered, and analyses performed to date. These reports included detailed compilations on subjects including site stratigraphy, geomorphology, and botanical reconstructions (Asch et al. 1972; Butzer 1977; Houart 1971). Horizon Eleven, being among the last deposits excavated, contained some of the last data gathered, and therefore, very little on Horizon Eleven is in the reports. Styles and McMillan’s 2009 article included a comprehensive analysis of faunal use throughout the Archaic, including the limited faunal data from Horizon Eleven from Sarah Neusius.

Edwin Hajic’s dissertation (1990) on Early Archaic Koster, and the lower Illinois River valley’s geology, geography and morphology was central in understanding the Koster site’s formation, stratigraphy and physiography. A recent collaboration resulted in a collection of studies on varying features of paleoethnobotany to understand plant use prior to, and the transition to, domesticated plants (Buikstra and Messner 2008). Studies on Horizon Eleven artifacts involved the inspection of ground and chipped stone tools for starch grains and phytolith analyses, as well as use-wear analyses. My samples were drawn from the same units as this study (Buikstra and Messner 2008). Therefore, when completed, the data from this collaboration and my thesis will be greatly compatible and effective in answering further questions regarding Horizon Eleven.

Only two works involve both Horizon Eleven and faunal data. These are Sarah Neusius’ (1982, 1986) and the un-analyzed identifications of Andreas Paloumpis. Dr. Paloumpis identified
80 units of flotation fish specimens totaling more than 30,000 specimens, contributing a vast quantity of data to Horizon Eleven faunal studies. The most notable work for this thesis is Sarah Neusius’ dissertation and its inclusion of over 3,000 specimens from Horizon Eleven. Her work also included over 90,000 macro and micro specimens from the Middle Archaic horizons. Her conclusions are the starting point for this thesis. Her dissertation focused on five principal expectations for the faunal assemblages.

1. The utilization of fish and mussel intensified into the Middle Archaic.
2. Small mammal utilization decreased and white-tailed deer use increased into the Middle Archaic.
3. Subsistence strategies shifted from generalized to specialized.
4. Middle Archaic horizons represent longer term settlements.
5. And finally, there was an increase in selectivity of certain deer elements.

All of these expectations, except for the last, were confirmed by her results. The first four statements center on the transition from the Early to Middle Archaic and what changes occurred. Neusius examined the assemblages by taxonomic breakdown, element representation and bone condition to assess faunal procurement strategies and processing systems across the Early to Middle Archaic transition.

**Midwest Background**

Many of the mentioned Archaic studies place Koster in the greater Midwest context and many of the general Archaic conclusions are written as universal across the Midwest region. Despite its vast size and diverse environments, there are discernible social and settlement
patterns in the Midwest. However there are a few sites that do not follow the regional patterns. These are usually the result of differing environmental conditions and therefore resource availability. Koster is only one site within the greater Archaic Midwest history that document transitions, environmental and cultural, across the region. A goal of this study is to see if Koster falls within the regional patterns or has a unique history within the Midwest. Following Styles and McMillan (2009), Illinois and the surrounding Midwest regions have been broken down into five further sub-regions to facilitate the understanding of the region’s diversity: Illinois and Mississippi River Valleys, Western Prairie Peninsula, Ozark Highland, Eastern Deciduous Forest, and Great Lakes (Figure 5).

Figure 5. Midwest region.

These regions contain a range of environments including tall-grass prairies and savannahs, open and densely packed deciduous forests with a great variety of trees, as well as boreal forests in the northern portions. Riverine and lake environments appear throughout the midcontinent (Simon 2009). The diversity of environments in the Early Archaic Midwest sets up the possibility for a multitude of subsistence strategies. By taking a broad view to identify the regional subsistence pattern, if present, we can place Koster in a larger context.
Illinois and Mississippi River valleys

The river valleys are the most obvious features of this region running through Illinois and along the border of Illinois, Iowa and Missouri. A large variety of fish were a common, and expected, part of the assemblages, including catfish (Ictaluridae spp.), suckers (Catostomidae spp.), various bass species and sunfish (Centrarchidae spp.), as were a variety of freshwater mussels and the occurrence of aquatic-associated mammals, birds and reptiles (Styles 1981; Styles and McMillan 2009). Early Archaic river valley groups are believed to have been mobile groups of hunter-gatherers utilizing diverse subsistence strategies with a variety of fauna. Early Archaic sites reveal high numbers of tree squirrels in the faunal assemblages. In contrast, Middle Archaic site assemblages show a dominance of white-tailed deer over squirrels and small mammals (Neusius 1982; Styles and McMillan 2009; Wiant et al. 2009). The animal bone assemblage from Modoc Rock Shelter was one of the first systematically analyzed (Parmalee 1956; Styles et al. 1983). It included a diverse assemblage of mammals, particularly tree squirrels, birds, and reptiles, while fish were moderately abundant. White-tailed deer proportions increased in the Middle Archaic assemblage along with a rise in prairie species. Pecans and black walnuts were also gathered at the Modoc Rock Shelter. Studies have shown a diverse assortment of nuts was foraged by Early Archaic people across the region. In the Middle and Late Archaic hickory nuts were almost exclusively harvested.

The rise of white-tailed deer utilization in the Middle Archaic in the river valleys is believed to be the result of the open woods and dense forests becoming grasslands and open forests, respectively, creating quality white-tailed deer habitat in the open woods and forest edges (Neusius 1982). These environmental changes occurred due to the first of the two Hypisthermal dry and warm periods (Grimm and Jacobson 2004; Nelson et al. 2006; Webb et al.
Adaptations to the climate and resulting physiological changes are believed to be the possible cause of not only the subsistence changes but of further social and cultural changes as well.

The overall pattern seen in Midwest subsistence strategies is that of diversity of small mammals, except in a few cases, in the Early Archaic. This is followed by a shift to more specific, generally white-tailed deer focused, strategies in the Middle Archaic. In general, aquatic resource use was more minimal in the Early Archaic than in the Middle Archaic (Neusius 1982; Styles 1981). A generalized to specialized strategy of nut gathering, analogous to the faunal subsistence strategies, was also seen. From the emergence of nut-producing trees throughout the Midwest, though not uniformly, Simon (2009:89) suggests that Early Archaic groups foraged nuts on specific timetables as part of their mobile subsistence strategies.

*Western Prairie Peninsula*

Western Prairie Peninsula sites, found mostly in western Minnesota, Iowa and Missouri, included kill and processing sites that often contained high counts of fish remains. In Iowa, these included the appearance of bison kill sites. Populations here in the Early Archaic are considered to have been hunter-gatherers who utilized generalized subsistence strategies, meaning a broad spectrum of resources, at seasonal habitation sites (Caldwell and Henning 1978; Styles and McMillan 2009). The Stigenwalt site, in southeastern Kansas, included no bison but did include high numbers of small mammals in its buried and distinct Early Archaic strata (Finnegan and West 1990). Rabbits and small rodents comprised 82% of the assemblage. This decreases to 59% in the Middle Archaic (McMillan and Klippel 1981; Styles and McMillan 2009). Though the consensus is a subsistence strategy of diverse resources, the Cherokee Sewer site stands apart. Cherokee Sewer is located along the Little Sioux River but the assemblage contained relatively
little in the way of aquatic resources, only a few fish specimens were recovered. The assemblage was dominated by the presence of bison remains and a few prairie specimens, prairie vole, plains pocket gopher and ground squirrels, were also recovered. Tatum and Shutler (1980) concluded from this dominance of bison, despite other available resources, that Cherokee Sewer was probably a winter bison processing site.

Ozark Highland

The majority of the Ozark Highland is within southern Missouri where the cool and moist Early Archaic climate created open oak and hickory forests. Early Archaic Ozark sites included high numbers of white-tailed deer remains, though not at the expense of smaller mammals. Small mammals became more prominent in the Middle Archaic. In other Early Archaic Ozark sites prairie species were common and diverse resources were utilized. White-tailed deer would become more prominent in the Middle and Late Archaic in some sites (Styles and McMillan 2009). In the western Rodgers Shelter site, believed to be a seasonal base camp, white-tailed deer was commonly utilized in the initial Early Archaic. (Parmalee et al. 1976; Styles and McMillan 2009). In the later Early Archaic very little fish was recovered and rabbits, tree squirrels and small mammals are most abundant in the assemblage (Klippel et al. 1982; Styles and McMillan 2009). Even later, prairie species of bison, spotted skunk, plains pocket gopher and rabbits were utilized in the Ozark (Styles and McMillan 2009; Wood and McMillan 1976). This suggested that the drier climate, that affected much of the Midwest later in the mid-Holocene, had already begun in the western Ozarks (Ray et al. 2009). Klippel, Celmer and Purdue (1982) determined from changes in the mussel assemblage composition and the three-ridge species’ morphology at Rogers Shelter that the water level was lower. The dry climate opened the forests in the area of the Rodgers Shelter site, making quality habitat for white-tailed deer in the early Early Archaic
that gave way to more prairie-like conditions and fostered prairie fauna in the later Early Archaic. Further to the northeast, Graham Cave’s faunal analyses determined that gray squirrels were common in the Early Archaic to be followed by a predominance of white-tailed deer and Eastern cottontail later. Few fish were recovered from Graham Cave (Klippel 1971).

*Eastern Deciduous Forests*

This region extends from eastern Illinois to western Ohio, Michigan and includes sites in western Kentucky. Faunal assemblages from the Early Archaic here include diverse species but with high numbers of gray squirrel indicating generalized subsistence strategies. These groups were mobile and probably also made use of hickory and oak trees indicated by the presence of plant processing tools (Jeffries 2009; Styles and McMillan 2009). Later in the Archaic Period these strategies would turn to base camps in which white-tailed deer predominated, but also included, turtle, mussel and few fish. Open-forest conditions were likely maintained through the use of fire to encourage the presence of white-tailed deer (Minnis 2003; Styles and McMillan 2009). White-tailed deer predominated the faunal assemblage throughout the Early, Middle and Late Archaic periods at the Upland forest site of Raddatz Rockshelter in southern Wisconsin. The Early Archaic was more diverse including moderate percentages of tree squirrels and waterfowl (Cleland 1966). Additional white-tailed deer analyses have resulted in differing opinions on site function and occupation. In his season-of-death and mortality analyses for white-tailed deer Emerson argues that Raddatz Rockshelter was occupied year round with opportunistic deer hunting (Emerson 2003). Others argue that it was only seasonally occupied for the purpose of procuring deer (Theler 2000).
Great Lakes

The Great Lakes region is the most unique of the Midwest, having features that other areas do not possess. The focus of the region, the states of Minnesota, Michigan and Wisconsin, had a great deal of lake front property (as it does today), boreal forests and little prairie. The lakes were not as productive as the rivers and streams elsewhere in the Midwest and were harder to exploit given their size and the available technology (Rostlund 1952). The seasonal spawning of fish in the shallower waters made the lakes temporarily prolific with fish. Numerous advantageous fish species could be easily attained during these seasons (Cleland 1982; Styles and McMillan 2009). In the northern Great Lakes, where fish dominate the assemblages, there are few game animals found. The northern forests, comprised of spruce, fir, pine and deciduous woods, supported an important resource: moose and caribou in addition to white-tailed deer (Cleland 1982). The paucity of prairie accounts for the absence of prairie species. However, elk and bison were hunted in the little prairie land that was present in the region (Shay 1971; Styles and McMillan 2009).
CHAPTER 3: THEORY AND RESEARCH QUESTIONS

The analysis of subsistence strategies in this research is grounded in optimal foraging theories (Binford 1980; Carlson 1979; Hewitt 1983; Neusius 1982). These theories contend that subsistence strategies are based on supply, demand and distribution of desired resources as well as that humans will utilize whichever strategy requires the least cost in energy but has the highest returns. The basic idea is the identification of first-line and second-line resources. First-line resources are those that are the most plentiful and easily attained in an environment and will therefore be utilized first before additional energy is spent on other resources. Second-line resources may be less plentiful or easily acquired and therefore are utilized only when needed to supplement the first line resources (Hewitt 1983). In conjunction with this strategy is the idea of minimum-maximum: that when acquiring resources people want to spend the least amount of energy to obtain resources with a maximum energy reward. This means that, in an optimal setting, energy is expended only on first-line, abundant, easily attained and nutritionally efficient, resources and second-line resources will only be minimally sought. Such a focused strategy is called a specialized strategy. In areas and/or times of scarcer resource options a wider variety of second-line resources will be sought to maximize the foraging results; this is known as a generalized strategy (Binford 1980, Earle 1980; Jochim 1976, Neusius 1982). Rapport and Turner (1977) outlined four approaches with different optimization priorities: energy maximizer, time minimizer, generalist and specialist. Other scholars support the ideas that optimal foraging means obtaining the subsistence resources most easily available in the highest numbers and with the most nutritional value (Asch et al. 1972; Read 1977; Smith 1975).

Therefore, what is recovered in the archaeological record reveals what strategies were utilized there. However, materials recovered do not always correspond to the expected results
from the given model. Recovered materials may not include resources thought to be available or reflect the estimated environment. It is in these cases that other forces or models influencing subsistence decisions are considered (Reitz and Wing 2008). Arguably, one of the most important factors affecting human decisions is human agency. The reasoning for and actions of individuals’ agency often cannot be seen physically in the archaeological record, only gleaned from the results. Subsistence incongruities caused by agency can result from religious ideals, social relationships, or foodways. A group’s foodways are their perceptions of the existing fauna and their influence on the perception and use of the landscape. People divide fauna into categories such as suitable for consumption or not, utilitarian use, spiritual/ritual function (Neusius, personal communication). These intangible, cultural distinctions therefore can alter the expected outcomes of animal usage (Hewitt 1983). Clearly, subsistence strategies are not simple or straightforward relationships of energy expended versus energy rewarded. They result from complex relationships between resource distributions, cultural perceptions and social needs (Neusius 1982). Within these relationships are several influential factors such as the usual suspects of energy cost, energy reward and population caloric need but also factors like population growth or decline, environmental change, resource population changes, group interactions, technological changes, prestige ventures and more. A change in these relationships may cause a change in subsistence strategies and must be considered when analyzing faunal assemblages for subsistence strategies (Neusius 1982).

