

USING PROTEIN RESIDUE ANALYSIS AND OTHER METHODS TO DETERMINE
SCRAPER FUNCTION AND BISON INFLUENCE AT LA CROSSE LOCALITY SITES IN
SOUTHWESTERN WISCONSIN

By

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University of Wisconsin-La Crosse, 2010

A recurring question concerning Oneota archaeology at the La Crosse locality of southwestern Wisconsin is how bison scapulas are procured. More directly, do the scapulas and other bison skeletal elements found at La Crosse locality sites indicate seasonal hunting of bison, or simply the trading for scapulas to use as hoes? A second question often asked concerning this subject is whether or not the abundance of scrapers found at La Crosse locality sites indicates the processing of bison hides. This paper attempts to explore such questions through three methods. These methods include an adapted version of Binford's modified general utility index, scraper-to-point ratios, and protein residue analysis on lithic tools found at the Northern Engraving site (47Lc164), an Oneota site in La Crosse county, Wisconsin.

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INTRODUCTION

Investigations into the Oneota culture of western Wisconsin have led archaeologists to a clearer understanding of Oneota lifeways. Ceramic and subsistence studies have traditionally been the focus of Oneota research, mostly because of the ubiquity of each recovered at sites. While these areas of research have produced extensive and well-supported theories concerning Oneota cultural practices, other areas are lacking.

This paper intends to explore a concept of the Oneota at the La Crosse locality of western Wisconsin that has conventionally been difficult to understand. Bison scapulas found at La Crosse locality sites have a well-documented history as tools used for the cultivation and growing of maize, a staple of the Oneota diet. Beyond these well-supported finds however, lies the difficult question of whether or not bison had any further role within this culture. This question is spurred on by the recovery of bison remains (albeit few) at La Crosse locality sites that are not bison scapulas.

The recovery of such bison elements further ignites more specific questions concerning the Oneota and bison. Were these peoples conducting seasonal hunts of bison for subsistence as well as for the acquisition of scapulas for tools? Are the scapula bone hoe tools found at Oneota sites strictly a trade item? Does the increased amount of scrapers recovered at La Crosse locality sites signify the processing of acquired bison remains, specifically bison hides?

These questions concerning the Oneota and bison are difficult to answer through conventional archaeological faunal analysis. Therefore this paper attacks the question through a method that is relatively new to the archaeological domain. The method, protein residue

analysis, is one that allows for a direct link between an artifact and the materials on which it was used. The emphasis of this paper is on results from protein residue analysis conducted on fourteen lithic tools recovered at the Northern Engraving site (47Lc164) of the La Crosse locality. Grant money supplied by the Undergraduate Research and Creativity Foundation at the University of Wisconsin-La Crosse was used for the expenses in this analysis.

An Oneota site where known bison hunting occurred will also be explored in comparison to La Crosse locality sites. The site investigated in this paper is the Dixon site (13WD8) of Iowa. Targeted in this comparison is the presence or absence of specific bison elements. Binford's (1978) general utility index will be used to identify any correlations amongst elements present, specially targeting the amount of usable meat, bone grease, and marrow. Correlations between the sites are also explored through scraper-to-point ratios. Finally, cave drawings in the La Crosse locality that date to the Oneota time period are explored. Specifically, drawings and etchings of bison are inspected to provide the reader with an understanding of the link that the Oneota had with bison, and perhaps the western prairie.

BACKGROUND

Protein Residue Analysis

Prior to 1990, researchers began using a specific and sensitive enzyme-linked immunosorbent assay (ELISA) with monoclonal antibodies to detect blood in ancient contexts (Cattaneo et al. 1993). This is what would become to be known as "immunological analysis" or protein residue analysis. Testing was first done on human and cattle bone, with positive identifications reaching as far back as the Bronze Age. Since this time, protein residue analysis has not only been experimented with (Cattaneo et al. 1993), but also used to as a source of information in the

archaeological record (Loy and Wood 1989; Hyland et al 1990; Loy 1993; Loy and Dixon 1998). This analysis has proven to hold the potential to examine lithic tools and their direct link to the organic substances being processed.

With its roots dating back to only 1983 (Loy 1983), protein residue analysis is still in its infancy as far as its use as an archaeological tool. In fact, it was not until the late 1980s that experimentation concerning protein residue analysis began in earnest. These experiments gave both hope and skepticism. On one hand, protein residue analysis was able to provide the archaeologist with a direct link between tool usage and substance processing that had not existed before. However on the other hand, some experimentation was displaying the erratic nature of blood preservation, along with a failure to positively identify the correct blood type (Cattaneo 1993).

The skepticism concerning protein residue analysis does not necessarily originate from whether or not a specific type of hemoglobin can be detected, but why or how it is detected. For example, in the Downs and Lowenstein (1995) experiment they found while that all modern residue blind tests recorded zero negative results using three different forms of immunologic techniques, only six of the thirty archaeological specimens returned a positive result. Apart from this low positive result number (20%), none of the positive results from the three techniques were able to support each other, and thus unable to confirm whether or not the positive result was accurate. It is experiments like this that have led to skepticism about the use of protein residue analysis. Those opposing the critics point out that modern experiments that try to replicate prehistoric situations duplicate neither the processes or conditions that prevail on archaeological sites, nor the passage of time (Odell 2004). Meanwhile, other studies have found promising results.

For example, work with protein residue on lithic tools has proven successful in several studies (Gerlach et al. 1996; Loy 1998; Seeman et al. 1998). In these cases the researcher was able to identify and correlate species of animals with lithic tools. These studies are able to show the potential that protein residue analysis can offer the archaeological community. Even though it has been suggested that this type of analysis can never be more than complementary in archaeological research (Banard et al. 2007), it has proven successful in multiple instances. The site that has been chosen for protein residue analysis in this paper is the Northern Engraving site (47Lc164) of the La Crosse locality.

