Investigation into a Late Prehistoric Bison Kill/Butchering Event at Big Bone Lick State Park, Boone County, Kentucky

Robert A. Genheimer
George Rieveschl Curator of Archaeology
Cincinnati Museum Center

In late summer 2008, extreme droughty conditions at Big Bone Lick State Park in Boone County, Kentucky resulted in a fortuitous lowering of water within Big Bone Lick Creek, and exposure of a linear bone bed near the base of the stream channel (Figure 1). The bone bed had also been visible in late summer 2007, but heavy rains quickly buried the bone horizon. Paleontologists and archaeologists from the Cincinnati Museum Center acted quickly during the 2008 episode, and immediately began a systematic program of confinement, mapping, and excavation.

Big Bone Lick has been referred to as "the birthplace of American paleontology" because of its preservation of extinct megafauna, its collection history, and sporadic excavations, the latter of which span the last two centuries. While Native Americans knew of the large bones at the lick, it wasn't discovered by Europeans until 1739 when Captain Charles Lemoyne de Longueil noted their presence while passing through the area. Throughout the remainder of the 18th century, there were numerous visits and collections by Europeans. Large bones and tusks from now-extinct megafauna were clearly visible on the ground surface within and surrounding the lick area (Hedeen 2008; Jillson 1936). Meriweather Lewis assembled a collection of bones for Thomas Jefferson in 1803, but these were unfortunately lost in a river accident. Not to be deterred, Jefferson enlisted William Clark, the other member of the famous duo, to amass a similar collection in 1807 upon his return from the West. Those collections from September of 1807 did make it to the White House, and were later displayed at Monticello. But, by this date, it was necessary to excavate to produce a sizable collection. Of particular interest, three flint spear points were recovered during this search for large animal bones. Recognized today as Clovis points, these artifacts went through a complex chain of title and today are part of the archaeology collections of the Cincinnati Museum Center. They were recovered during perhaps the first paleontological excavation in America, at the behest of the President of the United States, and were collected by William Clark, famous for his part in the "Voyage of Discovery" that ended that same year (Tankersley 2002:52-55).

Collecting activities continued through the 19th century, but it was not until the second half of the 20th century that modern, systematic excavations were undertaken. With the aid of heavy equipment, the University of Nebraska conducted test excavations at the lick between 1962 and 1967. The Nebraska excavators quickly learned that the stratigraphy at the site was complex and often discontinuous. Silts and clay terraces extended for up to 7 meters in depth north of Big Bone Lick Creek, and between 3 and 4 meters in depth to the south. These backwater deposits were the result of the Wisconsin ice margin blocking the northward flow of the Creek into the Ohio River. Subsequent reworking of the deposits by stream migration has resulted in much of the complexity. Although megafauna remains were located during these excavations, no complete or articulated animals were identified.

Recovered and identified species from Big Bone Lick collecting and excavations include Jefferson's ground sloth (*Megalonyx jeffersonii*), Harlan's ground sloth (*Paramylodon Glossotherium harlani*), prehistoric horse (*Equus complicatus*), stag moose (*Cervalces scotti*), caribou (*Rangifer* sp), wooly mammoth (*Mammuthus primigenius*), Columbian mammoth (*Mammuthus columbi*), American mastodon (*Mammut americanum*), tapir (*Tapirus haysii*), elk (*Cervus canadensis*), and musk ox (*Bootherium bombifrons*). In addition to the modern bison (*Bison bison*), both ancient bison (*Bison antiquus*) and giant bison (*Bison latifrons*) have been identified (Hedeen 2008). These species were attracted to the active salt licks in the valley. How these individual animals died is an open question, although human predation may have been a significant factor (see Tankersley 2009).