The subsistence strategies of a group are also influenced by and linked with their settlement patterns or, vice versa, affect settlement decisions. Whether Horizon Eleven at Koster is a series of temporary seasonal camps or a base camp would have affected, or been affected by, the subsistence strategy ultimately employed. Plog and Hill (1971) believed site choice was
related to the minimum-maximum balances of energy and resources. Seasonality is another important factor affecting a group’s settlement decisions (Flannery 1971; Styles 1981). Hewitt (1983) found that other factors such as warfare or non-food resources, like firewood, could affect a group’s movement and settlement choices as well.

Essentially, both subsistence and settlement represent ways humans perceive their landscape and organize themselves to utilize it. Thus human agency and independent decision making also play a significant role in subsistence and settlement strategies. This is a factor not always considered by those studying the Archaic (Brown and Vierra 1983; Cleland 1976).

Humans can impact and change their environment, often times to suit their needs (Minnis 2003; Neusius 1986). At the most basic level however, humans choose resources based on who must be fed, how much labor is available, where consumers and producers are located, what social responsibilities must be met, what people believe to be appropriate food choices and other non-environmental factors.

**Research Questions**

*Question 1: What Were the Faunal Subsistence Strategies and Faunal Diet of the Koster Phase?*

The first research objective is to understand the subsistence practices of the terminal Early Archaic period at the Koster site. To enhance the comprehension of Koster phase food ways the subsistence strategies need to be determined. There have been a number of theories regarding the subsistence practices of the Early Archaic people. It has been theorized that during the Early Archaic hunter-gatherer populations were utilizing specialized resources and in the Middle Archaic generalized resources (Cleland 1976). However, more recent faunal analyses
have produced data that suggest a generalized subsistence strategy was employed in the Early Archaic (Neusius 1982, 1986; Styles and McMillan 2009).

Neusius’ analysis of a macro faunal sample of 3,343 specimens from Horizon Eleven suggests generalized resource use followed by more specialized strategies in the Middle Archaic (Neusius 1982, 1986). Current consensus, much of which is based on Neusius’ work, is that during Horizon Eleven at Koster squirrel species and other small mammals were the most common mammals being utilized within the generalized subsistence strategy. White-tailed deer was utilized as well though not in the large numbers seen in the later periods. Fish, fresh-water mussels, and some aquatic birds, mammals and reptiles were also harvested from the river and local streams in fewer quantities than later in the Middle Archaic (Neusius 1982, 1986; Styles and McMillan 2009; Styles 2011). The majority of fish remains recovered indicate small fish size which suggests non-selective methods of harvesting such as nets, traps and poisons (Styles 1986, 2011). Moving into the Middle Archaic faunal assemblages suggest that white-tailed deer were the predominant mammal of choice in the now specialized subsistence strategy. The exploitation of aquatic and semi-aquatic species greatly intensified due to the emergence of backwater lakes as a result of the newly stabilized Illinois River (Neusius 1982, 1986; Styles and McMillan 2009; Styles 2011).

Another facet of the Early Archaic Koster aquatic use is which aquatic bodies were utilized and how much. Analyzing the flotation samples in this study will add to the understanding of fish use in Horizon 11 which will allow for a comparison with Middle Archaic aquatic resource use. Analyzing the fish and mussel species’ habitat preferences could shed light on which aquatic bodies were being utilized such as the few possible backwater lakes, the Illinois River, or its smaller tributaries and streams.
Question 2: What Does the Faunal Assemblage Suggest About How Koster Phase People Organized Themselves on the Landscape?

One of the critical debates regarding Horizon Eleven is the settlement type it represents. How sedentary were the occupants, how often was it occupied and for how long are questions still under consideration. It is generally believed that Early Archaic occupants at Koster were small, highly mobile groups employing residential mobility within the greater region (Neusius 1982; Wiant et al. 2009). This subject has not yet been settled. Stratigraphy within Horizon Eleven has suggested to Koster archaeologists that there were multiple occupations within its 300 year span. The duration and exact nature of these occupations as of yet is uncertain. Heavy, time-consuming, non-portable artifacts such as large stone metates are further evidence to some of a long stay or frequent revisits to a site (Binford 1978; Wiant et al. 2009).

Horizon Eleven, with its high quality preservation of materials, offers a rare insight into Early Archaic settlement patterns. This study of Horizon Eleven subsistence strategies will enhance the comprehension of the settlement patterns represented in this Horizon. Such factors as faunal elements of particular ages or multiple species of migrating fowl would suggest multi-seasonal occupation. Determining the ages of individuals based on epiphyseal fusion rates and therefore a tentative season of death will allow me to estimate which season(s) Horizon Eleven was occupied. My seasonal data can be matched with charts created by other scholars showing the food resource productivity of the lower Illinois River Valley during the different months to see if correlations, or contrasts, of data appear. Specimens from seasonally specific taxa will help to narrow the time periods of occupation (Church 1994; Hart 1994). The dominance of certain elements of a white-tailed deer can suggest long-distance transport and therefore logistical foraging and base camps (Perkins and Daily 1969; Reitz and Wing 2008). Analyses like these
can indicate the presence or absence of a longer term, multi-seasonal base camp. Studies also exploring other assemblages of Horizon Eleven are simultaneously investigating aspects of this issue (Buikstra and Messner 2008).

**Question 3: Do Horizon Eleven Subsistence Strategies and Settlement Patterns Challenge the Existing Theories About the Early and Middle Archaic?**

Developing Archaic studies indicate that Archaic cultures were not uniformly simplistic hunter-gatherers who can be understood merely as a transition between the Paleoindian and the Woodland periods (Emerson et al. 2009). Moreover, the assumption that all terminal Early Archaic people were the same may be incorrect. A more complete assessment of the Horizon Eleven faunal record will be an important addition to this growing perspective. Comparisons of records may show that Koster Horizon Eleven is distinctive from similar neighboring sites within the region and rewrite the universal property of the Early Archaic period.

Other studies have concluded that the Middle Archaic was the period when Archaic peoples began to settle and became more sedentary than in the Early Archaic (Brown and Vierra 1983; Wiant et al. 1983). This transition has been attributed to the environmental shift of the Hypsithermal Interval. However, conclusive statements cannot be made about Early to Middle Archaic transitions with so little being truly known about the Early to Middle Archaic transition. This study will provide more solid evidence and may modify previous assumptions.
CHAPTER 4: METHODS

A sample was selected that included both macro- and micro-remains from excavation and flotation, respectively. The overall faunal assemblage of Horizon Eleven contains over 70,000 specimens, not including the flotation numbers for which there is no estimation at this time. The units selected for my sample best represent the strike and dip of the horizon and thus the best opportunity to explore the possibility of stratification within Horizon Eleven. Simultaneously, these units were included in the extensive botanical study of Horizon Eleven focusing on plant procurement, processing and utilization (Buikstra and Messner 2008). Choosing the same units as this study allows our data sets to be completely comparable, and is another enhancement to understanding the overall subsistence strategies and settlement type of Horizon Eleven.

Macro- and micro-remains of Horizon Eleven were pulled from units 250, 208 and 165; the three units also utilized in the botanical study. My strategy for sampling within these units was derived from the excavation method of Horizon Eleven: the six foot by six foot blocks divided into four quadrants: northwest, northeast, southwest and southeast. Figure 6 shows a layout of the excavation methods employed and in each unit. Sample units 208 and a portion of 165 were excavated in this manner. Some units were further subdivided into mini-blocks of sixteen 45.7 cm (18 in) squares. Units 250 and a portion of 165 were excavated in this method. Three site-long and 45.7 cm (18 in) wide transects were also laid across Horizon Eleven. Within these transects every object larger than .6 cm (.25 in) was piece-plotted with three dimensional provenience information. Two of these transects run through two of the sample units: 208 and 165 (Wiant, personal communication). The macro-samples are specimens from the northwest
quadrant or from the mini-blocks that make up the northwest quadrant: 9, 10, 13, and 14. Every macro-specimen from these chosen quadrants was identified and analyzed.

All Koster Horizon Eleven flotation samples were extracted from the northeast quadrant. Every specimen 2 mm or larger, determined by pouring the heavy fraction of samples through U.S. geological sieves size grades 4mm, 3mm and 2mm, from the selected flotation samples was identified and analyzed.

These samples include both vertebrate bone and invertebrate shell. This approach allowed me to acquire a sample that was large enough to cancel possible sampling biases but also small enough to analyze within a working timeframe. It is always kept in mind of course that no sample is entirely representative of a site or without biases, known and unknown (Reitz and Wing 2008). There was an issue with Unit 165’s flotation samples. The decades-old plastic bags the flotation samples had been stored in broke apart upon being picked up, spilling the level-separated samples together. The entirety of this sample was still collected, identified and analyzed, intra-level comparisons are not be possible however given the mixing of level proveniences and varying amounts within the uncontaminated provenience data.
The primary analysis consisted of the identification of the specimens to the most specific taxon possible using the comparative osteology collections located at the Illinois State Museum Research and Collections Center and Indiana University of Pennsylvania, Department of Anthropology. The specimens were categorized according to several taphonomic, anatomical, physical and cultural attributes. These attributes were coded according to the Faunal Coding Instructions which are based on the Indiana University of Pennsylvania Faunal Coding Instructions and modified for this study (see Appendix A). The data were collected and recorded on coding sheets modified for these purposes from the Indiana University of Pennsylvania coding sheets and instructions. Each specimen(s) was assigned a specimen number and recorded with its provenience information, excavation type and any additional pertinent curation information. Taphonomic data in the form of types of weathering were coded for. Cultural modifications investigated included the characteristics of functional alterations, other animal-caused effects, patterns of bone fractures, degrees of burning and types of butcher marks. Anatomical identification to specific skeletal structures, properties such as age of individual and percent of specimen completeness, and skeletal placement were also recorded. These records are retained in an Access database for digital preservation and for the program’s use in secondary analyses: manipulation and organization of the data, calculations and revelation of statistical relations.

As mentioned above, the secondary analyses of the faunal materials included applicable calculations and formulas that aid in solving the research objectives. The Minimum Number of Individuals (MNI) is often calculated in zooarchaeological research. MNI is the smallest number of individual animals that can be represented by the identified specimens from the sample. This thesis study will generally use the Number of Identified Specimens (NISP) as opposed to MNI.
NISP is the total number of specimens from the sample, or a subsample, which have been identified to a particular taxon (Reitz and Wing 2008). This will give me the total number of specimens identified to a particular variable being inspecting. A large number of specimens could, in reality, originally be from a single bone and using NISP could inflate the occurrence of a particular taxon or category. MNI is used to counter this since it counts only those individuals which we can be certain of. However, MNI has its own biases in minimizing particular taxa and has been found in the end to be a function of NISP (Grayson 1984). NISP was used to extract data for the majority of work on the faunal assemblage including proportions of mammal and avian habitat exploitation, subsistence strategies from element occurrences, and bone modifications.

Data was compared using the rank order correlation statistic Kendall’s tau. Correlation statistics compare two sets of data to determine whether they have a statistically significant correlation. Neusius used rank order correlation in her study, and I have applied these statistics to my data in order to compare the two assemblages statistically. The other comparative calculations used were squirrel, fish and deer indices based on those used by Bonnie Styles and Bruce McMillan (2009). Indices reveal the proportions of two taxa to in relation to each other to distinguish one’s prominence over the other. To calculate a taxon’s index the two taxa are added together and the NISP of the initial taxon is divided by the total then multiplied by 100.

\[(\text{taxa 1}/(\text{taxa 1+ taxa2}))*100.\]

The raw data was also used in diversity and equitability indices using the Shannon-Weaver (also known as Shannon-Weiner) formula (Shannon and Weaver 1949). Diversity is calculated as \(H=-\sum(P_i)(\log(P_i))\), the sum of the relative proportion of a taxon \(P_i\) multiplied by the log of the \(P_i\). Equitability, \(E=H/(S(\log))\), is calculated by dividing diversity by the log of the
total number of taxa (S) (Beals et al. 2000; Shannon and Weaver 1949). Calculating the
diversity index of the Horizon Eleven faunal assemblage will help interpret how diverse the
assemblage is in terms of different species utilized. Calculating the equitability index will show
how evenly the included taxa were selected and therefore if any species were preferred. Diversity
is relative and a diversity score alone is uninformative. The actual result of an assemblage being
more or less diverse comes from a comparison with another assemblage (Beals et al 2000;
Legendre and Legendre 1998). Diversity scores of my Early Archaic data will be compared to
Neusius’ ample Middle Archaic diversity scores. Equitability scores range from 0 to 1, where 0
is disproportionate and 1 is totally even (Beals et al. 2000; Krebs 1972).

In addition to data manipulation by Excel, the program UNIO, created by Dr. Robert
Warren of the Illinois State Museum, was applied to the fresh-water mussel data (1992). This
program scores specific aquatic environments through fresh-water mussel species’ habitat
preferences from which habitat utilization can be interpreted. The variables evaluated are water-
body type (large river, medium river, small river, large creek, small creek, and lake), water depth
(0-46 dm in 3 dm increments), current velocity (swift, moderate, slow and standing), and
substrate composition (cobble-gravel, gravel, gravel-sand, sand, sand-mud, and mud). The
program assigns a 1, .5 or a 0 to each variable in identified taxa based on the likelihood of that
taxon’s occurrence in those habitats. Each variable is given a score that loosely represents the
percentage of the taxa, or specimens, in the assemblage that would occur in the given category.
This is done through the formula \( H_j = \left[ \sum (C_i * W_i) / N_j \right] * 100 \), meaning the sum of the compositional
data for each species (\( C_i \)) multiplied by the habitat weight for a species (\( W_i \)) and for each habitat
variable category (\( W_j \)). This sum is then divided by the total number of taxa or specimens (\( N_j \))
and multiplied by 100 for a percentage value resulting in the habitat score for a category (\( H_j \))
(Warren 1992). This program was run by entering a 1 for each identified taxon for a qualitative analysis weighted by the presence or absence of the taxon. It was run again with the NISP of each taxon for a quantitative analysis weighted by the numbers of each taxon. I was unable to perform a similar calculation for the fish specimens, to achieve that is beyond the scope of this paper because fish habitat use is much more complicated. Nevertheless, I was able to put together a more informal habitat assessment.