The Northern Engraving Site (47LC164)

The Northern Engraving site (47Lc164) is a part of the Sand Lake Archaeological District and is adjacent to the Lower Sand Lake site (Figure 1). Phase III excavations conducted by the Mississippi Valley Archaeology Center (MVAC) and the Archaeological Studies Program of the University of Wisconsin-La Crosse at the Northern Engraving site began in August of 2009 for the proposed Elmwood Meier Farm East Development in Onalaska (Holtz-Leith 2010). The site is located on a high sandy dune and is artificially cut east-to-west by county highway S (Holtz-Leith 2010). Excavation of this site was conducted by University of Wisconsin-La Crosse archaeology students that were overseen by David A. Anderson, PhD. Additional excavation of the site was performed by MVAC's professional crew under the direction of Robert F. Boszhardt and Wendy K. Holtz-Leith.

Excavation of the Northern Engraving site involved mechanically stripping the entire crest of the site. Of the 78 features that were identified through this process, a total of 35 were excavated for material remains. Several of the features have been tentatively dated to phases through diagnostic pottery (See Appendix A for feature descriptions from which lithic tools were

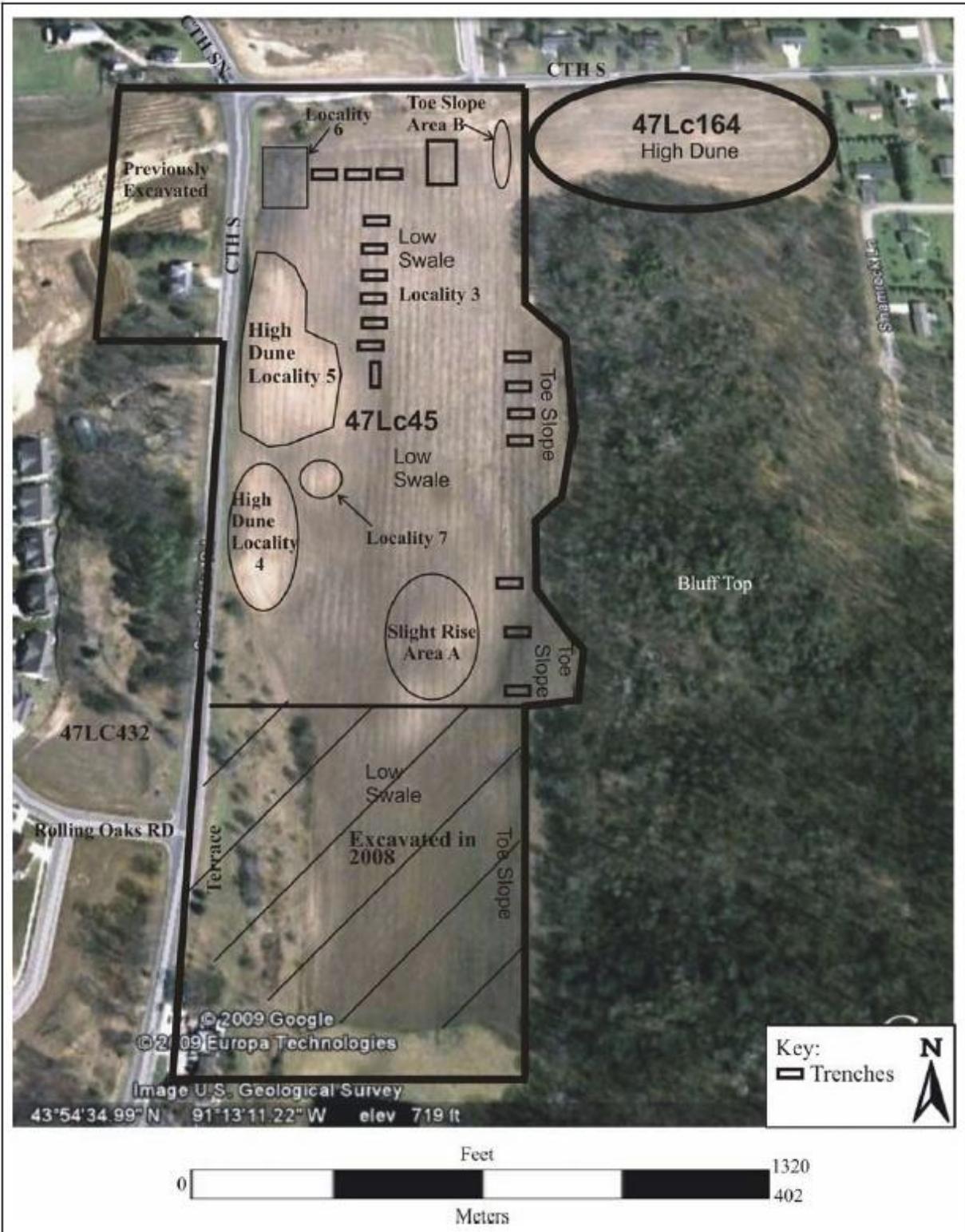


Figure 1. Displays the location of the Northern Engraving site (47Lc164) in reference to the Lower Sand Lake Site (47Lc45) (Holtz-Leith 2010).

selected for analysis). Based on the amount of material remains found at this site, it is suggested that it was located in or near a residential area (Holtz-Leith 2010). It is from this site that lithic tools were chosen to conduct protein residue analysis in order to obtain a more clear understanding of the Oneota.

Previous Oneota Based Research

The term “Oneota” as applied to a group of peoples can first be seen in 1927, when Charles Keyes looked to define cultural remains recovered in northeastern Iowa. He wrote:

... a designation for the culture does appear necessary and for this is suggested “the Oneota.” Oneota is the Indian name for the Upper Iowa River, where culture is most fully represented and has longest been known. This good, original name having been rejected for the river, it may serve here to designate the people that once lived on it [As cited in Sasso 1989:18].