2008 Excavations

The partially exposed bone bed consisted of a friable, organic-rich conglomerate with calcareous and ferruginous cements. This gravel bench was visible to varying degrees extending both up and down stream, and likely represents a prehistoric point bar sequence from stream migration. The dark black bison bones did not display stream orientation suggesting that they had not been moved down stream by stream action, and hence were likely not significantly disturbed after the event that led to their deposition. In an effort to isolate the bones and remove as much water as possible, a small coffer dam was established, and a mechanical pump was employed (Figure 2). A 12 square meter area was chosen and gridded off. Exposure proceeded with geological hammers, as the matrix was too hard to excavate with standard trowels. The thin bone bed was then mapped and photographed, with the position of bison bones, uncarbonized wood and nuts, and apparent archaeological material noted (Figure 3). The bones and artifacts were then removed, and all items were taken to the Geier Collections and Research Facility of the Cincinnati Museum Center for processing and analyses (Figure 4).

Nearly 600 *Bison bison* bones were recovered. Based upon duplicate elements, these bones represented a minimum of five individuals, although no complete bison skeletons were present. Although some bones appeared to be slightly abraded, there was no obvious taphonomy, such as bite marks or rodent gnawing, indicating that the bison were probably quickly covered by water and eventually fluvial debris within the stream channel. The five individuals are sub-adults and possibly juveniles. A reconciliation of elements indicated that between 1% and 80% of expected bones were present. Those bones represented by 50% or less of expected elements included scapulae, tibias, thoracic vertebrae, femurs, ribs, humeri, carpals, sternebrae, caudal vertebrae, hyoids, lateral malleoli, cuneiform tarsals, and sesamoids. Skulls had been subjected to mechanical breakage, and cranial and post-cranial cut marks were noted on numerous specimens.