In some instances the ages of individual animals recovered from an assemblage can be determined. This information can be used to determine the season in which that individual died if enough is known about that species’ habits. Age data from the Koster assemblage was compiled and research into the identified species’ life cycle was combined to determine seasons of use by the Koster phase people. This was cross-referenced with seasonal productivity charts determined by Neusius (1986:281) and Hewitt (1983:131) for the late Early Archaic lower Illinois River Valley. Life cycle research is also used to determine seasonality through identified species known to hibernate or semi-hibernate.

Finally, the data from this thesis will be uploaded to the Digital Archaeological Record (tDAR, www.tDAR.org) to join Koster data already there. This will not only provide a wide access to the data but will also allow for it to be used in conjunction with the other Koster faunal data already available there. This data will be an important contribution to the record and to other scholars looking to understand the Archaic with the tool of faunal analysis.
CHAPTER 5: RESULTS

This chapter includes the results of my faunal identification, analysis, research and calculations done in the effort to understand the subsistence strategies of the Koster phase, to understand the settlement strategies of the Koster phase, and to learn whether this new data set challenges the current conclusions and theories regarding the Koster phase and the Early Archaic in general.

Given the smaller size of the previous Horizon 11 faunal analysis, a key question is whether Neusius’ interpretations of Koster phase subsistence strategies as generalized are correct. To determine this data from my larger sample was compared to her Horizon Eleven sample. First, I needed to determine if the two data sets are comparable. Given the different sample sizes and my inclusion of flotation samples, differences are expected (Styles 1981). A straight comparison of the macro assemblages is made first as Neusius does not have a micro assemblage. My complete assemblage was then compared against Neusius’ assemblage. This comparison identified the specific differences between our data and, therefore, the contributions of flotation samples.

**General Categories**

Neusius’ analysis of Horizon 11 totaled 3,619 macro specimens. The majority of these were unidentifiable fragments; however 503 specimens were identified to order, family, genus or species within the broader categories. These categories include freshwater mussels, fish, turtle, other/herpivore (includes amphibians and other reptiles), bird, bird/mammal (unable to determine whether specimen is bird or mammal), small mammal, large mammal, indeterminate mammal,
and indeterminate vertebrate. The specimen per category breakdown is shown in Table 8. These categories were first used by Fred Hill (1975) and were continued by Neusius (1982) for consistency. Neusius’ identifiable assemblage consisted of a majority of mammals followed by mussels. Fish, reptiles and birds comprised only a small part of the identifiable assemblage. Of the mammals, squirrel (any specimens in the Sciuridae family, excluding woodchuck) remains are the most numerous totaling 151 specimens. Though specimens identified to the squirrel family are most common in the assemblage, overall there was still a variety of mammal and non-mammal species found. A total of 12 taxa were identified from the mammal specimens. Eighteen taxa were identified in the mussels, five fish taxa were identified and five reptile taxa were identified. The fish and mussel species are explored in greater detail later in this chapter.

Table 8. Neusius Broad Categories.

<table>
<thead>
<tr>
<th>Horizon 11</th>
<th>Identified</th>
<th>Indeterminate</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshwater Mussel</td>
<td>148</td>
<td>1079</td>
<td>1227</td>
</tr>
<tr>
<td>Fish</td>
<td>18</td>
<td>65</td>
<td>83</td>
</tr>
<tr>
<td>Turtle</td>
<td>20</td>
<td>7</td>
<td>27</td>
</tr>
<tr>
<td>Other/Herpivore</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Bird</td>
<td>18</td>
<td>148</td>
<td>166</td>
</tr>
<tr>
<td>Bird/Mammal</td>
<td>N/A</td>
<td>276</td>
<td>276</td>
</tr>
<tr>
<td>Small Mammal</td>
<td>161</td>
<td>200</td>
<td>361</td>
</tr>
<tr>
<td>Large Mammal</td>
<td>115</td>
<td>147</td>
<td>262</td>
</tr>
<tr>
<td>Unidentifiable Mammal</td>
<td>N/A</td>
<td>653</td>
<td>951</td>
</tr>
<tr>
<td>Unidentifiable Vertebrate</td>
<td>N/A</td>
<td>262</td>
<td>262</td>
</tr>
<tr>
<td>Total</td>
<td>503</td>
<td>2840</td>
<td>3619</td>
</tr>
</tbody>
</table>

Table 9 displays a breakdown of the major categories within my whole assemblage, the macro assemblage and the flotation assemblage. Breaking the assemblages into these categories
illuminates the role of flotation specimens in an assemblage as well as helps to compare it to Neusius’ study, with reservations regarding the differences in the horizon excavation methods.

For the majority of archaeological history there has been no flotation and subsistence theories have been formed solely from macro-specimen assemblages. The earliest theories, that the Early Archaic peoples in the lower Illinois River valley utilized a specialized subsistence strategy, focusing primarily on white-tailed deer, were challenged. Neusius’ dissertation sample of Early Archaic fauna suggested a generalized strategy that was used based mainly on squirrel species and other small mammals. Mussels were gathered but not intensively until the Middle Archaic.

Table 9. Boon General Breakdown.

<table>
<thead>
<tr>
<th></th>
<th>Macro Id.a</th>
<th>Macro Unid.b</th>
<th>Macro Total</th>
<th>Micro Id.</th>
<th>Micro Unid.</th>
<th>Micro Total</th>
<th>Whole Id.</th>
<th>Whole Unid.</th>
<th>Whole Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mussel</td>
<td>148</td>
<td>609</td>
<td>757</td>
<td>0</td>
<td>113</td>
<td>113</td>
<td>148</td>
<td>722</td>
<td>870</td>
</tr>
<tr>
<td>Fish</td>
<td>13</td>
<td>15</td>
<td>28</td>
<td>1032</td>
<td>3273</td>
<td>4305</td>
<td>1045</td>
<td>3288</td>
<td>4333</td>
</tr>
<tr>
<td>Turtle</td>
<td>11</td>
<td>39</td>
<td>50</td>
<td>0</td>
<td>9</td>
<td>9</td>
<td>11</td>
<td>48</td>
<td>59</td>
</tr>
<tr>
<td>Other/Herpivore c</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>-</td>
<td>27</td>
<td>27</td>
<td>-</td>
<td>27</td>
<td>27</td>
</tr>
<tr>
<td>Bird</td>
<td>3</td>
<td>124</td>
<td>127</td>
<td>3</td>
<td>197</td>
<td>200</td>
<td>6</td>
<td>321</td>
<td>327</td>
</tr>
<tr>
<td>Bird/Mammal</td>
<td>-</td>
<td>101</td>
<td>101</td>
<td>-</td>
<td>382</td>
<td>382</td>
<td>-</td>
<td>483</td>
<td>483</td>
</tr>
<tr>
<td>Small Mammal</td>
<td>40</td>
<td>131</td>
<td>171</td>
<td>101</td>
<td>574</td>
<td>675</td>
<td>141</td>
<td>705</td>
<td>846</td>
</tr>
<tr>
<td>Medium Mammal</td>
<td>18</td>
<td>57</td>
<td>75</td>
<td>4</td>
<td>149</td>
<td>153</td>
<td>22</td>
<td>206</td>
<td>228</td>
</tr>
<tr>
<td>Large Mammal</td>
<td>25</td>
<td>101</td>
<td>126</td>
<td>0</td>
<td>54</td>
<td>54</td>
<td>25</td>
<td>155</td>
<td>180</td>
</tr>
<tr>
<td>Unid. Mammal</td>
<td>-</td>
<td>121</td>
<td>121</td>
<td>-</td>
<td>485</td>
<td>485</td>
<td>-</td>
<td>606</td>
<td>606</td>
</tr>
<tr>
<td>Unid. Vertebrate</td>
<td>-</td>
<td>272</td>
<td>272</td>
<td>-</td>
<td>3640</td>
<td>3640</td>
<td>-</td>
<td>3912</td>
<td>3912</td>
</tr>
<tr>
<td>Total</td>
<td>258</td>
<td>1570</td>
<td>1828</td>
<td>1140</td>
<td>8903</td>
<td>10043</td>
<td>1398</td>
<td>10473</td>
<td>11871</td>
</tr>
</tbody>
</table>

a Identifiable specimens.
b Unidentifiable specimens.
c Amphibians and other reptiles.
d The nature of this category does not apply to the “Identifiable” specimens.
Acknowledging the lack of flotation in her sample, Neusius noted that the number of fish specimens would be much higher with the inclusion of a flotation sample. Differences in fish proportions based on recovery strategies was seen in Styles’ (1981) dissertation on Late Woodland sites in the lower Illinois River valley. Sites with expected aquatic exploitation showed minimal fish recovery in screened samples while the accompanying flotation samples recovered comparatively large numbers of fish specimens. The lower Illinois River valley, including the Koster site, has the longest history of including flotation samples and yet Horizon 11, despite the quantity, has still had limited flotation analysis. The flotation samples form a large portion of my assemblage, 85% of the NISP. In the macro assemblage the majority of the remains are mussel and mammal remains (42% and 27% respectively). In contrast, in the micro assemblage the majorities are fish and mammal remains, though in this case the fish dominate with 43% and the mammals just 14%. Fish remains are so numerous that they make up 37% of the overall assemblage even though they make up only 1.6% of the macro assemblage.

Table 10 lists Neusius’ and my data from just the macro assemblages in these broad categories and the results for the rank order correlation statistics. A correlation statistic is a measure of statistical correlation between two pairs of observations, in this case my data and Neusius’ data. I used Kendall’s Tau method to calculate the rank order correlation because this method internally corrects for ties in the observations (variables with the same counts). The ranks are determined by their frequency and listed in order by the first set of observations, Neusius’ data. The second set of observations, my data, is then entered into the table. The tau value is calculated from these rank orders with the null hypothesis that the assemblages are different. The maximum value for a Tau is +1.0, which is the highest indicator of a correlation between the two data, and a minimum value of 0 indicating no statistical correlation whatsoever.
(Thomas 1986; Grayson 1984). Tau scores were calculated for the categories: mussel, small mammal, large mammal, bird, fish, turtle, other/herpivore (includes other reptiles and amphibians), unidentifiable mammal (including specimens identified as small/medium and medium/large), and unidentifiable vertebrates (including species identified as bird/mammal). These are the broad categories that are the most comparable between the two data sets in this study as well as the broad categories that will indicate subsistence strategies, hence the divided mammal category. Table 10 shows that the two macro assemblages have a tau of .83, suggesting a high correlation. For this tau, the hypothesis that the assemblages are similar is accepted 99% of the time.

Table 10. Rank Orders of Macro Specimens.

<table>
<thead>
<tr>
<th>Macro Taxa</th>
<th>Neusius Rank Order</th>
<th>Boon Rank Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mussel</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Unidentifiable Mammal</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Unidentifiable Vertebrate</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Small Mammal</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Large Mammal</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Bird</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Fish</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Turtle</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>Other/Herpivore</td>
<td>9</td>
<td>9</td>
</tr>
</tbody>
</table>

Tau = .83

Table 11 shows the rank orders when the flotation specimens are added to my data. In this case the tau value is only .33 and does not suggest as strong a correlation. For this comparison the hypothesis that the assemblages are similar is rejected 95% of the time. I believe this is due to the high numbers of fish in the flotation sample. This was expected, but the
comparison shows that the flotation sample adds to and changes the overall assemblage and that subsistence strategies based solely on macro assemblages are incomplete (Styles 1981). The current expectation is that the proportions of fish are lower in the Early Archaic than in the Middle Archaic. Whether this quantity of fish specimens is higher than expected or not will be investigated in the next chapter.

Table 11. Whole Assemblage Rank Order.

<table>
<thead>
<tr>
<th>Whole Assemblages</th>
<th>Neusius Rank Order</th>
<th>Boon Rank Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mussel</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Unidentifiable Mammal</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Unidentifiable Vertebrate</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Small Mammal</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Large Mammal</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Bird</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Fish</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Turtle</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Other/Herpivore</td>
<td>9</td>
<td>9</td>
</tr>
</tbody>
</table>

$\tau = .33$

**Mammal Taxa**

Early expectations for the Early Archaic were that white-tailed deer was the primary subsistence source. However, Neusius’ data suggested that deer and large mammals were not as focused on as squirrel species and small mammals and, in fact, that these are the majority of the macro specimens. Correlation statistics have shown that flotation samples change the overall
assemblage makeup and therefore, my assemblage does have different results from Neusius, though the results still emphasize the importance of squirrels and small mammals.

Another way to look at this further is through indices. Typical indices are white-tailed deer and squirrel (Styles and McMillan 2009). Squirrel and deer indices reveal the proportions of squirrel to deer ([squirrel NISP/squirrel NISP + deer NISP]*100 or [deer NISP/squirrel NISP + deer NISP]*100) and the expectation is that this will show the importance of one over the other. Neusius did not calculate squirrel or white-tailed deer indices originally; I have calculated the indices from her data as another way to compare our data. Data used for these indices are displayed in Table 12. From Neusius’ data 149 specimens were positively identified to Sciurus species while only 48 specimens were positively identified as white-tailed deer. Given that most of the large mammal fragments are probably processed deer long bones, Neusius included these specimens in her deer count and this brings the NISP to 111. From my data 21 macro specimens were identified as white-tailed deer and no flotation specimens were identified as deer. As in Neusius’ assemblage, large mammal bone fragments are likely to be processed deer long bones and could be included in the deer index. Including the bone fragments in the deer NISP brings the counts to 32 macro specimens and 29 micro specimens totaling 61 deer specimens. Sixty-one macro specimens were identified to at least the squirrel family, Sciuridae, or better. One hundred seventy-four flotation specimens were identified to a squirrel species, genus or family for a total of 235 squirrel specimens.