This is not to say that artifacts from Oneota settlements have not been recovered prior to this date. For example, Cyrus Thomas claimed to have found shell tempered pottery located in northeastern Iowa in his work that was published in 1894. He states: “The paste of which this pottery was made had evidently been mixed with pounded shells” (Thomas 1894:104).

Following Keyes however, was the first “realignment” of Oneota terminology in the 1930’s with McKern’s archaeological work in Wisconsin. He believed that artifacts found in Wisconsin were comparable enough to those found by Keyes, and consequently wished to group the two areas together through related foci (Glenn 1974). The term Oneota was once again revisited in 1960 during the Columbia Conference. “Building on the pioneering foundations of Charles R. Keyes, Eliison Orr, Mildred Mott, and W.C. McKern, the Columbia Conference participants... determined that Oneota should be considered a tradition, with Emergent, Developmental, and Classic horizons” (Staeck 1995:3).

Since this time, research concerning the Oneota has heavily focused on three areas: the origins of the tradition, affiliations of Oneota with historic groups, and clarification of regional and chronological variation (Stevenson 1985). Meanwhile, research of the Oneota culture at the La Crosse locality has seen periods of intense interest as well as times of neglect. For example, this area of Wisconsin has seen research conducted by the likes of Lapham, Putnam, Brown, Squire, Sanford, and McKern (Arzigian and Boszhardt 1989). Following McKern however, excavations did not begin intensively again until the 1980s. The totality of these excavations led researchers to recover artifacts spanning a great deal of time and allows us to reconstruct aspects of Oneota culture.

Oneota Culture

Regionally speaking, the Oneota culture was one that covered a massive area of what is now much of the Midwest of the United States. The area that this culture occupied included Illinois, southwestern Michigan, northwestern Indiana, Iowa, Wisconsin, southern Minnesota, northern Missouri, and eastern Nebraska (Berres 2001) (Figure 2). Within this region, time period occupations of the Oneota differ from location to location. An overview however would indicate that the Oneota occupied this territory from approximately A.D. 1150 until after contact with Europeans, and eventually terminated in most areas in the late eighteenth century (Harvey 1979).

The origins of the Oneota is a topic that has been studied thoroughly, although it has not yet been completely agreed upon. For example, Theler and Boszhardt (2006) explore the idea that a “packing threshold” on the land and its resources may have played a critical role in the transition from a Woodland culture to an Oneota culture. Others (Gibbon 1970) have suggested that the transition involved an adaptation to the Neo-Atlantic climatic episode that allowed for a greater exploitation in horticultural resources. However, it was originally suggested by Griffin

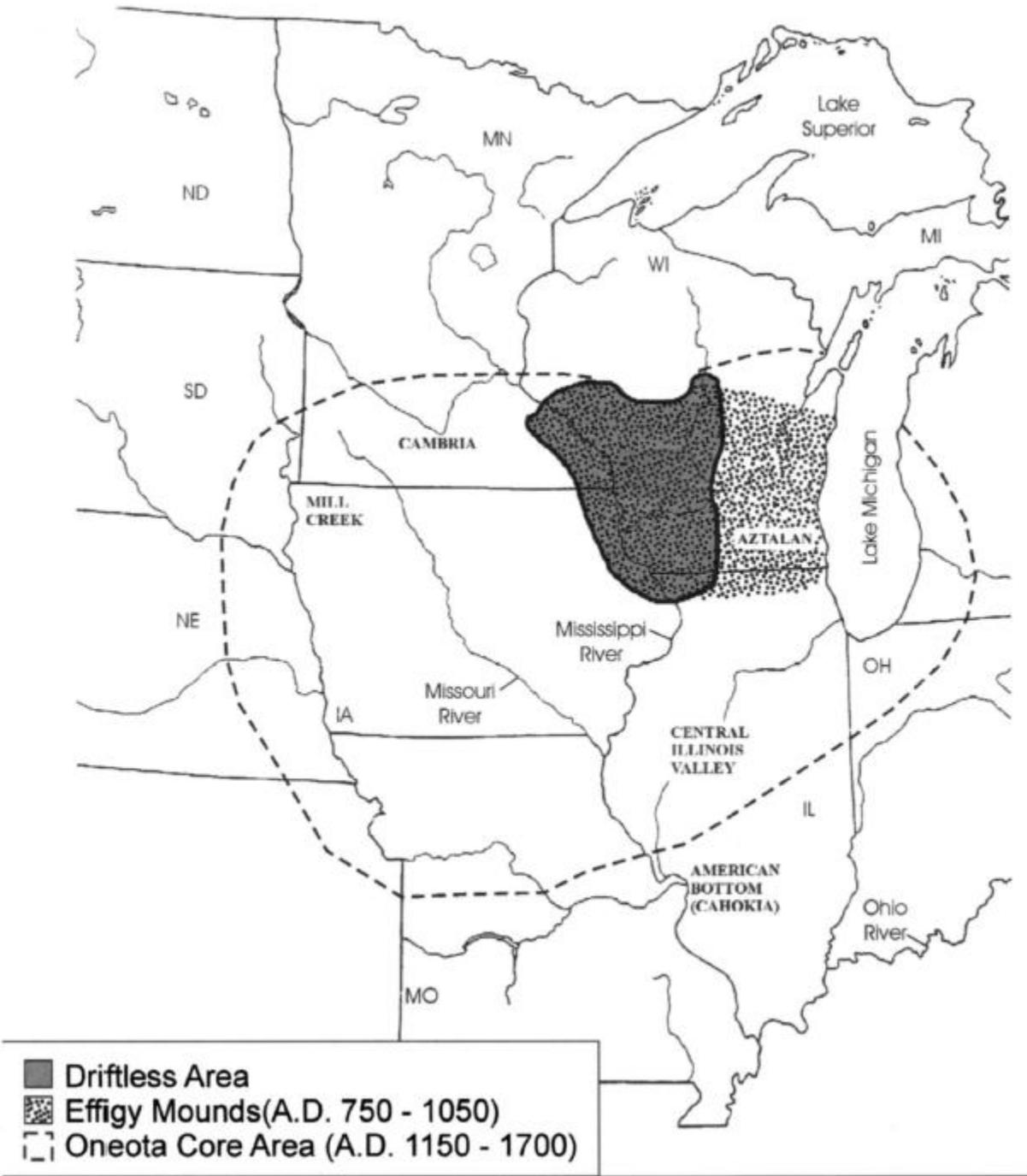


Figure 2. A map displaying the region in which the Oneota occupied (Boszhardt and Theler 2006).

