Woodland Period Subsistence at Lamoka Lake: Animal Bones from the Buffalo Museum of Science Excavations

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Excavations conducted by the Buffalo Museum of Science at the Lamoka Lake Site in Schuyler County, New York in 1981 and 1987 resulted in the recovery of faunal remains and artifacts dating to the Archaic and Woodland periods. The Woodland period assemblage, the primary focus of this article, is dominated by white-tailed deer bones, but the analysis shows that these bones have been affected by several taphonomic processes which have altered the surface condition of bones, taxonomic representation, and skeletal element profiles. There is no evidence that only high-ranking body parts of deer were transported to the site. Instead, entire carcasses were probably brought to Lamoka Lake, where they were processed for meat and marrow. Very limited seasonality data indicate that the site was occupied, at a minimum, during part of the summer or fall.

Introduction

The Lamoka Lake Site in Schuyler County, New York, is most famous for its Late Archaic component, but since its first scientific excavation, the presence of a Woodland period occupation at the site has been recorded (Ritchie 1932). In this paper I present the results of the first zooarchaeological study of animal bones from Lamoka Lake that date to the Woodland period occupation. These faunal remains were recovered during excavations by the Buffalo Museum of Science in 1981 (Gramly 1983) and 1987, and were analyzed as part of a study of Late Archaic subsistence in central New York (Madrigal 1999).

The Lamoka Lake Site is located on the Glaciated Allegheny Plateau on the eastern shore of a small stream about 1.1 km long that connects two small, shallow, weedy lakes: Waneta Lake to the north and Lamoka Lake to the south. Originally, Waneta Lake drained south through the stream to Lamoka Lake, which drained south into Mud Creek, a tributary of the Cohocton River.

Previous Archaeological Research

The Lamoka Lake Site is estimated to cover about one hectare, with the most intensively occupied portion of the site covering 0.4 ha (Ritchie 1969:71). The Rochester Museum of

Arts and Sciences (now the Rochester Museum & Science Center) conducted excavations supervised by William Ritchie from 1925 to 1928 (Ritchie 1932). In 1958, Ritchie, by then at the New York State Museum, excavated five trenches in association with palynological studies of Lamoka and Waneta Lakes conducted by Clair Brown. Ritchie's 1962 excavations exposed over 140 sq m in the northern portion of the site (Ritchie 1969:69). No further professional excavations were conducted at the site for almost twenty years. In 1981 and 1987, R. Michael Gramly, then of the Buffalo Museum of Science, excavated two 1 m x 4 m trenches in the western portion of the site near the shore of the stream (Gramly 1983, and personal communication 1993). Soil was screened through 6.4 mm (1/4 in) mesh. Abundant artifacts, bones, and macrobotanical remains dating to the Late Archaic and Middle Woodland periods were recovered. The most recent excavations at the site were conducted by a Utica College field school led by Tony Luppino in 1991. The field school excavated over 60 sq m to a depth of over one meter. All deposits and artifacts were attributed to the Late Archaic period.

Three main stratigraphic units have been identified at the site. The uppermost is a light-colored topsoil or plowzone, described as a light clay loam with few artifacts, approximately 30-46 cm thick. Woodland period artifacts are sometimes found in this level, especially in the northern portion of the site (Ritchie 1969:42).

Beneath the plowzone is the thick black midden deposit, which in some areas extends to a depth of over 1.2 m. Ash lenses, sand lenses, hearths, and other features were found throughout the midden. The dark midden overlies the subsoil, a grayish or light tan sand and gravel mix (Ritchie 1932:85, 1969:71). The subsoil had an irregular, uneven surface, due apparently to both intrusion by pit features and to natural depressions created by tree throws and rodent disturbance.

Gramly's 1981 excavation on the western edge of the site adjacent to the stream recorded a different stratigraphy. The lower 80 cm were below the water table and sterile deposits were reached at one meter. The uppermost strata, reaching a maximum depth of 40 cm, is a loose brown soil containing Late Archaic and Historic artifacts. Gramly identifies this as slopewash that accumulated after historical period cultivation of the area began. Beneath the slopewash was a layer of "very dark gray or black, peaty A soil" (Gramly 1983:130), averaging 40 cm thick and containing Woodland period artifacts. Beneath the peaty soil was a layer of "grayish brown silty sands – apparently lake or stream deposits. Capping this zone was a 10 cm layer of flat limestone pebbles intermixed with large animal bone fragments and Late Archaic artifacts. The black peaty zone "...lay unconformably upon this shingle or rubble. The rubble appears to be a lag deposit minus fines which had been removed by waves and currents" (Gramly 1983:136).