Table 12. Boon Squirrel and Deer NISP.

<table>
<thead>
<tr>
<th></th>
<th>NISP of Identified Specimens</th>
<th>NISP Including Large Mammal Longbone Fragments</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Macro</td>
<td>Micro</td>
<td>Macro</td>
</tr>
<tr>
<td>Deer (Cervid)</td>
<td>21</td>
<td>0</td>
<td>32</td>
</tr>
<tr>
<td>Squirrel (Sciurus spp)</td>
<td>61</td>
<td>174</td>
<td>61</td>
</tr>
</tbody>
</table>
With this data we can calculate the deer and squirrel indices. Figure 7 compares the indices for both Neusius’ and my data. Neusius’ data results in a squirrel index of 57% and a deer index of 43%. My macro data results in a squirrel index of 65% and a deer index of 35%. My micro data results in a squirrel index of 86% and a deer index of 14%. Together, my assemblage has a squirrel index of 79% and a deer index of 21%. In all cases, squirrel specimens are more numerous than white-tailed deer by a large margin.

**Diversity and Equitability**

Neusius’ conclusion about the Early Archaic was that a generalized subsistence strategy was being utilized. The relative diversity of an assemblage can be determined using the Shannon-Weaver index. The formula determines how diverse the assemblage’s taxa are as well as how even the distribution of specimens is. Diversity indices are compared against each other to determine which assemblage is more or less diverse than the other. A diverse assemblage that contains numerous taxa and an even distribution of said taxa among the specimens suggests a generalized strategy. Few taxa and an uneven distribution suggest a specialized strategy. From

Figure 7. Squirrel and deer indices
this data we can say with some certainty whether a generalized or specialized strategy was employed. I used the Shannon-Weaver formula to calculate the diversity and equitability indices for the specimens that could be identified to species or genera in the mammal, mussel and fish categories to determine if there is statistical diversity in my assemblage. This, in turn, will determine if any species were preferred or specifically exploited over others. Table 13 lists the diversity and equitability indices for my assemblage as well as Neusius’ macro assemblage for comparison. Instead of straight taxa categories I followed Neusius’ model of using subsistence strategy categories: mussel collecting, fishing, turtle collecting, waterfowl hunting, turkey hunting, rabbit hunting, squirrel hunting, aquatic mammal hunting, raccoon hunting, dog utilization (all canids), deer hunting, general mammal trapping and incidental reptile, amphibian and bird collection. Diversity Indices were calculated for my macro, micro and whole assemblage.

My diversity scores range from .48 to .68. The lower diversity score for the micro specimens is understandable given the relatively high values of fish and squirrel compared to the remaining taxa in the micro assemblage. Neusius’ diversity score of .71 is close to my macro and whole assemblage scores and even more diverse. The evenness scores are also similar in value with my micro assemblage being just a little less even, though not as different in value as the

<table>
<thead>
<tr>
<th></th>
<th>Diversity</th>
<th>Equitability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Macro Boon</td>
<td>.68</td>
<td>.63</td>
</tr>
<tr>
<td>Micro Boon</td>
<td>.48</td>
<td>.5</td>
</tr>
<tr>
<td>Whole Boon</td>
<td>.68</td>
<td>.63</td>
</tr>
<tr>
<td>Macro Neusius</td>
<td>.71</td>
<td>.65</td>
</tr>
</tbody>
</table>

Table 13. Diversity and Equitability Indices.
micro diversity score was. These diversity indices suggest that Neusius and I have assemblages of similar diversity and evenness.

**Habitat Origins**

The third research question of this thesis regards landscape use. Determining the habitat preferences of the species represented will indicate what areas and features of the environment Horizon 11 Koster occupants utilized. This section was mostly determined through the use of the identifiable remains as opposed to those in the general categories which hold little to no information for determining habitat origins. Determining the mammal origins is generally a more straightforward process, with fewer variables regarding terrestrial land use and habitat options. The larger issue at hand is the aquatic resource use. There are several possible habitats from the Illinois River, to the many tributaries and numerous streams, or backwater lakes as well as the many variables within each water body type. Terrestrial mammal species have fewer possibilities as to habitat origins: the closed forests or forest edge, open upland forests or forest edge, and grasslands. Mussels and fish species have a larger variety of aquatic habitats available to them and frequently can be found in multiple habitat types. They may be found in large and small rivers, streams and lakes, or fast waters and standing water, or gravel and muddy substrates. To determine mussel specimen habitats the UNIO program, created by Robert Warren, was implemented. As described in Chapter 5, this program takes into account the various habitats mussels utilize, then, within each species, score each aquatic characteristic on how likely that species is to appear in that characteristic. An overall score is then given for each habitat characteristic on what percentage of the assemblage species would occur there. Warren has used
this program to determine the most likely habitat that a mussel assemblage originated from. However, fish, even more so than mussels, do not conform to strict habitat preferences and are harder to determine habitats of origin for.

Table 14 lists the mammal species identified in my study. The majority are easily found in habitats near the Koster site in the Early Archaic. The majority are squirrel species and all would be found in the dense woods in the vicinity of the Koster site. Most of the species would be found in the dense woods, the forest edge at the boundaries, and along the Illinois River or tributaries. Even though we may not be able to determine which forest habitat the specimen originated from, all the forest habitats are available adjacent to the site. Only the meadow vole would generally be found outside of these habitats in the upper prairie and grasslands (Hoffmeister and Mohr 1972). There are only six specimens in this species and the occurrence of specimens from the prairie is not unexpected or implausible given the proximity of the prairie and that they are not solely found in open prairie means they could be there naturally or could have been brought back to the site by hand.

The mussel category from Neusius’ and my data is dominated by the three-ridge. Figure 8 shows the species of mussel from both Neusius’ and my data and shows how similar the two assemblages are. Neusius’ assemblage has 18 species while my assemblage is comprised of 23 species. In both assemblages the top two species, the three-ridge and the mucket, comprise about 51% of the identifiable specimens. Most of the remaining species are under 5% each. The variety of mussel species still suggests a generalized strategy for gathering mussels but the dominance of the mussel assemblage by just two species in mine and Neusius’ studies might suggest a focus on a particular habitat or even a particular series of mussel beds that contains these species.
Table 14. Mammal Species.

<table>
<thead>
<tr>
<th>Taxon</th>
<th>NISP</th>
<th>Habitat</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Large Mammals</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dog (<em>Canis familiaris</em>)</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Coyote (<em>Canis latrans</em>)</td>
<td>1</td>
<td>Prairie, Open Forest</td>
</tr>
<tr>
<td>Deer (<em>Odocoileus virginianus</em>)</td>
<td>21</td>
<td>Open Forest, Forest Edges</td>
</tr>
<tr>
<td><strong>Medium Mammals</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beaver (<em>Castor canadensis</em>)</td>
<td>1</td>
<td>Aquatic</td>
</tr>
<tr>
<td>Opossum (<em>Didelphis virginiana</em>)</td>
<td>4</td>
<td>Forest</td>
</tr>
<tr>
<td>Raccoon (<em>Procyon lotor</em>)</td>
<td>6</td>
<td>Forest</td>
</tr>
<tr>
<td>Bobcat (<em>Lynx rufus</em>)</td>
<td>1</td>
<td>Forest</td>
</tr>
<tr>
<td>Skunk (<em>Mephitis mephitis</em>)</td>
<td>3</td>
<td>Forest</td>
</tr>
<tr>
<td><strong>Small Mammals</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short-tail Shrew (<em>Blarina brevicauda</em>)</td>
<td>1</td>
<td>Forest, Grassland</td>
</tr>
<tr>
<td>Rabbits (<em>Lagomorphs</em>)</td>
<td>5</td>
<td>Forest Edge</td>
</tr>
<tr>
<td>Eastern Flying Squirrel (<em>Glaucomyssabrinus</em>)</td>
<td>2</td>
<td>Forest</td>
</tr>
<tr>
<td>Chipmunk (<em>Tamias striatus</em>)</td>
<td>3</td>
<td>Forest</td>
</tr>
<tr>
<td>Sciuirus spp.</td>
<td>85</td>
<td>Forest/ Open Forest</td>
</tr>
<tr>
<td>Grey Squirrel (<em>Sciuirus carolinensis</em>)</td>
<td>28</td>
<td>Forest</td>
</tr>
<tr>
<td>Fox Squirrel (<em>Sciuirus niger</em>)</td>
<td>7</td>
<td>Open Forest</td>
</tr>
<tr>
<td>Red Squirrel (<em>Tamiasciurus hudsonicus</em>)</td>
<td>1</td>
<td>Forest</td>
</tr>
<tr>
<td>Mice (<em>Zapodidae &amp; Cricetidae</em>)</td>
<td>9</td>
<td>Forest</td>
</tr>
<tr>
<td>Meadow Vole (<em>Microtus pennsylvanicus</em>)</td>
<td>6</td>
<td>Grassland, Streams, Forest</td>
</tr>
<tr>
<td>Mink (<em>Mustela vision</em>)</td>
<td>2</td>
<td>Aquatic</td>
</tr>
</tbody>
</table>

Figures 9 through 12 are graphs produced by the UNIO program showing the percentage of the species likely to be in that aquatic characteristic. The different habitat characteristics include water types: large river (LR), medium river (MR), small river (SR), large creek (LC), small creek (SC), lake (L); water depths in dm; velocity of the currents: swift (SW), moderate
(MO), slow (SL), standing (ST); and substrates: cobble-gravel (C-G), gravel (G), gravel-sand (G-S), sand (S), sand-mud (S-M), mud (M) (Warren 1991).

Figures 9 and 10 represent the mussel assemblage from my analysis. Figure 11 represents the Neusiak mussel assemblage. When Figures 9 and 11 are compared, obvious patterns emerge. The greatest difference is among the Water Type graphs. The preferences, when weighted by just the occurrence of a species, suggest the majority of the assemblage’s species tolerated larger and medium river types, depths of 9 to 15 dm (3 to 6 ft.), swift, moderate or slow currents and a gravelly, gravel-sandy or sandy substrate.

When the preferences are weighted by the NISP of each taxon it appears the majority inhabited smaller rivers. The variety of depth preferences is similar, though shallow-tolerant species are also common. The varieties of velocity and substrates preferences in the Taxa graphs are parallel with the NISP graph preferences. There are a few differences between the graphs by taxa and by NISP, but no great disparities. The graphs weighted by just the appearance of a taxon can divulge the variety of habitats that the taxa could have come from. The results of the graphs weighted by NISP likely indicate the habitats most frequently exploited, the habitat where the majority of the assemblage was gathered. The data I am interested in is not how diverse the possible habitats are, but the actual habitat of origin, which may be interpreted from the NISP graphs. The broader results of the Taxa graphs mostly indicate the variety of habitats the species could have inhabited or that the habitat of origin for the assemblage included a variety of characteristics itself such as swifter or slower areas and changing depths which is expected from shore to the center of body of water (Warren 1992). Given that 50% of the identified mussel assemblage is comprised of only two species, the preferences of these two species likely create the highest spikes on the graphs. The three-ridge and mucket species were entered into the UNIO
program, Figure 12, and their preferences equated with the spikes in preferences in the NISP graphs. Therefore, the habitat where the assemblage was harvested from was possibly a smaller river, from depths of 0 to 15 dm (0 to 5 ft.), that likely had a swift, moderate or a slow current (or a river with areas of differing currents), and probably had a gravelly, gravel-sandy or sandy substrate (or had areas of differing substrates).

Figure 8. Neusius and Boon Mussel species

Figure 9. Mussel habitat preference by taxa.
The Neusius mussel habitat preferences, Figure 11, are, expectedly, almost identical to mine and this is further evidence that the utilized habitat was likely a small river, from the depths 0 to 15 dm with multiple currents and multiple gravel and/or sand substrates.

Fish specimens are the most numerous in my assemblage. They potentially provide important information regarding Early Archaic habitat use. Fish make up 45% of the flotation sample and 38% of the entire assemblage. New aquatic-use discoveries from fish specimens in the flotation sample are an especially important part of why flotation samples must be analyzed. It is clear that macro-only samples represent only a fraction of the whole assemblage and therefore skew perceptions of subsistence. As the white-tailed deer and squirrel comparisons can

Figure 10. Mussel habitat preference by NISP.

Figure 11. Neusius mussel habitat preference by taxa.

Figure 12. Three ridge and Mucket preferences by NISP.
determine importance, the same can be done with fish specimens in an index: \[ \text{Fish NISP}/(\text{Fish NISP} + \text{Deer NISP}) \times 100. \] Fish NISP for this calculation consisted of only identifiable fish specimens. Deer NISP included deer specimens as well as the large mammal long bone fragments. The same was done in the squirrel indices. Identifiable fish specimens totaled 499 specimens; 13 macro specimens and 486 micro specimens. White-tailed deer specimens totaled 61; 32 macro and 29 micro specimens. Data for these fish indices came only from my assemblage. Paloumpis’ fish specimens could not be used in these fish indices as there are no deer specimens from those units to be included. As shown in Figure 13, fish is clearly an important component of the site and its impact cannot be known without the analysis of flotation samples.