(as cited in Stevenson 1985) that the Oneota derived from pre-existing Middle Mississippian cultures. This idea in particular has received varying degrees of support over the years. Despite the differences of opinion concerning the origins of the Oneota, excavations and the recovery of artifacts has provided more to the discussion than the topic of origins alone.

The Oneota were an agricultural community whose main crops included corn, beans, and squash. Some hunting as well as a reliance on wetland resources was part of the Oneota subsistence pattern (Theler and Boszhardt 2003). Shell tempered pots, sandstone abraders, circular manos, metate grinding stones, celts, bison scapula hoes, sheet copper pendants, and catlinite discs are all part of the artifact assemblage of the Oneota (Theler and Boszhardt 2003). Stone tools were chipped from locally available chert and regionally available silicified sandstone. Other artifacts, such as bison scapula hoes, display more than just an agricultural significance. They show that the Oneota had communications and contact with surroundings groups in the west, and probably hunted bison in the winter (Theler 1989).

The abundance of two types of artifacts, scrapers and projectile points, can help identify the different kinds of activities taking place at a site. Points suggest hunting activities, often at special hunting sites, while scrapers indicate the processing of hides, an activity usually taking place back at base camp locales. It is very possible that the Oneota brought bison hides back to the La Crosse area to use for shelters and other uses, but there would be little archaeological evidence of the hides themselves. However, tools used to work the hides might be able to provide indirect evidence. Scrapers outnumber projectile points in La Crosse Oneota sites and it has been suggested by some that this high frequency of scrapers indicates that bison hides could have been dragged back to La Crosse from winter season hunts in the tall-grass prairies in eastern Minnesota (Theler and Boszhardt 2003).

Oneota at the La Crosse Locality

Established by Boszhardt (1994), and subsequently re-evaluated (Boszhardt 1998), a three phase system within the La Crosse locality for the Oneota culture has been proposed. The three phases include Brice Prairie, Pammel Creek, and Valley View. According to Boszhardt, these phases are based on "...surveys that have established spatial limits for the La Crosse locality, a refined chronology that relies on over 70 radiocarbon dates from local sites, and formal "traits" used to distinguish one phase from another (Boszhardt 1994:173).

Since ceramics have played a large role in the identification of the Oneota tradition from other traditions, it is to no surprise that they would be included in the process of identifying phases at the La Crosse locality. Boszhardt however, also identifies frequencies of lithic raw materials, settlement patterns, and protohistoric artifacts as distinguishing characteristics of the three phases. These sets of data indicate that the three phases in La Crosse occurred roughly from A.D. 1300 to 1625.

Brice Prairie Phase

Sites at the La Crosse locality that fall into the Brice Prairie phase include Brice Prairie, Olson, North Shore, Hartig, Shrake-Gilles, Schoolyard, and Jim Braun. Other sites contain early components that have attributes of this phase, but are not strictly part of this phase. These sites include Midway/Tremaine, area four of Overhead, Gunderson, and to a lesser extent, Sand Lake and Pammel Creek (Boszhardt 1994). Of the 70 radiocarbon dates mentioned from La Crosse locality sites, only three exist for this phase.

Sites dating to the Brice Prairie phase at the La Crosse locality are the earliest known for the Oneota in the region. Ceramics of this phase display inner lip decoration, shoulder motifs often demonstrating punctuate-border elements, and handles that attach to the lip. This style is

known as *Perrot Punctate*, and is the diagnostic ceramic style of the Brice Prairie phase (Boszhardt 1994). Associated with this ceramic style are those that demonstrate a slight difference in shoulder decoration. The three associated types include *Brice Prairie Trailed*, *Brice Prairie (variety festoon)*, and *Brice Prairie Trailed (variety zig zag)*.

Lithic material found at Brice Prairie sites typically consist of Grand Meadow chert and Hixton silicified sandstone. Another raw material, Burlington chert, is found at Brice Prairie sites, and may indicate a direct interaction with Iowa localities via the Mississippi River (Boszhardt 1994). Lithic and ceramic similarities between Brice Prairie and Blue Earth localities in Minnesota also suggest interaction, indicating a possible link to the western prairies and bison locales. Chipped stone artifacts during this phase include unnotched triangular points, end scrapers, and drills.

Pammel Creek Phase

Sandwiched between the Brice Prairie and Valley View phases lies the Pammel Creek phase. Named after the Pammel Creek site, this phase also includes sites such as Overhead, Sand Lake, and some of the Midway and Tremaine sites. During this time, populations moved away from the Mississippi flood plains, and towards the bluffs (Boszhardt 1998). This phase lasts roughly from A.D. 1400 to 1500.

Ceramic styles of the Pammel Creek phase display several distinctions from the previous Brice Prairie phase. For example, shoulder motifs as well as boldly impressed lips defined as a finger or tool notching are characteristic of this phase. A few types of styles of the previous phase do make their way into the Pammel Creek phase, but are extremely rare. It is also noted that some vessels from this phase are exceptionally large (Boszhardt 1998).