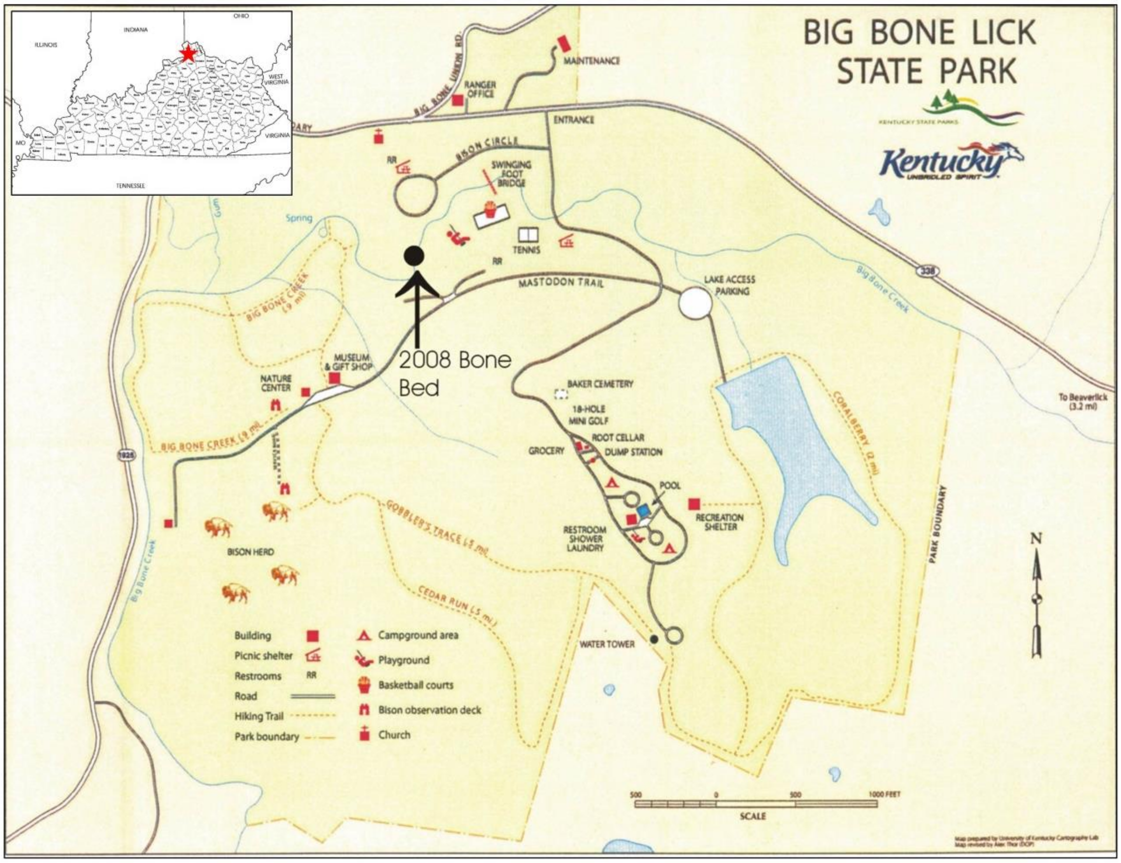


Figure 1. Approximate location of 2008 bone bed excavations within Big Bone Lick State Park.

Figure 2. Coffer dam confining portion of bone bed.

Figure 3. Dark black bison bones in conglomerate matrix.

Figure 4. Bison bones in excellent condition after removal from matrix.

Archaeological Material

Thirteen archaeological specimens associated with butchering of the bison were recovered. These include six flint bifacial tools, three retouched flint flakes, a flint core, a quartzite hammerstone, a stone adze bit, and a bison vertebra exhibiting use-wear as a possible scraper. The bifacial tools appeared to be expedient implements (Figure 5). Each was crudely knapped, and several exhibited a pebble cortex indicating that they were probably acquired from secondary chert-bearing gravels, perhaps within the stream itself. Three of the bifaces were made from Breathitt chert, a middle Pennsylvanian rock outcropping in southeast Kentucky approximately 210 km from Big Bone Lick. But two of these exhibited pebble cortex. The retouched flakes included one made from Breathitt, one from an unknown bedded chert, and one from Newman chert, which outcrops approximately 85 km from Big Bone Lick. The quartzite hammerstone, possibly used to break apart large bones, had suffered a fatal flaw – nearly a third of the hammer had detached (Figure 6). The adze bit was all that was recovered from this traditional wood-working implement. It too was probably utilized to break apart and perhaps cut bones. Its shattered state indicated that it too failed under repeated stress. No cultural/temporal diagnostics were encountered during the excavations.

Figure 5. Crude bifacial tool recovered from bone bed.

Figure 6. Shattered quartzite hammerstone recovered from bone bed.

Food Utility Index

In an effort to analyze the relative food value of recovered and missing bison elements, Emerson's (1993) Food Utility Index for bison was employed. Utilizing the Food Utility Index values for *Bison bison* axial, forelimb, and hindlimb elements, it was apparent that high food utility bones were more frequently missing (Table 1). Food utility measures values of meat, marrow, and bone grease. In general, bones of low food utility (e.g., cervical vertebrae 1-2, radius/ulna, metacarpals, metatarsals, and phalanges) occurred at greater frequencies than those of high food utility (e.g., femora, tibiae, ribs, and thoracic vertebrae) (Figure 7 A-C). Although based upon a small sample, these data suggest that higher value cuts of meat with their bones were probably removed from the site by Native American groups.

Table 1. Food Utility Index values for bones of *Bison bison* (Emerson 1993).

AXIAL SKELETON	
SKULL (SKUL)	25.3
CERVICAL VERTEBRAE 1-2 (C1C2)	9.1
CERVICAL VERTEBRAE 3-7 (C3C7)	38.6
THORACIC VERTEBRAE (THOR)	47.4
RIBS (RIB)	62.3
LUMBAR VERTEBRAE (LUM)	45.1
SACRUM-PELVIS (SAC)	34.7
FORELIMB	
SCAPULA (SCAP)	27.5
HUMERUS (HUM)	27.5
RADIUS-ULNA (RAD)	19.2
METACARPAL (MTC)	6.5
HINDLIMB	
FEMUR (FEM)	100.0
TIBIA (TIB)	57.7
NON-CUNEIFORM TARSALS (NCT)	30.0
METATARSAL (MTT)	16.1
FOOT	
PHALANGES	6.4