For an overview of the fish assemblage, the Paloumpis data has been integrated with my data to create an even greater understanding of the composition of fish utilization in Horizon Eleven. Figure 14 shows the composition of the combined fish data by family and the few species that are lone representatives, *Amia calva* and *Aplodinotus grunniens*. The most numerous fish taxa are catfish specimens. The most numerous of these, and second most numerous of any species, is the black bullhead (*Ictalurus melas*). The bullhead genus is common among the catfish making up 68% of the identifiable catfish specimens. The high NISP for the catfish family, as well as per species, is likely at least partially due to highly diagnostic elements of the catfish skeleton, such as the pectoral spine element, which is unique to the catfish. Gar specimens are the next most common. This is due to the extremely diagnostic gar scales and vertebra. Without these element specimens, gar NISP is only 40, though it still has the highest MNI count (Figure 15). Gar and catfish specimens make up 88% of the total identifiable fish specimens. After these two large categories the counts drop off sharply into the low hundreds for
the sucker (Catostomidae), sunfish (Centrarchidae) and minnow (Cyprinidae) families and into only double digits for the remaining bowfish (*A. calva*), freshwater drum (*A. grunniens*), pike and muskie (Esocidae), and perch (Percidae) specimens. Here, as with the mammals, MNI is considered a function of the NISP counts. Yet given some of the highly diagnostic elements that may have inflated the NISP counts for certain fish species, MNI was calculated to account for that inflation and show truer numbers of species’ occurrences (Figure 15). Gar still remains high as do the catfish species when totaled together have 64 MNI. Catfish MNI remains high due to the diagnostic element pectoral spines which, if whole, can also be easily identified to the right or left side, increasing the distinction of individuals and therefore MNI. The black bullhead has the second highest overall MNI and the channel catfish (*Ictalurus punctatus*) has the fourth overall highest. The freshwater drum, though low in NISP, is the third highest in MNI due to high recovery of atlas vertebra. After these top species, the MNI counts drop into the single digits. The species that have only one MNI include lake chubsucker (*Erimzyon sucetta*), black redhorse (*Moxostoma duguesnei*), black buffalo (*Ictiobus niger*), muskie (*Esox lucius*), yellow bass (*Morone mississippiensis*), rock bass (*Ambloplites rupestris*), orangespotted sunfish

![Figure 13. Fish index.](image-url)
Figure 14. Fish species by family (Boon & Paloumpis data).

Figure 15. Fish MNI.
(Lepomis humilis), green sunfish (Lepomis cyanellus), pumpkinseed (Lepomis gibbosus), spotted bass (Micropterus punctulatus), white crappie (Pomoxis annaulris), stonecat (Noturus flavus), and the tadpole madtom (Noturus gyrinus).

There is a great variety of fish species in this assemblage. Because most fish species are less rigid about their habitat preferences than mussels a process like the UNIO program cannot be done for fish to determine their habitat of origin. Given the indiscriminate habitat preferences of most fish species, and the frequency of fish taxa with low NISP, it could be that one habitat, preferred by the high-NISP taxa, was utilized and small numbers of the less common taxa were harvested as a result of none-specific collecting techniques. A way to hypothesize the habitat of origin could be to look at the most preferred habitats of the most common species. These include: bowfin (A. calva), gar (Lepisosteus spp.), the catfish species, white sucker (C. commersoni), bigmouth and smallmouth buffalo (I. cyprinellus and bubalus), drum (A. grunniens) and walleye (S. vitreus). Table 15 lists the preferences for these species.

Any of these species could be found in any size river or stream or in the slower pools and runs of a river. The white sucker is particularly unpreferential and widespread in habitat types. The gar and bowfin species prefer sluggish to standing water over any kind of current but are tolerant of the slow moving sections of a river. The other species all prefer a slow, and no more than a moderate, current. The majority prefer a sandy or muddy substrate though the blue catfish (I. furcatus) and the bowfin also have a preference for rocky, or rock-inclusive, substrates. Half also favor habitats with vegetation and the blue catfish that like large debris on the bottom. Some of the species; blue catfish, bigmouth buffalo and drum, are found in deeper waters. However, young fish often stay in shallower waters and the majority of the fish specimens represented quite small fish. The flathead catfish and the walleye also move into the shallow waters to feed at
dusk. This all suggests that the fish were harvested from the slower moving, shallow edges of a
river or stream with a muddy or sandy substrate with at least some vegetation (Page and Burr
2011).

Table 15: Fish Habitat Preferences

<table>
<thead>
<tr>
<th>Species</th>
<th>Size</th>
<th>Depth</th>
<th>Current</th>
<th>Substrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bowfin</td>
<td>lake, pond</td>
<td>shallow</td>
<td>slow/standing</td>
<td>stones/plants</td>
</tr>
<tr>
<td>Gar</td>
<td>any</td>
<td>shallow</td>
<td>slow/standing</td>
<td>mud/sand/plants</td>
</tr>
<tr>
<td>Black bullhead</td>
<td>any</td>
<td>any</td>
<td>slow</td>
<td>mud/sand</td>
</tr>
<tr>
<td>Brown bullhead</td>
<td>any</td>
<td>any</td>
<td>slow/standing</td>
<td>mud/plants</td>
</tr>
<tr>
<td>Yellow bullhead</td>
<td>any</td>
<td>shallow</td>
<td>slow/standing</td>
<td>mud/sand/plants</td>
</tr>
<tr>
<td>Channel catfish</td>
<td>runs, pools</td>
<td>deep</td>
<td>slow</td>
<td>stones/sand</td>
</tr>
<tr>
<td>Blue catfish</td>
<td>any</td>
<td>deep</td>
<td>moving</td>
<td>stones/mud/sand</td>
</tr>
<tr>
<td>Flathead</td>
<td>streams</td>
<td>Day: deep</td>
<td>moderate</td>
<td>debris</td>
</tr>
<tr>
<td>White sucker</td>
<td>any</td>
<td>any</td>
<td>moving</td>
<td>any</td>
</tr>
<tr>
<td>Bigmouth buffalo</td>
<td>rivers</td>
<td>deep</td>
<td>moving</td>
<td>mud/plants</td>
</tr>
<tr>
<td>Smallmouth buffalo</td>
<td>rivers</td>
<td>deep</td>
<td>slow</td>
<td>mud/plants</td>
</tr>
<tr>
<td>Drum</td>
<td>large river</td>
<td>deep</td>
<td>slow</td>
<td>stones/mud</td>
</tr>
<tr>
<td>Walleye</td>
<td>river, pools, lake</td>
<td>Day: deep</td>
<td>moving</td>
<td>sand</td>
</tr>
</tbody>
</table>

**Seasonality**

Several methods can be taken to determine seasonality: age of individuals at death by
epiphyseal fusion or bone growth, presence, or absence, of species that hibernate or semi-
hibernate, migratory species and dates of fish spawning (Neusius 1982; Walker 1998). Not all of
these tactics were applicable to this study. Determining season of death from fresh-water mussel
ring growth was not feasible due to the considerable time needed to complete this. Determining
season from the presence or absence of migratory animals, in Koster’s case migratory birds, was
also not feasible as there were no migratory species identified in my assemblage. The absence of
migratory birds from my study does not imply Koster was occupied during seasons outside of the migration as Neusius’ study did contain a few migratory bird species.

The presence or absence of hibernating, or semi-hibernating, species can be a useful indicator of season of occupation. The most commonly thought of hibernating animal is the bear. However, no bear was identified in my study. There were no true-hibernation species identified though four semi-hibernating species were identified: raccoon (*Procyon lotor*), skunk (*Mephitis mephitis*), common box turtle (*Terrapene carolina*) and red-ear slider (*Trachemys scripta*).

Raccoons generally enter a period of winter dormancy from about November through February (Whitney 1931). Skunks also experience mid-winter dormancy and are strictly nocturnal during this period from late November to February (Aleksiuk and Stewart 1977). The common box turtle and the red-ear slider both become inactive from October through March. The common box turtle enters a deeper hibernation-like state under vegetation and soil or in mud under a pond or stream, while the red-ear slider does not hibernate so much as simply becomes inactive in a state called “brumate” and resides under mud in a pond bottom (Arkive 2003; Red Ear Slider 2011). Assuming then that these species are inaccessible from October/November through February/March we could assume that Koster was not likely occupied during those months. However, other scholars have mentioned that because these animals are inactive it may actually make them easier to obtain (Kroskie 2011).

Specimens of determinable age were unfortunately few in my study. Only a single white-tailed deer radius epiphysis could be included from the deer specimens. This radius’ status of fusion suggested that it was a subadult, about 20-29 months old (Purdue 1983). If this deer was born during the average calving season of June, then it likely died some time between February and November. Again, this is only accurate if this individual was not conceived earlier or later.
than the average. The outliers of average birth dates and fusion rates could put the season of
death at any time of the year. The most numerous ageable specimens belong to the grey squirrel.
These specimens include adult molars with slight wear and a radius, tibia, humerus and a femur
with unfused epiphyses. Grey Squirrels are born in between either February and March or June
and July. They are subadults from ages three to ten months and reach adulthood at about 12
months (Lawniczak 2002). Slight tooth wear of adult teeth means the individual had adult teeth
and was still young. Grey squirrel adult molars can erupt as early as six months of age and no
later than 12 months, or as subadults (Halloran 1999). Given that grey squirrels would have
slight wear on their molars while they are subadults as well as young adults, this could be a time
period of over a year or more. This makes the molar specimens unhelpful as they could have
been taken at any point in the year. The unfused epiphyses are not helpful either as they would
fuse sometime before full adulthood which would be anytime in their first year (Halloran 1999).
There was also a meadow vole femur with an unfused epiphysis found. Meadow voles are born
between February and June and are adults in about five months, between July and November
(Britannica 2013). Exact fusion rates for meadow voles are also unknown but the femur
epiphyses would be fused before adulthood and therefore the vole died young between July and
November. The adult molar of an opossum with slight wear was found which would occur at
about the age of five months old. Born in between the months of July and November, this
individual likely died between the months of February and June (Link 2004).

All of the fish species spawn in the spring and early summer. Most of them also move
into deeper waters in winter and are less active. Since the vast majority of the specimens that
both Paloumpis and I identified were quite small, it is appropriate to assume that they are quite
young specimens. Fish such as the bullheads are almost 7.6 cm (3 in) long by autumn and the
buffalo species are quite large by autumn as well. While in the first year walleye can grow up to 30.4 cm (12 in) and gar up to 55.8 cm (22 in) (Page and Burr 2011; Pflieger 1997). Given that the fish specimens were likely of young fish and they are all done spawning by early summer they were likely taken within the early part of the individual’s first year, that being late summer and autumn.

All of these analyses, calculations and examinations of the features provided data that I used to interpret subsistence strategies and settlement patterns of the Koster Phase. The following chapter expounds upon these results and interpretations and what they mean for determining subsistence strategies, settlement patterns and interpreting changes through time.
The first analysis performed was a comparison of my data to Neusius’ data with Rank Order statistics. These statistics showed that while our macro assemblages were statistically similar, as expected, the addition of flotation samples to my assemblage changed the composition of the assemblage to the point where it was no longer statistically similar to the macro-only assemblage. The differences result from the large numbers of unidentifiable vertebrate fragments and fish specimens recovered in the flotation. Fish specimens went from the eighth most frequent specimen to the most frequent specimens. Small mammals remained proportionately the same, retaining the third rank even among the rising numbers of fish and unidentified fragments. The extent of fish remains in the flotation was unknown until now and plays a major part in understanding the contrast of aquatic utilization between the Early and Middle Archaic at Koster. Aquatic utilization comparisons are discussed later in this chapter.

My first research question for this thesis was to understand the faunal subsistence strategies of the Koster phase. To accomplish this objective, I used the Koster Horizon Eleven faunal assemblage to substantiate or counter Neusius’ theory of a generalized strategy, which was achieved through the comparison of the two data sets’ taxa and diversity. Small mammal, especially squirrel specimens, and large mammal, specifically cervids, proportions were examined, as well as the diversity of the whole assemblages. The similarly high squirrel indices over deer indices in both data sets indicate that my data do substantiate Neusius’ conclusions regarding a generalized subsistence strategy. As do my results on how diverse my assemblage taxa are. Both data sets include higher proportions of squirrel and small mammal taxa as compared to white-tailed deer and both data sets were determined to be about equally diverse with a similar extent of evenness. My assemblage was determined to be generally diverse in
terms of taxa, though more focused on small mammal taxa than specializing in deer, which leads to the conclusion of a generalized subsistence strategy and supports Neusius’ conclusions. Knowing that Neusius and I have similar diversity scores for the Early Archaic confirms that our assemblages are similar, comparing them to Neusius’ Middle Archaic data will confirm that they are more diverse than the Middle Archaic assemblages. This comparison of diversity indices is illustrated in Table 16. While there is some disparity between the two Middle Archaic period scores, the difference between those and Horizon 11 scores are even greater. Middle Archaic 2 initially included horizon 8A, this has been determined to be disturbed and possibly not a horizon at all, and therefore not included in the indices (Hajic 1980; Neusius 1986). The Middle Archaic 1 horizons have a lot of variation within the period, though still more diverse and even than the later Middle Archaic 2. This variation is attributed to short-term occupations with different site functions from the other periods. Neusius concluded from the low debris density and from the procurement, processing and disposal evidence that the Middle Archaic 1 horizons were more similar to the Early Archaic than the later Middle Archaic 2 (Neusius 1982). Scores for horizon 9 C/D were not given because of the minute sample size. All of the scores, except for my data, were calculated by Neusius (1986) and her scores only include macro specimens. My scores include both the macro and micro samples. The Middle Archaic 2 horizons have an average diversity score of .3, Middle Archaic 1 has a score of .61 and Horizon Eleven has an average of .69. The Middle Archaic 2 horizons have an average evenness score of .35, Middle Archaic 1 has an evenness score of .72 and Horizon Eleven has an average of .64.