Distinctions from the previous phase can also be seen in the lithic raw materials used for tools making. While in the previous phase, Grand Meadow chert and Hixton silicified sandstone were the dominant lithic raw material, the Pammel Creek phase saw a shift towards materials of lesser quality from local sources such as Prairie du Chien chert. Because of this shift, it is suggested by Boszhardt (1994) that a break in the exchange network with Blue Earth locality peoples occurred.

Valley View Phase

The last phase of the Oneota continuity at the La Crosse locality is the Valley View phase. Sites from this phase include Valley View, State Road Coulee and Long Coulee. Other sites that display some components of the Valley View phase include Sand Lake, Midway, Tremaine, and Gunderson. This phase lasts from about A.D. 1500 until 1625, or until the Oneota abandoned the locality. The date A.D. 1625 is attributed to the fact that European trade goods should have been entering the area by this time, and none are seen at Valley View sites.

Diagnostic artifacts of this phase at the La Crosse locality are ceramics that appear to have evolved from the Pammel Creek phase. Ceramics from this phase have finer lip top notching, attachment of handles below the lip, and no longer exhibit punctuate-border shoulder motifs (Boszhardt 1994). However, it should be noted that several shoulder motifs did continue to be used during this time from the Pammel Creek phase. These included punctuate filled zones, alternating panels of oblique tools trails, and vertical finger trails. Finally, ceramics during this time saw the average rim height increase from preceding phases (Boszhardt 1998). The source of lithic material did not change during this phase, as Prarie du Chein chert continued to dominate the assemblage.

The disappearance of the Oneota has plagued investigators just as much, if not more, than the origins of the Oneota at the La Crosse locality. It has been strongly suggested the Oneota culture at the La Crosse locality eventually transitioned into what is documented as the historic Ioway Indians (Blaine 1979). Others have suggested that the Winnebago are the ancestors of the Oneota (Gibbon 1970). Reasons for this shift away from the La Crosse locality vary. Moving to less condensed areas to avoid approaching European diseases is one suggestion (Boszhardt 2000). Others have noted the defensive nature of the Valley View Site displaying social tensions and eventual reason for abandonment of the locality (Stevenson 1985; Theler and Boszhardt 2003). Another suggestion (Boszhardt 2000) is that the appeal of western prairie bison may have enticed the peoples of this area to locate themselves to a new region. Of particular importance in this final theory is the idea that the Oneota peoples of the La Crosse locality became what are historically known as the Ioway.

The Ioway/Oneota and Bison Hunting

Like the Oneota, the Ioway relied on the cultivation of corn, beans, and squash for subsistence. Through historical documents however, we are able to see signs of dependence on and economic value of the bison in the Ioway culture. For example, Wedel (1986) is able to piece together the early Ioway culture through the various documents of French traders, missionaries, and officials. One particular document of the Jesuit priest Père Liouis André states: "...their (Ioway) greatest wealth is in buffalo hides and red stone calumet pipes" (Wedel 1986). The wealth of the bison hides lies in their multiple functions, as these hides could be used for clothing, structures, containers, bedding, and many other items (Wedel 1986). It is also pointed out that the winter hunting of bison most likely occurred because of the prime condition the hide was in for winter clothing. The question now becomes if the Oneota peoples of the La Crosse locality took part in

the hunting of bison during the winter months. One avenue of research with a potential to shed light on this topic is the expression and replication of bison drawings found at rock shelters in the La Crosse locality.

Rock Art and the Bison Motif

Although the dating of rock shelters and caves can be a controversial subject, some inferences can be made that provide enough information to set a tentative date of use. Assigning relative dates to rock shelters can be accomplished through stratigraphy, measuring patina development rates, and recognizing artifacts that provide a minimum age such as the bow and arrow (Salzer 1997). Meanwhile, absolute dating can be obtained through using accelerator mass spectrometry based radiocarbon dating on elements of the actual drawings and paintings such as pigments. All of these techniques present pros and cons, but have been known to provide acceptable dates.

Within the La Crosse locality there are four rock shelters and caves that provide images of bison, as well as two that offer tentative dates to the Oneota time period. Three that display bison heartline motifs include Gullickson's Glen, La Moille Cave, and Bell Coulee (Boszhardt 2000)(Figure 3). Samuels Cave also depicts images of bison (Boszhardt 2003) but does not have the heartline motif as seen in other rock shelters.

The two mentioned rock shelters and caves that have been tentatively dated to the Oneota time period are Gullickson's Glen and Samuel's Cave. Both have documented findings of shell tempered pottery, which is a diagnostic artifact of the Oneota culture (Boszhardt 2003). The La Moille Cave (not to be confused with La Moille Rock Shelter) was destroyed (Dudzik 1997; Connie Arzigian personal communication), but not before the heartline motif could be recorded from the site by Winchell (1911). It has however been suggested that it was occupied by Oneota peoples. Finally, shell tempered pottery has not been recovered from the Bell Coulee Rock



Figure 3. Bison heartline motifs at Gullickson's Glen (top), La Moille (middle), and Bell Coullee (bottom). (Boszhardt 2000).

Shelter either, but does contain the bison heartline motif as well. This becomes an important tangent in this research because someone at the La Crosse locality, most likely from the Oneota time period, was able to replicate an image of a bison on the wall of a cave or rock shelter indicating firsthand knowledge of the animal.

The debate of what the images located in rock shelters and caves may indicate is one that continues to dominate the field of interest. For example, possible meanings may indicate:

- Boundary markers
- Clan or personal symbols representing the “I was here” message
- Supplication- marks made by individuals to accompany a prayer or request for some benefit
- Hunting magic- ritual to increase the supply of game
- Astronomical significance
- Representations of visions
- Important historical events
- Witchcraft
- Mortuary marks commemorating the dead
- “Doodling”- marks to while away the time
- Aesthetics

[As cited in Salzer 1987:280]

Absent from this list however is the literal meaning that can be taken from the image. In the case of this research, it pertains to the image of bison at rock shelter cave or sites in its context. Specifically, the research pertains to images of bison at *La Crosse locality* sites that date to the Oneota time period. Consideration needs to be taken as to how these images arrived at their destination. In my estimation, there are three instances in which the image of the bison could have come to be placed within a rock shelter or cave at the La Crosse locality during the Oneota time period; of which only two appear to be of sound reason.