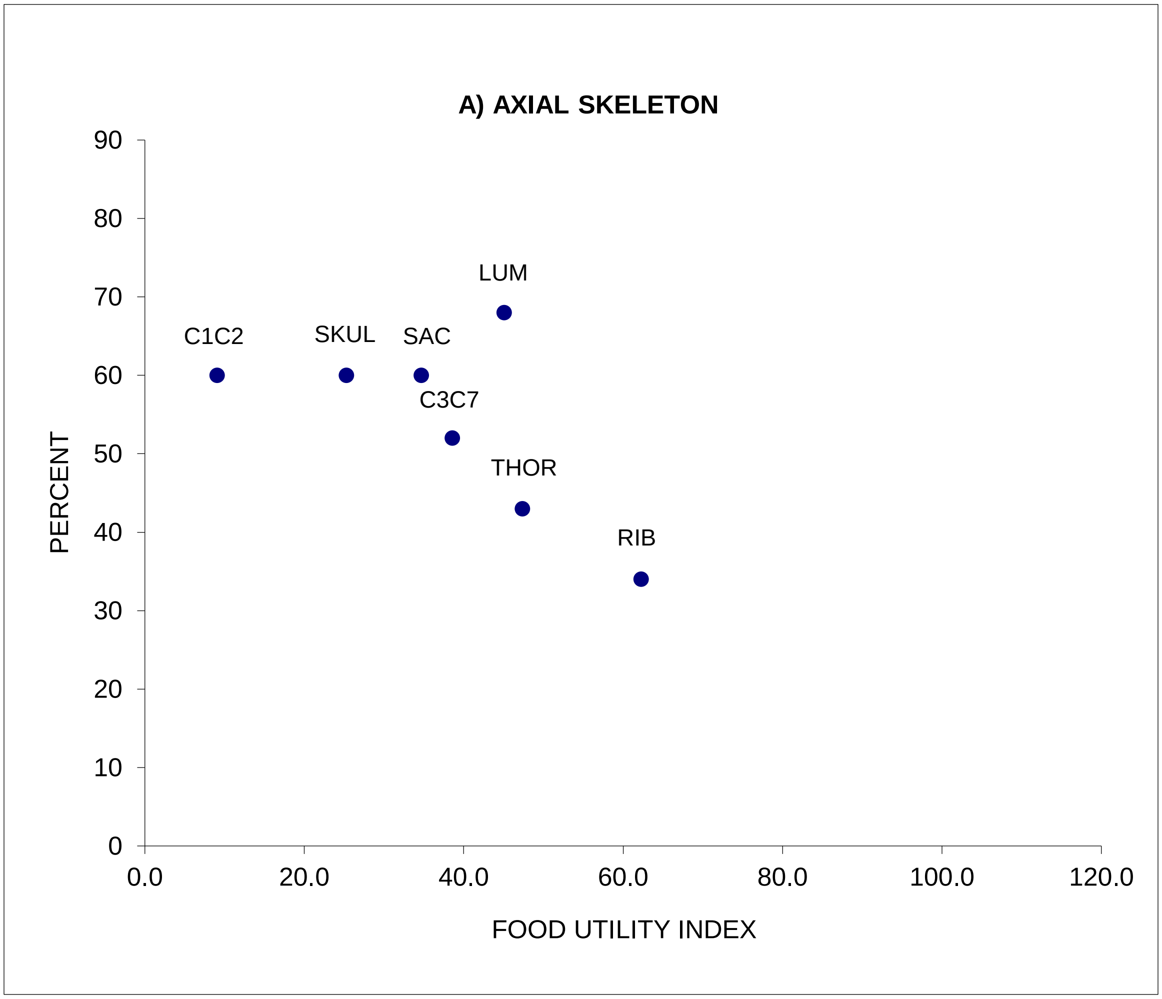