The 1981 test excavation by the Buffalo Museum of Science (Gramly 1983) recovered 700 artifacts, including a small number of historic period artifacts from the uppermost layer. Woodland period artifacts from the dark gray silty sand include Levanna and Jack's Reef points and 142 potsherds, only three of which could be identified; these include one Jack's Reef Corded, one Point Peninsula Corded, and a third sherd with a "coarse cord-malleated exterior with horizontal and oblique cord impressions" (Gramly 1983:133). Gramly attributes this strata to the Kipp Island to early Owasco phases (c. seventh-tenth century A.D). Butternut (*Juglans*), wild cherry (*Prunus*), plum (*Prunus*), and arrowwood pits, as well as twigs, branches, and roots, were found in this level (Gramly 1983:133). Additional artifacts were found during the 1987 excavations but have not yet been studied.

Zooarchaeology

Buffalo Museum of Science Faunal Assemblage

The entire faunal assemblage contains 10,808 specimens. Based on stratigraphic information and associated artifacts, bones were divided into four temporal groups: Late Archaic, Woodland, Mixed, and Unprovenienced. The last group includes all teeth from the 1981 excavation, which had been accidentally combined in the same bag during initial processing (see Gramly 1983), and a small number of other specimens. The Late Archaic sample was chosen for the most detailed analysis. All minimally identifiable bones were measured and checked for modification marks using a 10x hand lens. All medium mammal long bone fragments were also measured and examined for marks. Minimally identifiable bones from the other time periods were examined using the same methods as for the Late Archaic, with the exception that medium mammal long bones were not measured or examined for marks. Unidentifiable bones from all contexts were counted and checked for burning.

The greatest number of bones, 8,076, date to the Woodland period; 1,298 are attributed to the Late Archaic; 1,217 are from mixed levels; and 217 are unprovenienced. A total of 21 taxa were identified from all levels. These include three reptiles, five birds, and 13 mammal species. Only one taxa, the domestic dog (*Canis familiaris*) was found exclusively in the unprovenienced sample, where it is represented by a single tooth. Many bones could only be tentatively assigned to a specific taxa. These are indicated by a "cf." designation in Table 1, but are combined with the more firmly identified bones in the text.

White-tailed deer is easily the most abundant animal in the assemblage, and the vast majority of bones identified as medium mammal are almost certainly also from deer. Therefore, in the following discussion, identified medium mammal axial bones are combined with the deer bones for the study of skeletal part profiles. Skeletal part profiles were quantified using Number of Identified Specimens (NISP), Minimum Number of Individuals (MNI), Minimum Number of Elements (MNE), and Minimum Animal Units (MAU). MNE is determined for each element without regard to side. For example, an assemblage with five left distal humeri and four right distal humeri would have an MNE of nine. MNE was also determined for long bone segments (proximal, distal, or shaft). A complete humerus, for example, would be recorded as one proximal, one distal, and one shaft segment. In fact, there were no complete deer long bones in any of the assemblages, and the humerus is the only long bone for which some specimens retained both one epiphysis and part of the shaft. MAU is calculated by dividing the MNE for each element by the number of that element in a single carcass. For example, humeri and other long bones would be divided by two because each animal has a left and a right of each long bone, but deer first phalanx MNE would be divided by eight, because each of the four limbs has two first phalanges.

Deer bones provide limited evidence for seasonality. Three antler fragments and two frontals came from the Woodland context, but the antlers do not provide any definitive information on seasonality. Both of the Woodland frontals have pedicles, but because of severe surface abrasion, it is not possible to say with certainty whether the antlers had been shed. Epiphyseal fusion data (Table 2) indicate an emphasis on yearling and adult deer, although three unfused second phalanges indicate at least one deer younger than five to eight months old, most likely indicating a summer-fall death.