1. Venturing of the Oneota people into the western prairies – As much of the research conducted in the Upper Mississippi Valley would suggest, Oneota peoples may have departed on seasonal hunts to the western “little prairies”

(Wedel 1986). This interaction of hunting bison would have given the Oneota peoples of the La Crosse locality plenty of imagery to replicate an image of a bison.

2. Venturing of the western prairie peoples to the La Crosse locality – A topic that does not receive as much attention in literature is the concept of western prairie peoples coming to the La Crosse locality for trade or other reasons. This group of people (presumably other Oneota groups) would have the needed interaction with bison that would allow them to replicate an image as well.
3. Depictions of visions or other abstract forms – The most unlikely of the three possibilities, this theory rests upon the maker of the bison image being able to conjure up the illustration with no prior interaction. This possibility is deemed most unlikely, and will not be included henceforth in discussion of this research.

Although subjective in nature, evidence as that seen at rock shelters certainly demonstrates a knowledge and interaction with bison at the La Crosse locality. Also, although lacking the concrete evidence to have a definitive answer, some have suggested seasonal hunting of bison (Arzigian et al. 1989; Theler 1994; Boszhardt 2000). This paper aims to further explore this concept through faunal, lithic, and protein residue analyses.

METHODOLOGY

The following attempts to answer two questions: 1) are the Oneota at the La Crosse locality conducting seasonal hunting?; and 2) do the increasing amounts of scrapers found at Oneota sites at the La Crosse locality indicate the processing of bison hides? In order to approach an answer as to whether or not the Oneota seasonally hunted bison, several forms of research were

explored. First, non-scapula bison elements found at the La Crosse locality were compared against bison elements found at the Dixon site in Iowa. The Dixon site of Iowa (Fishel 1999) was chosen for its well documented analysis of an Oneota occupation that hunted bison near the western prairies. The number of bison elements at these sites was used to determine if correlations of element type exist between the sites. The ensuing ratios were then compared against an adapted form of Binford's general utility index (Binford 1978) to determine if a trend is present towards elements that provide the greater amounts of marrow, grease, and meat. The quantity of bison scapula at each site are incorporated in this research for reference purposes, but are not taken into account due to the fact that it is impossible to determine if they are a trade item or acquired through seasonal hunting. The entire La Crosse locality has been chosen in comparison to the single Dixon site due to the small amount of bison remains found at La Crosse Oneota sites. While this comparison may initially seem to bias the results, ratios of elements found are examined instead of total number of elements recovered. In this instance, the results then indicate which elements are being selected for and brought back to the La Crosse locality if seasonal hunting is occurring. Theler (2000) was used to determine which Oneota sites at the La Crosse locality recovered non-scapula bison elements. It should be noted that because elements recovered at the Dixon and La Crosse locality sites were not documented to proximal and distal specifications, an adapted version of the modified general utility index (MGUI) was used for this research (See Table 1).

Next, the same sites are compared against each other for correlations amongst scrapers to projectile point ratios. This ratio displays the importance of the scraper at a given site. In theory, as the ratio of scrapers to projectile points increases, the importance of the functions that scrapers provide also increases at the site. If this is true, then a high scraper-to-point ratio at a

Table 1. A comparison of Binford's (1978) MGUI (left) and the MGUI incorporated for this research (right). Several of the elements and their corresponding values had to be averaged: metacarpals, metatarsals, humeri, tibia, and radio cubitus (fused radius and ulna). The vertebra were averaged through a weighted average.

Element	MGUI Value	Element	MGUI Value
Antler	1.02	Antler	1.02
Atlas	9.79	Atlas	9.79
Axis	9.79	Axis	9.79
Distal metacarpal	10.5	Metacarpals	11.34
Proximal metacarpal	12.18	phalanges	13.72
phalanges	13.72	Mandible	13.89
Mandible	13.89	Carpals	15.53
Carpals	15.53	Skull	17.49
Skull	17.49	Ulna-Radius*	24.44
Distal radio-cubitus	22.23	Metatarsal	26.93
Distal metatarsal	23.93	Tarsals (Astragalus and Calcaneus)	31.66
Proximal radio-cubitus	26.64	Humerus	40
Proximal metatarsal	29.93	Vertebra	40.32
Tarsals	31.66	Scapula	43.47
Lumbar vertebrae	32.05	Pelvis	47.89
Cervical vertebrae	35.71	Ribs	49.77
Distal humerus	36.52	Tiba	55.91
Scapula	43.47	Sternum	64.13
Proximal humerus	43.47	femur	100
Thoracic vertebrae	45.53		
Distal tibia	47.09		
Pelvis	47.89		
Ribs	49.77		
Sternum	64.13		
Proximal tibia	64.73		
Proximal femur	100		
Distal femur	100		

given site may indicate the high amounts of scraping activities, presumably in this case the processing of bison hides. Scraper form and function is reviewed briefly in the coming section. However, this concept is somewhat problematic when used to determine the importance of a singular entity such as bison at a site. This is due to the fact that Oneota have been known to rely on deer for subsistence as well, and would therefore require scrapers for the processing of deer hides. This problem is addressed in the following segment of methodology, of which protein residue analysis is concerned.