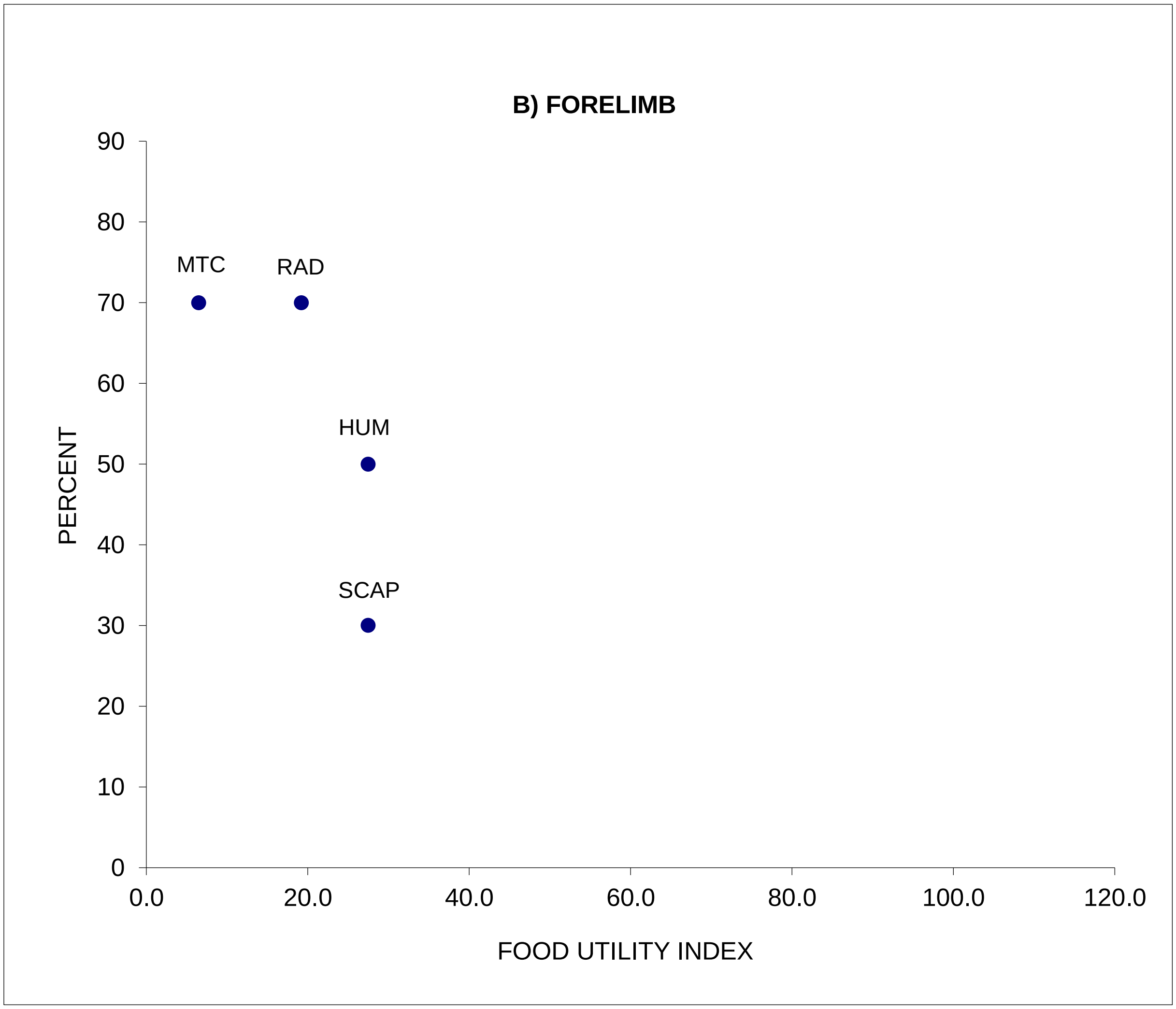