Late Archaic Sample

The Late Archaic assemblage contains 16 taxa. Of these, deer is by far the most common species, represented by 188 of the 385 identifiable bones and at least eight individuals. The next most common species is turkey, with five bones and at least two individuals. No other species has more than two specimens or one individual. Species found in Late Archaic but not later contexts are possible blue-winged teal, possible wolf, lynx or bobcat, striped skunk, and muskrat. The Late Archaic Table 1. Lamoka Lake Animal Bone From the Buffalo Museum of Science Excavations. Number of Identified Specimens (NISP) and Minimum Number of Individuals (MNI) of Taxa by Chronological Period.

			12										
_		Late A	rchaic	Mixed		Woodland		No Provenience		Total and Percent			
Taxon	Common Name	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MN1		NISP	N	INI
Sternotherus odoratus	common musk turtle	1	1			2	1			3	0.12%	2	3.03%
cf. S. odoratus	cf. common musk turtle					1				1	0.04%		
Terrapene carolina	common box turtle	2	1	1	1	2	1			5	0.20%	3	4.55%
	turtle	6		8		22				36	1.43%		
	snakes			1	1	1	1			2	0.08%	2	3.03%
	vipers	1	1							1	0.04%	1	1.52%
Nycticorax nycticorax	black-crowned night-heron			1	1			1		1	0.04%	1	1.52%
Anas cf. discors	cf. Blue-winged teal	1	1							1	0.04%	1	1.52%
Bonasa umbellus	ruffed grouse			2	1					2	0.08%	1	1.52%
Meleagris gallogavo	turkey	5	2	1	1	1	1			7	0.28%	4	6.06%
Ectopistes migratorius	passenger pigeon			2	1					2	0.08%	1	1.52%
	bird					12				12	0.48%		
	large bird	1								1	0.04%		
	medium bird					1				1	0.04%		
Canis familiaris	dog							1	1	1	0.04%	1	1.52%
cf. Canis lupus	cf. wolf	1	1							1	0.04%	1	1.52%
cf. Urocyon cineroeoargentus	cf. gray fox					1	1			1	0.04%	1	1.52%
Vulpes/Urocyon	red or gray fox					1		1	1	2	0.08%	1	1.52%
cf. Vulpes/Urocyon	cf. red or gray fox	1	1					2140		1	0.04%	1	1.52%
Lynx sp.	lynx or bobcat	2	1							2	0.08%	1	1.52%
Mephitis mephitis	striped skunk	2	1							2	0.08%	1	1.52%
Procyon lotor	raccoon	2	1			4	1	1	1	7	0.28%	3	4.55%
Ursus americanus	black bear	2	1	1	Ι	5	1			8	0.32%	3	4.55%
cf. U. americanus	cf. black beer			1		1				2	0.08%		
	carnivore	1				1				2	0.08%		
	cervid	4		3		11		1		19	0.76%		
Cervus canadensis	wapiti					3	1	2	1	5	0.20%	2	3.03%
cf. C. canadensis	cf. wapiti	2				1		0.000		3	0.12%		
Odocoileus virginianus	white-tailed deer	172	8	104	4	482	12	128	4	886	35.28%	28	42.42%
cf. O. virginianus	cf. white-tailed deer	16	97.0	1		17		COLUMN COLUMN	2	34	1.35%		
0	rodent					1		1		2	0.08%		
Castor canadensis	beaver	1	1			1	1	3	1	5	0.20%	3	4.55%
Marmota monax	woodchuck	1	1			6	1			7	0.28%	2	3.03%
cf. M. monax	cf. woodchuck	1	877 () 							1	0.04%		
Ondatra zibethicaus	muskrat	1	1							1	0.04%	1	1.52%
Sciurus sp.	tree squirrel		150			2	1			2	0.08%	1	1.52%
Sector of Pr	large mammal	3				1				4	0.16%		
	medium mammal	96		191		992		15		1294	51.53%		
	small mammal	2		1		5				8	0.32%		
	indeterminate Mammal	58		2		30		46		136	5 42%		
	Total Identifiable	385	23	318	10	1609	24	199	9	2511	100.00%	66	100%
	Not Identifiable	913		899		6467		18	8	8297			
	Grand Total	1298		1217		8076		217		10808			