Finally, but perhaps most importantly, protein residue analysis was conducted on 14 lithic tools recovered from the Northern Engraving site of the La Crosse locality. Twelve end scrapers and two points were selected for this procedure. They were chosen for size and porous attributes, as these most often procure the best results (Chad Yost, personal communication 2009). These tools were selected from six different features at the Northern Engraving site (Appendix A). The tools were not handled or washed, and a soil sample was taken for feature six. The PaleoResearch Institute headed by Dr. Linda Scott Cummings and located in Golden, Colorado was the lab chosen for this analysis. This analysis provides a direct link between the scraper and the materials it was used on, usually to the family class in the case of animals. This is different from the assumed correlations that archaeologists apply from scraper wear patterns and experimental archaeology. This is not to say that wear pattern experimental archaeology has no merit. I am simply stating that it does not have the direct link that protein residue analysis can provide. It is important to note that the lithic tools at the Northern Engraving site were analyzed for animal proteins only, and not that of plants. Further, it is important to note that the artifacts submitted were not previously subjected to washing or other handling. The soil sample from feature 6 was submitted for a control against false positives.

Soil samples were not submitted from additional features.

Modified General Utility Index

Through his studies of the Nunamiut of Northern Alaska, Binford (1978) proposed a general utility index that suggests the elements of sheep and caribou that are most sought based on marrow, bone grease, and usable meat. This index proved to be quite accurate when judging the amount of food any one element may provide, but did not provide accurate data for realistic scenarios. Binford points out that when butchering an animal, the butcher looks to remove a segment or section of the animal rather than a specific element. For example, when butchering an animal the butcher may remove a leg for transportation rather than just the femur. This leads to elements (such as metatarsals) of the animal being removed from the kill site that do not contribute as much usable meat. Therefore, Binford expanded on the general utility index and created the modified utility index. Binford states:

I reasoned that the probability of a given part being assimilated to a part of higher value will increase as a function of the mean value between the two parts. Where a given part has a low value but is anatomically between two parts of a higher value, it would be assimilated to the part of the highest value as a function of the mean of a general utility value for the adjacent parts of higher value.
[Binford 1978:74]

It should be noted that this index was based on the values from caribou and sheep as these were the animals that the Nunamiut hunted. To my knowledge, there has not been an index created for bison, and therefore I will be using Binford's index for this paper. Although this index was intended for different taxa, Binford (1978) claims its use for bison should provide the researcher with a fairly accurate representation. To maintain transparency in my research, it should also be noted that this index does not account for kill site meat deboning, distance traveled from kill site, and decomposition rates of skeletal elements. However, when used in comparison of multiple sites, it provides a structure in which correlations can be examined.

Scraper Form and Function

As the name suggests, the scraper has traditionally been an artifact assigned to one specific function: namely the scraping and working of hides or animal skins. However, this terminology may be a misnomer as several studies have shown that scrapers may have been used on other objects such as wood, bone, and antler (Andrefsky 2005). Three main types of scrapers exist. These include the side scraper (working edge on the long edge), end scraper (working edge on the short margin, generally the proximal or distal end of the flake), and thumbnail scraper (approximately the size and shape of a thumbnail)(Kooyman 2000). The scraper may be hafted onto wood or antler, and the scraping edge typically has an angle that ranges from 70 to 90 degrees. However, experimental work on Oneota end scrapers (McCarthy 1995) has found edge angles of 60 degrees or less work best for the scraping of hides. End scrapers can be re-sharpened multiple times over the course of their use, typically resulting in a steepening of the edge angle. At La Crosse locality Oneota sites, scrapers are typically found in greater quantities than other tools (Boszhardt and McCarthy 1999), and are discussed further below when examining the scraper-to-point index.

RESULTS

The following results were gathered from research that was conducted in attempt to answer two primary questions: 1) are the Oneota at the La Crosse locality conducting seasonal hunting?; and 2) do the increasing amounts of scrapers found at Oneota sites at the La Crosse locality indicate the processing of bison hides?

Modified General Utility Index

The objective of using the modified general utility index (MGUI) was to help answer the former

question by comparing the bison elements at the Dixon site of Iowa to that of the La Crosse locality. The results of this comparison can be seen in both graph form (Figure 4) as well as table form (Appendix C). Several interesting pieces of information were found. Upon first glance, it may appear that neither the Dixon site nor the La Crosse locality sites provide any real trends when compared to Binford's MGUI. However, closer inspection reveals that the Dixon site for the most part, favors elements that reside on the right side of the scale, such as femurs, tibias, ribs, etc. According to Binford (1978) these elements would more often be chosen for their usable meat, marrow, and grease. Elements from the Dixon site that do not follow this trend are phalange bones, sternum, and pelvis. Phalanges at the Dixon site can be explained through their abundance in a single bison. For example, if a bison were butchered in a way that one hind leg was brought back to camp, and assuming no loss of preservation of the bones, we would recover one femur and six phalange bones (first, second, and third phalanxes). The pelvis and sternum also do not partake in this trend, but may also be explained through reasoning. While the pelvis may provide substantial amounts of meat, marrow, and grease, it is assumed that it would also be the most awkward of all bison elements to take back to a camp after butchering. Apart from perhaps its potential marrow and grease extraction and vicinity to other higher indexed elements, it is unclear as to why the sternum receives such a high value in the MGUI. Scapulas outnumber any other bison element found at either La Crosse or Dixon sites by three times the amount. It has long been known that bison scapulas were used as hoes for the cultivation of Oneota fields. Therefore this particular bone holds special significance, and would have been selected and traded above all other bison elements.