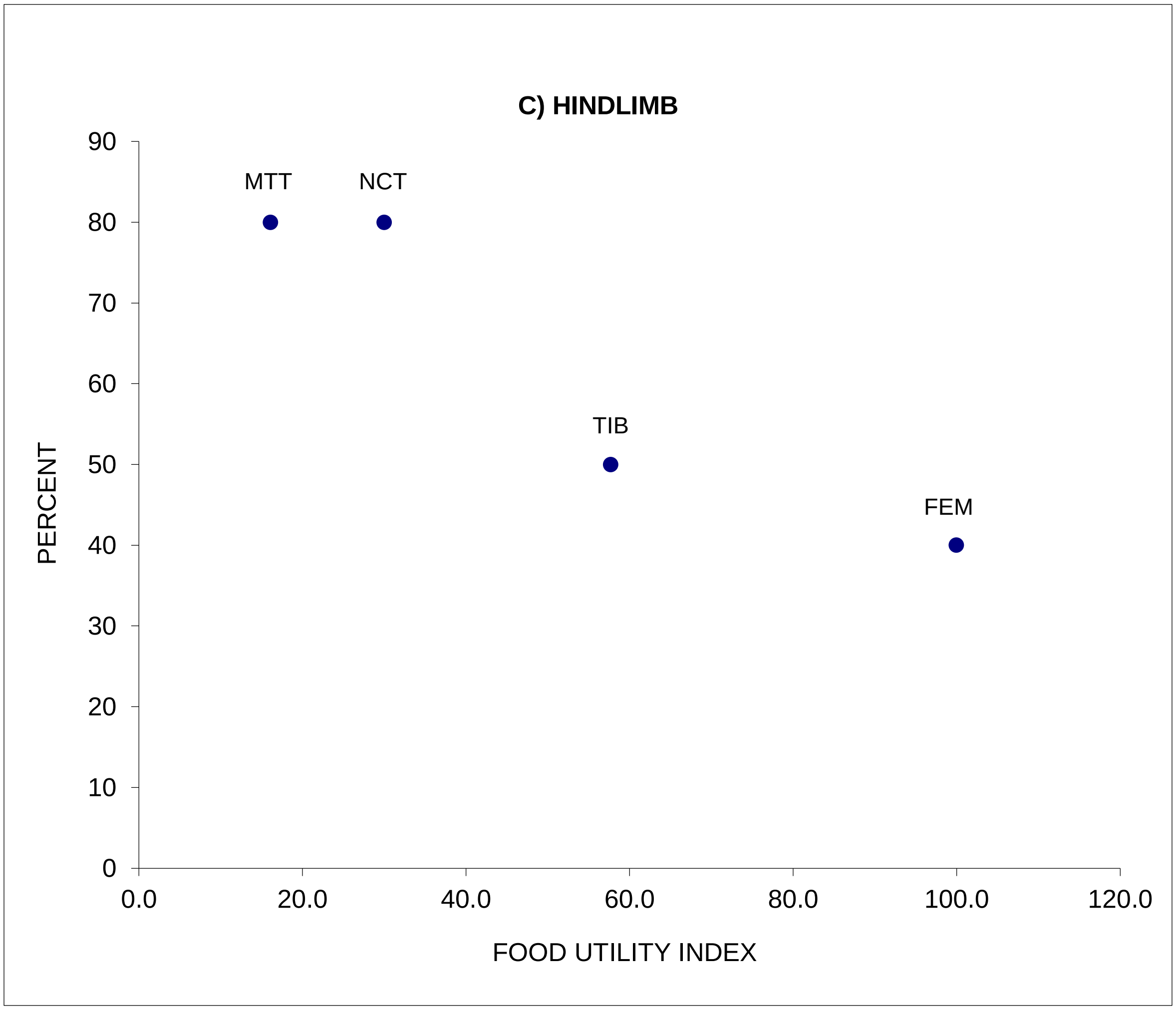