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Element		Late Archaic		Mixed		Wood	Minimum	
	Epiphysis	Total	Fused	Total	Fused	Total	Fused	Age
Humerus	Distal	8	100.0%	2	100.0%	8	100.0%	2-8 mo
Radius	Proximal	1	100.0%	3	100.0%	6	100.0%	2-5 mo
2nd Phalanx	Proximal	7	100.0%	2	100.0%	11	72.7%	5-8 mo
1st Phalanx	Proximal	4	75.0%	4	100.0%	10	70.0%	11 mo
Tibia	Distal	0		1	0.0%	5	40.0%	17 mo
Femur	Proximal	3	33.3%	1	0.0%	3	0.0%	20 mo
All Metapodials	Distal	3	0.0%	1	0.0%	9	88.9%	20-23 mo
Radius	Distal	1	0.0%	2	0.0%	3	33.3%	20-29 mo
Femur	Distal	0		0		7	42.9%	23-29 mo
Tibia	Proximal	0		0		3	66.7%	23-29 mo

Table 2. Lamoka Lake Animal Bone from the Buffalo Museum of Science Excavations. Summary of Epiphyseal Fusion of Deer Bone. Total = the total number of specimens with data on epiphyseal fusion. Fused = the percentage of the total number of elements that were completely fused.

fauna are discussed in more detail and compared with other Late Archaic fauna from Lamoka Lake in a separate report (Madrigal 1999).

Woodland Sample

Of the 8,076 Woodland specimens, 1,609, comprising 13 taxa, were minimally identifiable (Table 1). Once again, deer is the most common species, with 499 specimens and at least 12 individuals. In contrast to the Late Archaic sample, wood-chuck (NISP=6), bear (NISP=6), and raccoon (NISP=4) are the next most common species, although no taxa other than deer has an MNI greater than one. Three of the woodchuck bones (a complete cranium, a scapula, and a cervical vertebra) are stained differently than the other bones, and this, together with their completeness and better preservation, suggest that they result from a relatively recent natural death and not the result of Woodland period occupation. Ruffed grouse and tree squirrel were found only in the Woodland assemblage. Other species found in the Woodland assemblages are musk turtle, box turtle, snake, turkey, fox, wapiti, and beaver.

Mixed Sample

The Mixed sample is similar to the Late Archaic one, although it contains two species not found in the Late Archaic sample: passenger pigeon and black-crowned night heron. There are 105 deer bones, but passenger pigeon is the only other species represented by more than one identified bone.

Unprovenienced Sample

The unprovenienced sample contains mostly loose teeth; of these, the majority (128 of 217) are deer. Dog, raccoon, fox,

Taphonomy

made when relevant.

Abundant actualistic and experimental research has convincingly demonstrated that all bones are affected by a series of taphonomic processes from the time an animal dies until its bones are analyzed by the zooarchaeologist (Binford 1981; Brain 1981; Lyman 1994). At each stage, taphonomic agents, such as weathering, consumption by carnivores, and butchering, can modify, delete, destroy, or add to the faunal assemblage. Therefore, a taphonomically informed analysis is essential to any study of archaeological faunal remains in order to correctly understand the processes by which bones are introduced to a site, modified, and differentially destroyed or preserved, and to determine more precisely which characteristics of faunal assemblages are directly attributed to human activity. Failure to identify how non-human taphonomic factors have affected an assemblage means that it will be impossible to identify specific human behaviors that have patterned an assemblage.

wapiti, and beaver were also identified. The remainder of this article focuses on the Woodland assemblage, although com-

parisons with the Late Archaic and the Mixed samples will be

All sediment from the Buffalo Museum of Science (BMS) excavations was screened using 1/4 in mesh, and all bone was saved. No flotation analysis was conducted during these excavations, so small animal remains are expected to be severely underrepresented. In fact, no fish bones are present in this assemblage, and small birds and mammals are very rare. Fish and other small bones were found, however, in a Late Archaic assemblage from a different part of the site that was excavated using identical techniques (Madrigal 1999). This suggests that the complete absence of fish remains and the paucity of

other small animal remains in the assemblage is not solely a result of excavation techniques. Many very small bone fragments are present, but these are mainly unidentifiable fragments of larger mammal bones. As discussed below, the specific characteristics of the BMS sample are more readily explained by other taphonomic processes.