The second objective of this study, research question 2, was to utilize the Koster faunal assemblage to understand Early Archaic settlement strategies. The subsistence strategy is only one part of understanding how Early Archaic occupants at Koster utilized and viewed their
Table 16. Middle and Early Archaic Diversity Scores.

<table>
<thead>
<tr>
<th></th>
<th>Diversity</th>
<th>Evenness</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA2 8B</td>
<td>.35</td>
<td>.4</td>
</tr>
<tr>
<td>MA2 8C</td>
<td>.22</td>
<td>.25</td>
</tr>
<tr>
<td>MA2 8D</td>
<td>.35</td>
<td>.4</td>
</tr>
<tr>
<td>MA1 8E</td>
<td>.67</td>
<td>.75</td>
</tr>
<tr>
<td>MA1 8F</td>
<td>.57</td>
<td>.7</td>
</tr>
<tr>
<td>MA1 9A/B</td>
<td>.7</td>
<td>.85</td>
</tr>
<tr>
<td>MA1 10A</td>
<td>.5</td>
<td>.55</td>
</tr>
<tr>
<td>MA1 10B</td>
<td>.65</td>
<td>.75</td>
</tr>
<tr>
<td>EA 11 (Neusius)</td>
<td>.71</td>
<td>.65</td>
</tr>
<tr>
<td>EA 11 (Boon)</td>
<td>.68</td>
<td>.63</td>
</tr>
</tbody>
</table>

environment and landscape. Knowing where the fauna were obtained from is another element in understanding that relationship between Early Archaic people and the land. As previously seen in Table 14, the majority of the mammal specimens came from the various wooded environments or along the various aquatic environments. The single species that would not have preferred a wooded or aquatic environment is the Meadow Vole (Microtus pennsylvanicus). This species prefers the grasslands but it is not implausible that it would have been found in a habitat in closer proximity to Koster or that it was caught in the grasslands. The prairie at the time was not so far that it would be unlikely that people were in its vicinity. It is also possible, though less likely, that given the small number of specimens of this species, six, that the occurrence of this species in the assemblage is natural and not anthropological. The taxa suggest then that on the terrestrial front the denser woods were utilized first and most heavily which is not surprising as Koster was surrounded by the closed woods and these were the first environment at hand. The open woods were second-most utilized which, again, is not surprising as open woods are to be found in the vicinity of dense woods, were also nearby, and are a productive environment. The water’s edge
environment was third most utilized of the terrestrial environments. Perhaps not the closest of the environments but there were several close options from creeks, streams and tributaries. These are also productive environments, providing numerous species’ habitats as well as a resource that draws in non-residential fauna (Butzer 1977; Hajic 1990; Neusius 1982; Styles and McMillan 2009).

The aquatic environment of habitat use was more difficult to determine given the variety in the area. According to the mussel data, the majority of the assemblage would have been found in a small river, in depths ranging from shallow to six feet, in gravel, gravelly-sandy, or sandy substrates, and in any velocity of moving water. Only 30% of the mussel species could be found in standing water but less than 5% of the assemblage could be found in lakes. This makes sense since the consensus is that the backwater lakes of the Illinois River had not yet developed in the lower Illinois River valley at this time (Neusius 1982; Styles and McMillan 2009). The aquatic options were creeks, streams, tributaries and the Illinois River itself. The Illinois River is the only nearest river. Macoupin Creek is the nearest intermediate order tributary being 2.4 km (1.5 miles) south of the site. The next nearest is Cole Creek at 5.2 km (3.25 miles) north of the site, and farther away than the river, and then Apple Creek is about 17.7 km (11 miles) north of the site. Koster Creek is the nearest low order tributary and runs right on the edge of the site, though it was likely too small to contain an adequate mussel population. Numerous other low order tributaries are in the vicinity (Butzer 1977). The preference of a river rules out the creeks and streams and the variety of depth and velocity preferences could indicate the different points along a river where depth and velocity vary. The Illinois River is the most likely water source in the vicinity of Koster that satisfies these habitat preferences.
The data from the fish assemblage also contribute to the understanding of what aquatic resources were utilized. After analyzing the most frequent fish species’ behavior, life cycles and habitat preferences it was determined that the resource utilized to gather these species was probably a slowly moving, shallow water source, most likely a river, with a muddy or sandy substrate with at least some vegetation. As discussed above, the options for nearby moving water sources are tributaries, most likely Macoupin Creek, and the Illinois River. The Illinois River represents the resource that is most like the description garnered from the data. However, in the case of the fish preferences most prefer rivers but this may not rule out a large stream or creek. With this in mind, it would be prudent to note that more than one aquatic form could have been utilized and would also account for the broad spectrum of possible habitats.

In relation to my third research question regarding new and current theories, the aquatic habitats data has another, more important, function. The data regarding aquatic specimens is not only important for understanding the nature of the assemblage and which resources were utilized, but for understanding that the aquatic resources were utilized and to what extent. Currently, the consensus is that the Early Archaic had minimal aquatic use and that the Middle Archaic was the innovative era of perfecting aquatic resource use from the matured river (Parmalee et al. 1976; Snyder and Parmalee 1991; Styles et al. 1983). The vast amounts of fish specimens analyzed in this thesis and by Paloumpis conclude that Early Archaic groups did in fact make significant use of the aquatic habitats and had a well-developed tradition of doing so by the Middle Archaic. The diversity of recovered fish species suggests unspecialized fishing techniques including trapping, netting or poisoning (Styles 1986). Such high specimen counts and diverse fishing tactics are signs of an established practice of utilizing the local aquatic resources. Table 17 is a comparison of the aquatic proportions of the Early and Middle Archaic assemblages of mine and
Neusius’ studies. The counts are based on NISP of specimens that could be identified to “definitely aquatic” or “definitely terrestrial,” so specimens that are indeterminate are not included. According to my data aquatic specimens, which includes fish, mussels, turtles and aquatic mammals, make up 46% of the macro assemblage, as well as 46% of the micro assemblage. Since fish are a very small portion of the macro assemblage and aquatic specimens are still almost half of the assemblage, this suggests that aquatic resources were important to the Early Archaic peoples and that they were well prepared to take advantage of the abundance of aquatic resources that the Middle Archaic would bring.

Table 17. Aquatic Proportions.

<table>
<thead>
<tr>
<th>Period/Horizon</th>
<th>% of Macro Assemblage</th>
<th>% of Micro Assemblage</th>
<th>% of Whole Assemblage</th>
</tr>
</thead>
<tbody>
<tr>
<td>M.A. 2 /H8B</td>
<td>63.4%</td>
<td>96%</td>
<td>49%</td>
</tr>
<tr>
<td>M.A. 2 /H8C</td>
<td>80%</td>
<td>98%</td>
<td>687%</td>
</tr>
<tr>
<td>M.A. 2 /H8D</td>
<td>64%</td>
<td>96.5%</td>
<td>84.7%</td>
</tr>
<tr>
<td>M.A. 1 /H8E</td>
<td>27%</td>
<td>88%</td>
<td>34.3%</td>
</tr>
<tr>
<td>M.A. 1 /H8F</td>
<td>23%</td>
<td>89%</td>
<td>32%</td>
</tr>
<tr>
<td>M.A. 1 /H9A/B</td>
<td>38.5%</td>
<td>-</td>
<td>23.8%</td>
</tr>
<tr>
<td>M.A. 1 /H10A</td>
<td>13%</td>
<td>79%</td>
<td>19%</td>
</tr>
<tr>
<td>M.A. 1 /H10B</td>
<td>49%</td>
<td>98%</td>
<td>24.5%</td>
</tr>
<tr>
<td>E.A. 2/H11 (Neusius)</td>
<td>36.6%</td>
<td>-</td>
<td>36.6%</td>
</tr>
<tr>
<td>E.A. 2/H11 (Boon)</td>
<td>46.5%</td>
<td>46.2%</td>
<td>46.3%</td>
</tr>
</tbody>
</table>

Koster is not unique in this phenomenon of Early Archaic river valley aquatic use. Renee Walker’s (1998) dissertation on Dust Cave also showed an Early Archaic culture with a developed tradition of utilizing riverine resources. Walker’s (1998) faunal analysis revealed a
high proportion of aquatic resource utilization including waterfowl, fish, turtles and aquatic mammals. There were two Early Archaic components, the Late Paleo-Indian and the Early Side-notched dating to 10,500 to 10,000 B.P. and 10,000 to 9,000 B.P., respectively. In the Late Paleo-Indian component the proportion of aquatic resources was 62% of the entire assemblage, while the proportion of the Early Side-Notched aquatic resources was 76%. Unlike in the lower Illinois River valley, aquatic use here drops off into the Middle Archaic as a result of environmental factors, drying during the Hypsithermal, less conducive to aquatic resources and more conducive to terrestrial fauna. Even though Dust Cave is located in the North East corner of Alabama it is an early site located in a river valley that had a high reliance on aquatic resources. Dust Cave sets precedence that there was an efficient understanding of aquatic resource use being fully employed before the Middle Archaic.

The last interpretation to be made from these analyses that will also lead to an understanding of the relationship between the people and the land is the seasonality of the specimens. The goal being to determine the periods of occupation from the absence or lack of specimens that indicates a time of year. Table 18 illustrates all of the seasonality data previously described in the Results chapter. For animals that were aged (deer, opossum, vole and fish), the X’s are the months they were probably killed. For the animals who become inactive (turtle, raccoon and skunk), the X’s are the months when they would have been active and available to hunt. The table shows that, for the seasons that could be determined, the most productive period was July through October. Spring and early summer months had moderate productivity in comparison and there was little to no productivity in winter.

Neusius also created a chart of productivity from her faunal data which produced similar results of high productivity in the summer and autumn. In his dissertation, Hewitt created a
Table 18. Calendar of Faunal Productivity.

<table>
<thead>
<tr>
<th></th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deer</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Turtle</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raccoon</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skunk</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opossum</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meadow Vole</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>Fish</td>
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<td>TOTAL</td>
<td>1</td>
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<td>5</td>
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productivity calendar including both fauna and flora. His chart reflected analogous results to mine. Overall there was moderate productivity throughout spring and high productivity in late summer peaking in early autumn (Hewitt 1983). The flora productivity followed closely with the fauna productivity and could not have been used to supplement the diet during the times of lean faunal productivity.

Overall, this thesis upholds most of the current theories regarding Early Archaic life at Koster. A generalized subsistence strategy was likely implemented over other strategies. Aquatic resource use was well developed before the Middle Archaic, but still not as heavily utilized as it would be in the Middle Archaic. The broader issue however that needs to be addressed is the idea of applying conclusions universally. What can be said for one Early Archaic site may not be said for another. Does the Koster phase fit into the general pattern seen so far? Given the variety of site settings: river valleys, rockshelter, bluff base, woods, prairie, etc., the environmental differences should be taken into account when grouping sites culturally. For the Midwest Early
Archaic the general pattern is that of a diverse and generalized subsistence strategy dominated more by squirrels and other small mammals than larger mammals, mainly white-tailed deer. There was also utilization of aquatic resources present, though less than in the Middle Archaic. My data does support that the Koster phase fits into this pattern. The differences in site type: rockshelter, cave, bluff base, or open air, to me, does not seem to alter a site’s conformity with the perceived Midwest Early Archaic trend (Styles and McMillan 2009). The influential characteristic is the environment of the site. The few exceptions are the sites where the Early Archaic was defined by open woods and prairie to begin with and there was an abundance of large mammal prey animals and a scarcity of squirrels and other forest small mammals (Styles and McMillan 2009).

Where Koster does not necessarily conform to the Midwest Early Archaic trend is in its settlement patterns. Whether Horizon Eleven is like other Early Archaic sites and was a small mobile band or more like Middle Archaic sites and more sedentary remains unknown. Horizon Eleven consisted of a diverse tool kit suggesting a variety of activities which is consistent with a longer term occupation. Heavy, non-portable tools, such as metates, also suggested an investment in the location for long term occupation or repeated occupations. The rare occurrence of just two human graves inside the “living” area also suggests the site was frequently revisited. Koster is also strategically placed near multiple required resources (Wiant et al. 2009). The productivity calendars for the Early Archaic do not suggest that Koster would have been a strategic occupation in the winter months and the faunal data does not support resources from other areas being brought in for winter occupation. At minimum, a year-round occupation is unlikely. It has been suggested by Wiant that Horizon Eleven could be a precursor to the sedentism that arose in the Middle Archaic: an Early Archaic site with characteristics of both the
Early and Middle Archaic. Longer, repeated short-term occupations as well as a diversity of tools and activities reminiscent of a more sedentary group (Wiant et al. 2009).

This latest understanding of the Early Archaic that my thesis provides I hope will lead to a better understanding of the transition that led to the Middle Archaic and help to prove that its level of importance in understanding the past is on par with that of the later, more thoroughly studied Woodland transitions. This thesis has solidified the conclusions of an earlier study as well as shown that flotation samples are an essential factor in analyzing faunal assemblages and can enhance older theories about strategies based on macro specimens only. Complete and thorough analyses are a requirement for comprehensive understanding of prehistoric subsistence strategies for a site and their changes through time. This study continued the work of decades of scholars before me and the data contained in tDAR will aid and encourage new scholars to continue further work into the exceptional assemblage that is Koster.
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APPENDIX: FAUNAL ANALYSIS CODING INSTRUCTIONS

Boon Archaeology Faunal Analysis Coding Instructions

A blank field in the database is an indicator of non-evidence of that attribute.

**Specimen Number: 2 digits**

An item number assigned to each unique bone or group of bones as analysis is done. Numbering begins again for each unit, quad, & level. Assign specimen number consecutively within each bag/provenience. Use the following rules.

1. Each worked bone must have a separate spec number.
2. Each hold bone must have a separate spec number.
3. All bones in a single level & quad Number with identical coding on all variables may have the same catalog number. DO NOT assign more than one bone the same catalog number unless their coding including taxon, element, side, portion, and condition, etc. match. This means that most identifiable bone will have individual catalog numbers, but indeterminate fragments can be lumped up to 99 (see Number of Items).
4. Separate cf (compares favorably) from certain and assign two catalog numbers.