Figure 7 A-C. Relations between proportional frequencies of skeletal elements and Food Utility Index values for axial, forelimb, and hindlimb segments. Refer to Table 1 for list of abbreviations.


B) FORELIMB
PERCENT
90
80
70
60
50
40
30
20
10
0
MTC
RAD
HUM
SCAP
0.0
20.0
40.0
60.0
80.0
100.0
120.0
FOOD UTILITY INDEX



Absolute Dating

Modern bison were last reported at Big Bone Lick in ca. 1800. Their presence in great numbers is evidenced by broad and deeply rutted bison trails extending from the Ohio River to Big Bone Lick (Hedeen 2008:22). Tankersley (1986:293) has argued that modern bison may have arrived in the Central Ohio River Valley as early as AD 1450, based upon a radiocarbon age determination made on charcoal from a pit feature from which a bison incisor was recovered from the Rogers site in Boone County, Kentucky. In addition, a 1981 cut bank test excavation by Tankersley very near our 2008 excavation along Big Bone Lick Creek resulted in the discovery of the disarticulated remains of a single adult bison, retouched flakes, a scraper, and two cordmarked shell tempered pottery sherds. A radiocarbon age determination of AD 1420 +/- 105 was noted for the deposit (Tankersley 1986:295). These data clearly suggest that modern bison may have been present in the area of Big Bone Lick by the middle of the 15th century AD.

Three radiocarbon age determinations were run from our 2008 excavations. The first (Beta 257505) was an attempt to directly date the fauna. Unfortunately, a submitted bison rib had sufficient collagen, but was found to be C13/C12 depleted. The collagen may have been depleted in carbon as a result of prolonged contact with stream waters. Its conventional radiocarbon age was AD 1820 +/- 40, with a two sigma calibrated range of cal AD 1660-1960, a result considered too late given historical documentation of bison in the area. The second (Beta 259933) was an attempt to date botanical material from within the bone bed. A non-carbonized hickory (*Carya* sp) nut had a conventional radiocarbon age of AD 1830 +/-40, with a two sigma calibrated range of cal AD 1670-1960, again a date considered too late for bison presence. The third (Beta 257506) was run on a large segment of non-carbonized wood recovered from the bone matrix. This specimen produced a conventional radiocarbon age of AD 1390 +/- 50, with a two sigma calibration of cal AD 1300-1440. At least the more recent portion of the two sigma range is in line with Tankersley's estimate of the mid-15th century for the arrival of bison in the study area. In any event, documented historical data for bison presence, the presence of Native American tools, and radiocarbon determinations clearly indicate that the Big Bone Lick bison kill/butchering event is contemporaneous with the Late prehistoric Madisonville Phase (ca. AD 1400/1450 – 1625).

Conclusions

The 2008 Cincinnati Museum Center excavations at Big Bone Lick resulted in the exposure, mapping, and excavation of a segment of a bison bone bed in the channel of Big Bone Lick Creek. Available evidence suggested that this was a primary deposition of killed and butchered bison dating to the Late Prehistoric Madisonville Phase, sometime between as early as the 15th century and as late as the 17th century AD. Among the remains of at least five individual bisons were found more than a dozen archaeological specimens, mostly of flint, but also stone and bone. A series of bifacial and unifacial flint tools appeared to be expedient in nature, with many only crudely fashioned from locally available pebble chert. The bone bed, which continues both up and down stream, may represent a single or multiple kill episode within a steep-sided drainage channel. The presence/absence of bison elements with perceived high food utility suggested that valuable cuts of meat may have been removed with their bones from the butchering site.

Acknowledgements

The Big Bone Lick excavations were undertaken with the permission of the Office of State Archaeology in Kentucky and the staff of Big Bone Lick State Park. Numerous individuals worked on the project including Glenn Storrs, Stanley Hedeen, Brenda Hunda, and Robert Genheimer. The Cincinnati Museum Center is to be commended for their support of the project. An earlier version of this summary took the form of a poster presentation at the 9th North American Paleontological Convention in Cincinnati (Storrs et. al. 2009).

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