Based on experimental and actualistic research, Marean (1991) has suggested that the amount of post-depositional fragmentation that a faunal assemblage has undergone can be estimated by recording the relative completeness of carpals and tarsals, which are relatively dense and are unlikely to be intentionally broken by humans. The Completeness Index (CI) is determined by "estimating the fraction of the original compact bone that is present, summing the values, and dividing by the total number of specimens" (Marean 1991:685). A high CI value does not preclude earlier carnivore ravaging of podials, nor can it be used to argue that the abundance of podials accurately represents the original assemblage deposited by humans; the use of the CI is based on the observation that while carnivores often destroy podials, those that survive ravaging are relatively complete (Marean 1991). The BMS assemblages have greater evidence of post- depositional fragmentation than do the other Lamoka assemblages (Madrigal 1999). The Mixed group has the lowest CI value (60.7%), while the Archaic (71.8%) and Woodland (70.5%) samples are slightly less fragmented. The Mixed levels appear to have been redeposited as slopewash (Gramly 1983), which may help explain its slightly lower CI value.

Several taphonomic processes, including weathering, trampling, and abrasion, can affect bones after they are discarded by humans and carnivores, but before they become buried. Bone weathering is rare, with over 96% of all bones being unweathered. Rodent gnawing is virtually non-existent, with only two specimens from the Woodland assemblage having rodent tooth marks. Only two trampling marks were identified, and these could have been caused by the movement of gravel across bone surfaces by fluvial action.

In contrast, surface abrasion, resulting in a rough (not polished) texture over the surface of most or all of the bone, is common in all contexts. It is most common in the Archaic period sample, where over three-fourths (78.8%) of examined bones have some abrasion, with moderate to heavy abrasion found on about one-third of all bones. While 70.7% of the Woodland sample are abraded, only 53.1% of the Mixed sample are similarly affected. Trampling, fluvial action, and eolian activity may all cause bone surface abrasion, but fluvial action seems to be the most likely candidate for causing the modification seen in this assemblage, especially given the context from which the bones were recovered. Abrasion is not limited to a single surface, as would be expected with eolian activity, and almost no trample marks were identified on any of the bones. Abrasion is caused by the impact of sedimentary particles carried by the water on the bone surface; however, it is also possible that some of the modification of bone surface texture may be due in part to the bones being buried in a wetter, less-well-drained sediment than were bones in the main site. The surface abrasion is likely to have destroyed most bone modification marks (Shipman and Rose 1983).

In addition to abrading bone surfaces, water can transport certain bones away from a site, or cause bones to accumulate at another site. Beginning with Voorhie's (1969) experimental study of water transport of sheep and coyote skeletons, many archaeologists and paleontologists have studied the differential transport of skeletal elements by water (Behrensmeyer 1975; Korth 1979; Boaz 1982; Frison and Todd 1986; Coard and Dennell 1995). Voorhie's original study (1969) found that ribs, vertebrae, sacrum, and sternum are readily transported by water, while the skull and mandible are more resistant to transport and form a lag deposit. Other bones are intermediate in their susceptibility to transport. There are several problems with applying this and other studies to the BMS assemblage. First, while experimental studies deal with complete elements, virtually all of the Lamoka bones are fragmented. Differences in the size, weight, and shape of specimens between whole and fragmented elements will affect transport potential, so that, for example, a distal humerus fragment cannot necessarily be expected to be as susceptible to fluvial transport as a complete humerus. Secondly, experimental studies generally deal only with intrataxonomic, not intertaxonomic, variation in transport potential. The near-absence of small animal remains in the BMS assemblage may be due to the winnowing of smaller, lighter bones (including small mammal, bird, and fish) by fluvial action. Nevertheless, because it is not clear exactly how the bones of different sized animals are affected by water, a different depositional pattern between near-stream and main site contexts - such that only deer and a few medium-sized mammals were discarded near the stream - cannot be ruled out. Finally, Behrensmeyer (1975) and others (Lyman 1994:172) have noted that the Voorhies groups are related to the structural density of bones, with the most easily transported bones (ribs and vertebrae) also being the elements most susceptible to density-dependent destruction. Therefore, in a situation like Lamoka Lake, where it cannot be assumed that complete, unmodified skeletons were discarded intact, the relative abundance of different elements cannot be used, by itself, to distinguish between fluvial dispersal and other density-dependent patterning, such as carnivore scavenging.

There is scarce but definite evidence for carnivore activity on white-tailed deer bones. While only eleven deer bones exhibit carnivore tooth marks (Table 3), it is likely that many less conspicuous tooth marks were destroyed by the subse-

Table 3. Woodland Period BMS deer bones with at least one carnivore tooth mark. N = number of bones with at least one carnivore tooth mark/total number of bones examined.