**Unit Number: 3 digits**

The 3 digit unit or square number assigned by the archaeologist that the specimens were recovered from.

**Quadrant number: 2 digits**

The double letter quadrant designation assigned by the archaeologist that the specimens were recovered from within the unit. Or the numerical mini-block designation(s) within the unit.

**Provenience, additional: 2 digits**

Additional provenience information that may apply to certain specimens assigned by the archaeologist. i.e. flotation sample, miniblock #.

- 000-regular excavation macro fauna specimen
- 009-miniblock 9
- 010-miniblock 10
- 013-miniblock 13
- 014-miniblock 14
- 100-flotation sample

**Level/Special Provenience: 2 digits**

Alphanumeric variable for additional provenience information such as horizon, level and/or feature part. (e.g. 68)

**Weathering: 1 digit**
Code as follows for evidence of weathering:
1-weathered
2-root-etched
3-both weathered & root etched

**Cultural Modification: 1 digit**
Code as follows for evidence of cultural modification:
1-modified
2-worked tool or decorative item
3-polish
4-grooving
5-drilling
6-multiple types (write in details under comments)

**Animal Modifications: 1 digit**
Code as follows for evidence of animal modifications:
1-rodent tooth marks
2-carnivore tooth marks
3-indeterminate tooth or animal-made marks
4-pitting from digestion or saliva
5-more than one

**Fracture Pattern: 2 digits**
Code as follows for evidence of fracture patterns:
01- Medial stepped or columnar
02- Lateral stepped or columnar
03- Sawtoothed
04- V-shaped
05- Flaking
06- Irregular perpendicular
07- Smooth perpendicular
08- Medial spiral
09- Lateral spiral
10- Medial longitudinal
11- Lateral longitudinal
12- Pattern evident but indeterminate

**Burning Modification: 1 digit**
Code as follows for evidence of burning modifications:
1-calcined
2-blackened
3-reddened
4-blue-black
5-indeterminate
Butcher Marks: 1 digit
Code as follows for evidence of butcher marks:
1-cut (knife) marks
2-scratch marks
3-chop marks
4-blunt force marks
5-saw marks
6-multiple types of butcher marks- write type details in comments

Taxon: 4 digits
This variable records the taxonomic assignment for the bone and shell.

Assign indeterminate items as follows:

Vertebrata, unidentifiable/uncertain .........................................................0000
Invertabarta, unidentifiable/uncertain .....................................................0100
Mammalia, unidentifiable .........................................................................1000
Mammalia, medium or large (≥ 4 kg).......................................................1100
Mammalia, medium (4 -30 kg) .................................................................2000
Mammalia, large (> 30 kg) ......................................................................3000
Mammalia, small (< 4 kg) ......................................................................4000
Mammalia, small or medium ..................................................................4900
Mammalia or Aves ..................................................................................5000
Aves, indeterminate ................................................................................6000
Aves, large (informally determined, turkey or eagle size)........................6001
Aves, medium (informally determined, duck size) ....................................6002
Aves, small (informally determined, Passeriform size) ............................6003
Reptilia, indeterminate ..........................................................................7000
Herpivore ..............................................................................................7500
Amphibia, indeterminate ........................................................................8000
Osteichthyes, indeterminate ................................................................9000

Assign indeterminate items as follows:

Mammalia

Marsupialia

Didelphidae

Didelphis Virginiana
(Opossum)..........................................................4901
Insectivora ........................................................................................................4050

Talpidae (moles) ..........................................................................................4051

**Scalops**
*Scalopis aquaticus*  
(Eastern Mole) ..........................................................................................4054

**Parascalops**
*Parascalops breweri*  
(Hairy-tailed Mole) .......................................................................................4052

**Condylura**
*Condylura cristata*  
(Star-nosed Mole) .......................................................................................4053

Soricidae ........................................................................................................4060

**Sorex** (Long-tailed shrews) .......................................................................4061
*Sorex cinereus*  
(Masked Shrew) ...........................................................................................4062
*Sorex palustris*  
(Water Shrew) ..............................................................................................4063
*Sorex fumeus*  
(Smoky Shrew) .............................................................................................4064

**Microsorex**
*Microsorex hoyi*  
(Pygmy Shrew) ............................................................................................4066

**Cryptotis**
*Cryptotis parva*  
(Least Shrew) .............................................................................................4067

**Blarina** (Short-tailed shrews)
*Blarina brevicauda*  
(Short-tailed shrew) ......................................................................................4068

**Chiroptera** ................................................................................................4100

Vespertilionidae

**Myotis** ....................................................................................................4111
*Myotis lucifugue*  
(Little Brown Bat) .......................................................................................4112
*Myotis keenii*  
(Kenn’s Bat) .................................................................................................4113
Myotis leibii
(Small-footed Bat) .................................................................4114

Lasionycteris
Lasionycteris noctivagans
(Silver-haired Bat) .................................................................4115

Pipistrellus
Pipistrellus subflavus
(Eastern Pipistrelle) .................................................................4116

Eptesicus
Eptesicus fuscus
(Big Brown Bat) ..................................................................4117

Lasiurus
Lasiurus borealis
(Red Bat) .............................................................................4118
Lasiurus cinereus
(Hoary Bat) ............................................................................4119

Lagomorpha

Leporidae (Rabbits and Hares) ..................................................4200

Lepus
Lepus americanus
(Snowshoe Hare) ....................................................................4210

Sylvilagus
Sylvilagus floridanus
(Eastern Cottontail) ................................................................4213
Sylvilagus floridanus
(Swamp Bunny) ......................................................................4214

Rodentia ......................................................................................4902

Erethizontidae

Erethizon dorsatum
(Porcupine) .............................................................................2100

Sciuridae (Woodchucks and Squirrels) ........................................4903

Marmota
Marmota monax
(Woodchuck) .........................................................................4904

Glaucomys
Glaucomys volans
(Southern Flying Squirrel – 35-88g) ............................................4311
Glaucomys sabrinus
(Northern Flying Squirrel – 62-123g) .................................................................................. 4312

**Tamias**

*Tamias striatus*  
(Eastern Chipmunk – 65-125g) .................................................................................. 4313

**Sciurus** .................................................................................................................... 4314

*Sciurus carolinensis*  
(Gray Squirrel) ........................................................................................................... 4315

*Sciurus niger*  
(Fox Squirrel) ............................................................................................................... 4316

**Tamiasciurus**

*Tamiasciurus hudsonicus*  
(Red Squirrel – 126-234g) ........................................................................................ 4317

**Castoridae (Beavers)**

*Castor canadensis*  
(Beaver) ....................................................................................................................... 2101

**Zapodidae (Jumping Mice)** .................................................................................... 4320

**Zapus**

*Zapus hudsonius*  
(Meadow Jumping Mouse) ........................................................................................ 4321

*Napaeozapus insignis*  
(Woodland Jumping Mouse) ....................................................................................... 4322

**Cricetidae (Native Rats and Mice)** ........................................................................ 4350

*Peromyscus* .................................................................................................................. 4351

*Peromyscus maniculatus*  
(Deer Mouse) ............................................................................................................... 4352

*Peromyscus leucopus*  
(White-footed Mouse) ................................................................................................. 4353

**Neotoma**

*Neotoma Floridana*  
(Eastern Woodrat) ....................................................................................................... 4354

**Microtinae (Voles, Lemmings, and Muskrats)** .......................................................... 4361

**Ondartia**

*Ondatra zibethicus*  
(Muskrat) .................................................................................................................. 4355

**Synaptomys**

*Synaptomys cooperi*  
(Southern Bog Lemming) ............................................................................................ 4356

**Clethrionomys**
Clethrionomys gapperi
(Gapper’s Red-backed Mouse) .................................................................4357

Microtus ........................................................................................................4358
Microtus pennsylvanicus
(Meadow Vole) .............................................................................................4359
Microtus pinetorum
(Pine Mouse) ..................................................................................................4360

Carnivora .......................................................................................................1010

Large Carnivora .............................................................................................3035
Medium Carnivora ..........................................................................................2036
Canidae ..........................................................................................................1110

Canis ..............................................................................................................1111
Canis lupus
(Gray Wolf) ....................................................................................................3010
Canis latrans
(Coyote) ........................................................................................................2200
Canis familiaris
(Dog) .............................................................................................................2202

Vulpes
Vulpes vulpes
(Red Fox – not native) ..................................................................................2201

Urocyon
Urocyon cinereoargenteus
(Gray Fox) ...................................................................................................4910

Vulpes or Urocyon ..........................................................................................2203

Ursidae
Ursus americanus
(Black Bear) ..................................................................................................3020

Procyonidae
Procyon lotor
(Raccoon) ....................................................................................................2210

Mustelidae ......................................................................................................4921

Martes
Martes americana
(Marten) .........................................................................................................4400
Martes pennant
(Fisher)........................................................................................................4401
Mustela...........................................................................................................4401
  Mustela nivalus
(Least Weasel) ............................................................................................4402
  Mustela erminea
(Ermine) ........................................................................................................4403
  Mustela frenata
(Long-tailed Weasel) ....................................................................................4404
  Mustela vision
(Mink) ............................................................................................................4405
Mephitis
  Mephitis mephitis
(Striped Skunk) ..........................................................................................4912
Lutra
  Lutra canadensis
(River Otter) ..................................................................................................2220
Taxidae
  Taxidae Taxus
(American Badger) ......................................................................................2221
Felidae .............................................................................................................1115
Lynx..................................................................................................................2230
  Lynx lynx
(Lynx) .............................................................................................................2231
  Lynx rufus
(Bobcat) .........................................................................................................2232
Felis concolor
(Mountain Lion) ............................................................................................3030
Artiodactyla.......................................................................................................3116
Cervidae (Deer)..............................................................................................3100
Large Cervid ....................................................................................................3104
Cervus
  Cervus elaphus
(American Elk)..........................................................................................3101
Odocoileus
  Odocoileus virginianus
(White-tailed Deer) .....................................................................................3102
Alces
Alces alces
(Moose)..........................................................................................3103

Bovidae..............................................................................................3110

Bison or Cow ..................................................................................3111

Bison
  Bison bison
  (Bison)..........................................................................................3112

Ovis
  (Sheep)..........................................................................................3115

Suidae
Sus
  (Pig)..............................................................................................3121

Perissodactyla

Equidae
Equus
  (Horse)..........................................................................................3120

Aves .....................................................................................................6000

Gaviiformes

Gaviidae

  Gavia immer
  (Common Loon)............................................................................6010

Podicipiformes

Podicipedidae..................................................................................6020

Podiceps
  Podiceps auritus
  (Horned Grebe)............................................................................6021

Podilymbus
  Podilymbus podiceps
  (Pied-billed Grebe).......................................................................6022

Ciconiformes
Ardeidae ........................................................................................................6030

*Ardea*

*Ardea herodias*
(Great Blue Heron) ..................................................................................6031

*Leucophoyx*

*Leucophoyx thula*
(Snowy Egret) ...........................................................................................6032

*Butorides*

*Butorides virescens*
(Green Heron) ............................................................................................6033

*Nycticorax*

*Nycticorax nycticorax*
(Black-crowned Night Heron) .......................................................................6034

*Ixobrychus*

*Ixobrychus exilis*
(Least Bittern) ............................................................................................6035

**Anseriformes** ..........................................................................................6100

Cygninae (Swan subfamily)

*Cygnus columbianus*
(Whistling Swan) ........................................................................................6110

Anserinae (Geese subfamily)

*Branta canadensis*
(Canada Goose) ..........................................................................................6115

Anatinae or Aythyinae ..................................................................................6116

Anatinae (Surface feeding Duck subfamily) ..................................................6120

*Anas*

*Anas discors*
(Blue-winged Teal) ......................................................................................6121

*Anas platyrhynchos*
(Mallard) ....................................................................................................6122

*Anas rubripes*
(Black Duck) ...............................................................................................6123

*Anas strepera*
(Gadwall) .....................................................................................................6124
Anas acuta
(Pintail) .................................................................6125
Anas crecca
(Green-winged Teal) ................................................6126
Anas clypeata
(Shoveler) .....................................................................6131
Mareca
Mareca americana
(Baldpate) ................................................................6130
Aix
Aix sponsa
(Wood Duck) ................................................................6132
Aythynaw (Diving Duck subfamily) ...............................6140
Aythya ........................................................................6141
Aythya americana
(Redhead) ..................................................................6142
Aythya collaris
(Ring-necked Duck) ......................................................6143
Aythya valisneria
(Canvas-back) ................................................................6144
Aythya marila
(Great Scaup Duck) .......................................................6145
Aythya affinis
(Lesser Scaup Duck) .......................................................6146
Glaucionetta .................................................................6147
Glaucionetta clangula
(American Golden-eye) ..................................................6148
Glaucionetta albiola
(Buffle-head) ..................................................................6149
Clangula
Clangula hyemalis
(Old-squaw) ..................................................................6150
Somateria
Somateria spectabilis
(King Eider) ...................................................................6151
Melanitta
Melanitta fuscus
(White-winged Scoter) ....................................................6152
Erismaturinae (Ruddy Duck subfamily)

Erismatura jamaicensis
(Ruddy Duck) ................................................................6160
Merginae (Merganser subfamily) .................................6170
Lophodytes
  *Lophodytes cucullatus*
  (Hooded Merganser) .............................................................. 6171

Mergus
  *Mergus merganser*
  (American Merganser) .......................................................... 6173
  *Mergus serrator*
  (Red-breasted Merganser) ....................................................... 6174

Falconiformes ........................................................................... 6200

Cathartidae

  *Cathartes aura*
  (Turkey Vulture) ................................................................. 6201

Accipitridae ............................................................................. 6210