Element	N	Percent
Astragalus	2/33	6.1 %
Calcaneum	3/21	14.3%
Humerus	2/36	5.6%
Innominate	3/7	42.9%
Mandible	1/1	100.0%

a. BMS Woodland Deer and Medium Mammal



b. BMS Woodland Deer Long Bone Epiphyses

quent abrasion of the bone surfaces. Neotaphonomic studies indicate that several taphonomic processes, including carnivore gnawing and consumption of bone, are mediated by the structural density of bone parts. In general, less dense bones or bone parts are more prone to destruction. There is, however, no significant correlation (rp=0.03, p=0.886) between deer volume density (Lyman 1984) and deer and medium mammal MNE counts (Table 4, Figure 1a), suggesting that carnivore scavenging of deer bones did not play an important role in the formation of this faunal assemblage. A closer look at deer long bones provides further insight.

Marean and colleagues (Marean and Spencer 1991; Marean et al. 1992) have recently demonstrated experimentally that long bone epiphyses and axial elements are preferentially destroyed by scavenging hyenas, but long bone midshaft fragments will preserve nearly 100% of the original number of elements. Assuming that other carnivores, such as dogs, behave similarly, examination of long bone shaft fragments may therefore provide a more accurate record of the relative frequency of elements discarded by humans than do epiphyses. Because long bone shaft fragments are so important, a deliberate effort was made to identify as many of these shaft fragments as possible as to element. Although the sample size is small, there is a strongly negative but insignificant correlation between the Woodland period long bone shafts and volume density (rp=-0.42, p=0.483; Figure 1b). In contrast, a correlation using only long bone epiphyses and volume density



Figure 1. a. Comparison of Volume Density (VD) and Minimum Number of Elements (MNE) for Woodland period deer and medium mammal bone from the Buffalo Museum of Science Lamoka Lake Site faunal assemblage; b. Comparison of Volume Density (VD) and Minimum Number of Elements (MNE) for Woodland period deer long bone epiphyses from the Buffalo Museum of Science Lamoka Lake Site faunal assemblage; c. Comparison of Volume Density (VD) and Minimum Number of Elements (MNE) for Woodland period deer long bone shafts from the Buffalo Museum of Science Lamoka Lake Site faunal assemblage.

Table 4. Lamoka Lake Animal Bone From the Buffalo Museum of Science Excavations. Summary of Deer and MediumMammal in Terms of Number of Identified Specimens (NISP), Minimum Number of Elements (MNE), and Minimum AnimalUnits (MAU). *px=proximal, sh=shaft, di=distal. **Rib, cervical, thoracic, and lumbar values are for medium mammals.***VD=Volume density. Volume density and scan site from Lyman (1984).

	BMS Late Archaic				BMS Mix		BM	BMS Woodland			
Element	NISP	MNE	MAU	NISP	MNE	MAU	NISP	MNE	MAU	VD	Scan site
Scapula	15	10	5	1	1	0.5	3	2	1	0.36	SP1
Humerus, px	0	0	0	0	0	0	3	2	1	0.24	HU1
Humerus, di	11	. 11	5.5	4	2	1	28	14	7	0.63	HU4
Humerus, sh	4	3	1.5	1	1	0.5	5	2	1	0.53	HU3
Radius, px	1	1	0.5	3	3	1.5	7	5	2.5	0.42	RA1
Radius, di	3	3	1.5	2	2	1	3	3	1.5	0.43	RA5
Radius, sh	3	3	1.5	0	0	0	3	1	0.5	0.68	RA3
Ulna, px	1	1	0.5	2	2	1	12	7	3.5	0.45	UL2
Ulna, di	0	0	0	0	0	0	0	0	0	0.44	UL3
Ulna, sh	0	0	0	1	1	0.5	1	1	0.5	0.45	UL3
Metacarpal, px	6	5	2.5	2	1	0.5	6	6	3	0.56	MCI
Metacarpal, di	0	0	0	0	0	0	1	1	0.5	0.51	MC6
Metacarpal, sh	5	1	0.5	3	1	0.5	13	1	0.5	0.72	MC3
Carpals	10	4	2	6	2	1	35	8	4	0.98	Scaphoid
Femur, px	6	3	1.5	1	1	0.5	4	3	1.5	0.41	FE1
Femur, di	2	1	0.5	1	1	0.5	7	6	3	0.28	FE6
Femur, sh	1	1	0.5	3	1	0.5	7	3	1.5	0.57	FE4
Tibia, px	0	0	0	0	0	0	4	2	1	0.3	TI1
Tibia, di	0	0	0	0	0	0	12	9	4.5	0.5	TI5
Tibia, sh	1	1	0.5	2	2	1	2	1	0.5	0.74	TI3
Fibula	1	1	0.5	4	4	2	10	10	5		
Metatarsal, px	3	2	1	0	0	0	10	7	3.5	0.55	MR1
Metatarsal, di	0	0	0	0	0	0	0	0	0	0.5	MR6
Metatarsal, sh	6	1	0.5	10	1	0.5	26	1	0.5	0.74	MR3
Patella	0	0	0	0	0	0	2	2	1	0.31	PA1
Astragalus	19	15	7.5	13	6	3	33	23	11.5	0.47	AS1
Calcaneum	7	4	2	5	4	2	21	14	7	0.33	CA4
Other tarsals	4	4	2	6	3	1.5	15	7	3.5	0.33	NC2
First phalanx	9	5	0.63	8	4	0.5	25	12	1.5	0.36	P11
Second phalanx	12	8	1	4	3	0.38	16	10	1.25	0.25	P22
Third phalanx	3	3	0.38	2	2	0.25	13	8	1	0.25	P31
First phalanx of	3	3	0.38	2	2	0.25	2	2	0.25		
Second phalanx of	0	0	0	1	1	0.13	3	3	0.38		
Third phalanx of the styliform bone	0.	0	0	0	0	0	0	4	0.5		
Innominate	1	1	0.5	1	1	0.5	7	5	2.5	0.27	AC1
Atlas	Ô	Ô	0.0	2	2	2	0	0	0	0.15	AT1
Axis	1	1	1	õ	õ	õ	2	2	2	0.16	AX1 3
Mandible	2	1	0.5	0	Õ	õ	1	1	0.5	0.57	DE2.4.5
Cranial	3	2	1	0	0	0	6	3	1.5	0.01	DDD, 1, 5
Rib	4	1	0.04	2	1	0.04	15	3	0.12	0.25	R13
Cervical	1	1	0.2	0	Ô	0	3	1	0.2	0.15	CE1
Thoracic	1	1	0.08	0	0	õ	1	1	0.08	0.24	TH2
Lumbar	0	Ô	0	4	1	0.17	21	5	0.83	0.29	LU2

results in a strongly positive but insignificant correlation $(r_p=0.48, p=0.451;$ Figure 1c). These results indicate that some density-dependent patterning is present in the assemblage, but long bone shaft fragments do not appear to have been affected by this. The causes of the patterning seen in these assemblages cannot be ascertained solely through these correlations, but the differential representation of less dense epiphyses is most likely due to some combination of carnivore scavenging and fluvial transport.

Zooarchaeologists have often tried to explore hunter-gatherer transport and processing decisions by correlating skeletal element frequencies with indices of the economic utility of carcass parts (Binford 1978; Speth 1983; Metcalfe and Jones 1988; O'Connell and Marshall 1989). Plotting element frequency by utility should result in different utility curves (Binford 1978) that may be indicative of different exploitation and transport strategies. Because long bone shaft fragments from the BMS assemblage were identified as to element and used with epiphyses to calculate MAU values, the resulting skeletal part profile should be relatively immune to the effects of density-mediated attrition of skeletal elements that can affect skeletal part representation, and consequently, the shape of utility curves (Grayson 1989).

Deer whole-bone element MAU were compared to experimentally derived average net (Kcal/hour) meat and marrow yields (Figure 2a-b). Marrow net yields are based on an average of six modern deer killed in New Jersey (Madrigal and Capaldo 1999; Madrigal and Holt n.d.), while meat yield is based on the average of three deer (Madrigal and Holt n.d.). There is a strong positive correlation, significant at the 10% level, between marrow net yield and whole-bone MAU (r_p =0.60, p=0.09), but meat net yield is negatively correlated with deer MAU (r_p =-0.23, p=0.49). These results provide no evidence for the preferential transport and discard of high-ranking meat cuts at this site. Instead, it seems more likely that entire deer carcasses were transported to the site. The strong correlation with marrow net yields suggests that deer element abundances at the site are more indicative of processing techniques, specifically hammerstone fracture of long bones for marrow removal, than they are of any transport decisions.