  *Accipiter* ........................................................................... 6211
    *Accipiter gentilis*
    (Goshawk) ........................................................................... 6212
    *Accipiter striatus*
    (Sharp-shinned Hawk) .......................................................... 6213
    *Accipiter cooperii*
    (Cooper’s Hawk) ................................................................. 6214

Aquila
  *Aquila chrysaetos*
  (Golden Eagle) ................................................................. 6225

Halioeetus
  *Halioeetus leucocephalus*
  (Bald Eagle) ........................................................................... 6226

Pandionidae

  *Pandion halioetus*
  (Osprey) ................................................................................. 6230

Falconidae ................................................................................. 6240

Falco
  *Falco peregrinus*
  (Peregrine Falcon) .................................................................. 6241
  *Falco columbarius*
  (Merlin) .................................................................................. 6242
  *Falco sparverius*
(Kestrel) .................................................................................................................. 6243

Galliformes .................................................................................................................. 6300

Tetraonidae

Bonasa umbellus
(Ruffed Grouse) ........................................................................................................ 6301

Meleagrididae

Melagris gallopavo
(Wild Turkey) ........................................................................................................ 6302

Odontophoridae

Tympanichus cupido
(Greater Prairie chicken) .............................................................................................. 6304

Colinus virginianus
(Northern Bobwhite) .................................................................................................... 6305

Gruiformes .................................................................................................................. 6320

Rallidae ......................................................................................................................... 6321

Rallus............................................................................................................................ 6322

Rallus elegans
(King Rail) .................................................................................................................. 6323

Rallus limicola
(Virginia Rail) .............................................................................................................. 6324

Porzana

Porzana carolina
(Sora) ............................................................................................................................. 6352

Coturnicops

Coturnicops noveboracensis
(Yellow Rail) ................................................................................................................ 6326

Gallinula

Gallinula chloropus
(Florida Gallinule) ....................................................................................................... 6327

Fulica

Fulica americana
(Coot) .......................................................................................................................... 6328

Charadriiformes............................................................................................................ 6330
Charadriidae

Charadrius .................................................................................. 6332
  Charadrius melodus
  (Piping Plover) ........................................................................ 6333
  Charadrius vociferus
  (Killdeer) ................................................................................ 6334

Squatarola
  Squatarola squatarola
  (Black-bellied Plover) ............................................................ 6335

Arenaria
  Arenaria interpres
  (Ruddy Turnstone) .................................................................. 6336

Scolopacidae .............................................................................. 6340

Philohela
  Philohela minor
  (Woodcock) ......................................................................... 6341

Capella
  Capella gallinago
  (Wilson’s Snipe) ................................................................... 6342

Bartramia
  Bartramia longicauda
  (Upland Plover) ...................................................................... 6343

Actitis
  Actitis macularia
  (Spotted Sandpiper) ............................................................... 6344

Tringa
  Tringa solitaria
  (Solitary Sandpiper) ............................................................... 6345

Totanus
  Totanus melanleucus
  (Greater Yellow-legs) ............................................................. 6347
  Totanus flavipes
  (Lesser Yellow-legs) ............................................................... 6348

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Indicates confidence in taxonomic classifications.
Certain = 1
Uncertain = 2

Element: 3 digits
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- Synsacrum
- Caudal Vertebra
- Coccygeal
- Pygostyle
- 1st vertebra
- 3rd Vertebra
- Ultimate Vertebra
- Penultimate Vertebra
- Vertebral Epiphysis only
- Vertebral Centrum only
- Weberian Apparatus
- Neural Arch
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</tr>
</thead>
<tbody>
<tr>
<td>Indicates which side of the body bone comes from.</td>
<td></td>
</tr>
</tbody>
</table>
indeterminate = 0
Right = 1
Left = 2
Not a sideable element = 3

**Complete: 1 digit**

Use this column to record the amount of the skeletal part present.

Entire/Almost Entire...............................................................................................................1
Three-Fourths..........................................................................................................................2
Two-Thirds .................................................................................................................................3
One-Half .......................................................................................................................................4
One-Third .....................................................................................................................................5
One-Fourth ..................................................................................................................................6
Fragment .......................................................................................................................................7
Unknown/Not Applicable ...........................................................................................................8

**Class size: 2 digit**

Use this column, where applicable, to record what class size a specimen belongs to according to the range it falls in

<table>
<thead>
<tr>
<th>Class Size</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>01-0 ≤ 8</td>
<td>11-80 ≤ 88</td>
</tr>
<tr>
<td>02-8 ≤ 16</td>
<td>12-88 ≤ 96</td>
</tr>
<tr>
<td>03-16 ≤ 24</td>
<td>13-96 ≤ 104</td>
</tr>
<tr>
<td>04-24 ≤ 32</td>
<td>14-104 ≤ 112</td>
</tr>
<tr>
<td>05-32 ≤ 40</td>
<td>15-112 ≤ 120</td>
</tr>
<tr>
<td>06-40 ≤ 48</td>
<td>16-120 ≤ 128</td>
</tr>
<tr>
<td>07-48 ≤ 56</td>
<td>17-128 ≤ 136</td>
</tr>
<tr>
<td>08-56 ≤ 64</td>
<td>18-136 ≤ 144</td>
</tr>
<tr>
<td>09-64 ≤ 72</td>
<td>19-144 ≤ 152</td>
</tr>
<tr>
<td>10-72 ≤ 80</td>
<td>20-152 ≤ 160</td>
</tr>
</tbody>
</table>

**THE NEXT THREE VARIABLES CALLED PROXIMITY, AXIALITY AND LATERALITY PROVIDE INFORMATION ON THE LOCATION OF THE FRAGMENT BASED ON COMMON DIRECTIONALITY TERMS. DIAGRAMS ILLUSTRATING THESE DIRECTIONS FROM VON DEN DREISCH (1976) ARE ATTACHED.**

**proximity: 1 digit**

Use this column, where applicable, to record the location of a fragment in relation to a plane bisecting the element parallel to the plane of support (the ground). In the case of the head assume it is oriented horizontally rather than diagonally.
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Unknown or not applicable</td>
</tr>
<tr>
<td>1</td>
<td>Proximal</td>
</tr>
<tr>
<td>2</td>
<td>Distal</td>
</tr>
<tr>
<td>3</td>
<td>Medial</td>
</tr>
<tr>
<td>4</td>
<td>Medial and proximal</td>
</tr>
<tr>
<td>5</td>
<td>Distal and medial</td>
</tr>
<tr>
<td>6</td>
<td>Dorsal</td>
</tr>
<tr>
<td>7</td>
<td>Ventral</td>
</tr>
<tr>
<td>8</td>
<td>Basal</td>
</tr>
</tbody>
</table>

**Axiality: 2 digit**

Use this column, where applicable, to record the location of a fragment in relation to a plane which bisects the element lengthwise into front and back halves.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Unknown or not applicable</td>
</tr>
<tr>
<td>1</td>
<td>Cranial/anterior</td>
</tr>
<tr>
<td>2</td>
<td>Caudal/posterior</td>
</tr>
<tr>
<td>3</td>
<td>Dorsal</td>
</tr>
<tr>
<td>4</td>
<td>Palmer/volar</td>
</tr>
<tr>
<td>5</td>
<td>Planter/posterior</td>
</tr>
<tr>
<td>6</td>
<td>Nasal/oral</td>
</tr>
<tr>
<td>7</td>
<td>Nuchal/aboral</td>
</tr>
<tr>
<td>8</td>
<td>Medial</td>
</tr>
<tr>
<td>9</td>
<td>Labial</td>
</tr>
<tr>
<td>10</td>
<td>Lingual</td>
</tr>
</tbody>
</table>

**Laterality: 1 digit**

Use this column, where applicable, to record the location of a fragment in relation to a plane parallel to the median or sagittal plane which bisects the element into right and left halves.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Unknown or not applicable</td>
</tr>
<tr>
<td>1</td>
<td>Lateral</td>
</tr>
<tr>
<td>2</td>
<td>Mesial/medial</td>
</tr>
</tbody>
</table>

**Structure: 2 digits**

This variable is intended as a further aid in defining the portion of a bone present. However, it should not be used as a replacement for the portion variables above, rather as a supplement when the fragment being coded is a specific structure only. If the fragment is larger than or contains more of a skeletal part than the structure described here, it should not be coded for this variable. Add additional codes as needed.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Antler tine</td>
</tr>
<tr>
<td>2</td>
<td>Antler beam fragment</td>
</tr>
<tr>
<td>3</td>
<td>Antler brow tine</td>
</tr>
</tbody>
</table>
Tooth root .......................................................... 10
Tooth crown ...................................................... 11
Tooth neck ........................................................ 12
Tooth indeterminate enamel fragment......................... 13
Mandible coronoid process .................................... 15
Mandible angular process .................................... 16
Mandible alveolar process .................................... 17
Mandible horizontal ramus .................................... 18
Mandible ascending ramus .................................... 19
Frontal postorbital process .................................. 20
Frontal pedicel .................................................. 21
Frontal zygomatic process .................................... 22
Sphenoid sella turcica .......................................... 25
Sphenoid lesser wing .......................................... 26
Sphenoid greater wing ........................................ 27
Occipital condyles ............................................. 28
Occipital jugular or paraoccipital process ................... 29
Occipital nuchal crest/cruciate eminence .................... 30
Zygomatic maxillary process ................................ 32
Zygomatic temporal process ................................ 33
Zygomatic postorbital process ............................... 34
Temporal petrous portion ..................................... 35
Temporal zygomatic process ................................ 36
Temporal squamous portion ................................... 37
Temporal mastoid .............................................. 38
Temporal auditory bulla ....................................... 39
Maxilla alveolar process ..................................... 40
Maxilla zygomatic process ................................... 41
Maxilla palatine process ..................................... 42
Maxilla nasal process .......................................... 43
Vertebra spinous process ..................................... 50
Vertebra centrum .............................................. 51
Vertebra transverse process ................................ 52
Vertebra odontoid process ................................... 53
Vertebra ventral process ..................................... 54
Vertebra zygapophysis ........................................ 55
Vertebra prezygapophysis ..................................... 56
Vertebra postzygapophysis ................................... 57
Vertebra neural arch ......................................... 58
Vertebra centrum and neural arch ........................... 59
Rib capitulum .................................................. 60
Rib tuberculum ............................................... 61
Rib uncinate process ......................................... 62
Sternum caudal or xiphoid process .......................... 63
Sternum keel ................................................... 64
Sternum coracoidal facets ................................... 65
Sternum costal facets .................................................................66
Sternum carinal margin ..............................................................67
Scapula glenoid fossa .................................................................68
Scapula acromium process ..........................................................69
Scapula metacromial process ......................................................70
Scapula coracoids process ..........................................................71
Scapula blade fragment ...............................................................72
Innominate acetabulum ..............................................................80
Innominate auricular surface .......................................................81
Innominate iliac crest .................................................................82
Innominate ala/wing .................................................................83
Innominate ischial tuberosity .......................................................84
Innominate pubic symphysis .......................................................85
Innominate ilium and ischium .....................................................86
Innominate ischium and pubis .....................................................87
Innominate ilium and pubis .......................................................88
Innominate ilium and acetabulum ..............................................89
First sacral segment .................................................................90
Metapodial, both distal condyles ................................................91
Metapodial, right condyle ............................................................92
Metapodial, left condyle .............................................................93
Metapodial condyle indeterminate .............................................94
Longbone complete articular end ............................................95
Longbone mesial condyle ...........................................................96
Longbone lateral condyle ..........................................................97
Ulna semilunar notch .................................................................98
Femur head ...............................................................................99
Femur Lesser Trochanter ..........................................................07
Mandibular condyle .................................................................04
Occlusal Surface ........................................................................05
Humerus Head ..........................................................................06

**Breakage: 1 digit**
Use these columns to record the age of breakage whether or not breakage can clearly be attributed to human agencies.

1- old
2- new
3- both old and new breaks

**Maturity (age): 2 digits**
Use these columns to record observations on the maturity of the animal represented by each bone.
Immature, precise age unknown ................................................................. 01
Mature, precise age unknown ................................................................. 50
Mature, epiphysis fully fused ................................................................. 26
Mature, epiphyseal line not visible .......................................................... 27
Immature, epiphysis not fused ................................................................. 02
Immature, epiphysis fused with line present ............................................. 03
Immature, proximal epiphysis only not fused .......................................... 04
Immature, distal epiphysis only not fused ............................................... 05
Immature, medial epiphysis only not fused ............................................. 06
Immature, less than 3 weeks old ............................................................. 07
Immature, 3-6 weeks old ................................................................ 08
Immature, 2-3 months old ................................................................ 09
Immature, 3-6 months old ................................................................ 10
Immature, less than 1 year old ............................................................... 11
Immature, fetal ................................................................................... 12
Immature, sutures not fused ................................................................ 13
Immature, teeth show no wear ............................................................... 14
Immature, teeth show slight wear ........................................................... 15
Mature, teeth show moderate wear ....................................................... 51
Mature, teeth show heavy wear .............................................................. 52
Immature, only deciduous teeth ............................................................. 16
Immature, deciduous teeth still erupting ................................................ 17
Immature, permanent M1 erupting, M2-5 not erupted .............................. 18
Immature, M1 erupted, M2 erupting, M3 not erupted .............................. 19
Immature, M1 and M2 erupted, M3 erupting .......................................... 20
Milk premolars gone but permanent not yet erupted ............................... 21
Permanent P3 erupting, P4-M3 erupted .................................................. 22
Immature, diaphysis not fused ............................................................... 23
Mature, teeth show slight wear ............................................................. 24

Number of Items: 2 digits
Use these columns to record the number of specimens fitting the description contained in this record. If you have more than 99 specimens fitting this description use two lines. Never code specimens that are not identical on the same line.

COMMENTS: This is a memo variable used for additional information. consecutive