Stone tool cut marks and hammerstone percussion marks (Blumenschine and Selvaggio 1988) can provide additional information on the butchery techniques used, but unfortunately they are rare on these bones, presumably because of the surface abrasion on most bone surfaces. Eight deer bones and two medium mammal rib bones have cut marks. Cut marks are found on two humeri and on one each – radius, femur, fibula, innominate, metatarsal, astragalus, and occipital condyle. Percussion marks are found on two femur shaft fragments, one metatarsal shaft fragment, and one medium mammal dentary fragment.





Discussion

The Buffalo Museum of Science assemblage is less well preserved than any of the other Lamoka assemblages studied (Madrigal 1999), and many bones have some degree of surface abrasion. There are many large bone fragments, and the assemblage is dominated by deer. Fluvial action has modified the surfaces of deer bones (making them less useful for modification mark studies), and perhaps removed some small deer elements. Fluvial activity may have also preferentially removed or destroyed many small animal bones, although different depositional patterns by humans and natural processes cannot be ruled out. Both species representation and deer skeletal part profiles have been affected by fluvial action and carnivore scavenging. While there is no evidence for differential transport of deer body parts to the site, long bones with higher marrow net yields appear to have been broken open more often than those bones with lower marrow yields. At a minimum, the site was occupied at least during part of the summer or fall, based on epiphyseal fusion data. While deer appear to have been a very important food source during the Woodland period at Lamoka Lake, it is not possible, using only this assemblage, to evaluate the importance of birds, fish, or small mammals.

Preserved animal bones from Woodland contexts are relatively rare in central New York and the Woodland assemblage from Lamoka Lake is one of the larger ones known. Animal bones from two other important Woodland sites in central New York have been studied by John Guilday. The Kipp Island Site is located on a drumlin in Montezuma Marsh in Seneca County. Animal bone was found in both pit features and in the marsh adjacent to living areas. Fish bones and scales were found mainly in pits, while most large mammal bone was found in the marsh, not in pits. Guilday identified 4,613 specimens and 30 species (Ritchie 1969:242-243). Bullhead catfish were the most common taxa, represented by 1,100 specimens and at least 411 individuals. A total of 741 deer bones from at least 22 individuals was also found. Other fish identified include channel catfish, walleye, northern pike, bass, and sucker. Other species identified at Kipp Island include frog, turtle, Canada goose, merganser, turkey, dog, bear, and elk. Deer bones were poorly preserved and no bone modification marks were identified (Ritchie 1969). The bone assemblage from the marsh may represent a depositional pattern similar to that of Lamoka Lake.

The Westheimer Site is located near Schoharie on Fox Creek. Bone found in stratum 3, locus 1, dating to the Woodland period was identified by John Guilday (Ritchie and Funk 1973:149). A total of 7,441 bones from at least 62 individuals was recovered. All bone was poorly preserved and fragmentary. Deer, represented by 4,567 bones and at least 49 individuals, was the most abundant animal. Based on their size, an additional 2,812 unidentified bones are probably also from deer. Other animals include moose, bear, fox, wolf, lynx or bobcat, beaver, porcupine, box turtle, painted turtle, and rattlesnake. Among deer bones, astragali are most common, followed by mandibles or teeth. Most bones had a limey coating, but seven cut marks were identified on astragali. The presence of both attached and recently shed antlers indicate a fall or winter occupation. Five fawns were identified; four of these were over six months old, while one was only one month-old. The latter indicates a summer death. Some fish vertebrae were found at the site, but they were not studied by Guilday.

The Lamoka Lake Woodland assemblage discussed here appears similar to those of the Kipp Island and Westheimer sites in that deer is very abundant. Unlike Kipp Island, no fish bones were found at Lamoka, but this may be due to the fact that no Woodland period features were excavated at Lamoka. Very little information was provided on skeletal part profiles of deer from either Kipp Island or Westheimer, so it is not possible to compare the Lamoka deer bone sample to those from other Woodland sites. However, based on this analysis, the Lamoka and Kipp Island sites seem to have similar depositional patterns, with large mammal bones deposited in or near the water, away from the main living areas. Both the Westheimer bones and those Kipp Island bones from the marsh have probably also suffered taphonomic attrition similar to that seen at Lamoka Lake.

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