While a trend does present itself with the Dixon site (13WD8) concerning bison remains, a lack of a trend is prevalent concerning bison remains at La Crosse locality sites. Like the

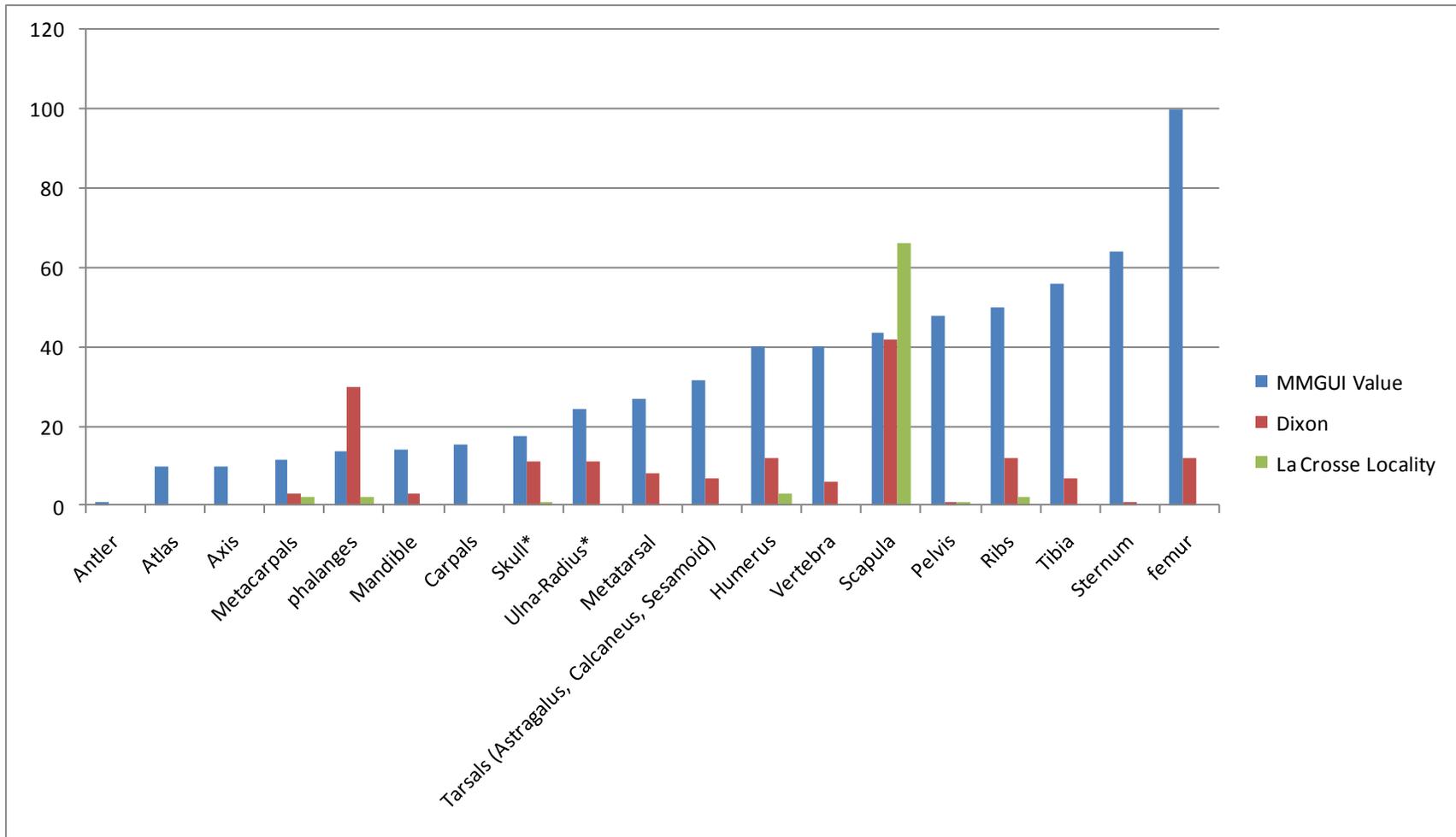


Figure 4. Displays the bison elements found at both the Dixon and La Crosse locality sites in references to Binford's (1978) modified general utility index. Of note is how the Dixon site elements are fairly uniform on the right side of the graph while the La Crosse locality site are in much more disorder. Scapulas are represented highly due to their use as a hoe for cultivation. The asterisk next to the skull indicates fragmentary bones instead of the recovery of a complete skull. The asterisk next to the ulna-radius indicates that these two bones are fused together in bison.

Dixon site, La Crosse locality sites show a high recovery rate of bison scapulas. Unlike the Dixon site however, the La Crosse locality sites do not show a trend toward bison elements that provide the highest amounts of usable meat, marrow, and grease. Instead, we see bison elements such as horn cores, bones of the hooves, fragments of skull bones, ribs, and humeri being the most prevalent. This assemblage is high in bison elements that could be used as artifacts. For example, bison horn cores could be used for spoons; ribs may be turned into rib rasps, scapulas were used for hoes, etc. Finally, the hoof bones may also have been used for artifacts, or may also have been left on the hide to be used as a way to carry back items (Arzigian 1989:164). Of particular note however, is that the modified general utility index does not account for the deboning of elements, and therefore can only account for usable meat when the bone is recovered. Therefore, if the Oneota peoples were deboning bison skeletal elements for transportation after seasonal hunts, the bones would not be brought back to the La Crosse region and thus would not show up in the archaeological record.

Figure 5 shows the pattern of bison skeletal elements recovered from La Crosse locality sites. When exploring the data through this method, one piece of information is suggestive; namely *if* the Oneota of La Crosse were conducting seasonal hunts, a preference towards skeletal elements that are used as artifacts rather than of high meat, marrow and grease were being brought back to the region. Exceptions in this conclusion include the humerus and the pelvis, as they both provide substantial amounts of meat, marrow, and grease. It is interesting to note that the humerus is jointly connected to that of the scapula, an element that was highly prized for its cultivation uses. Therefore, *if* seasonal hunting of bison was practiced by the Oneota, I would suggest that butchering practices incorporating the humerus and scapula as a single segment for return to camp were used. Apart from this suggestive piece of information, an examination of

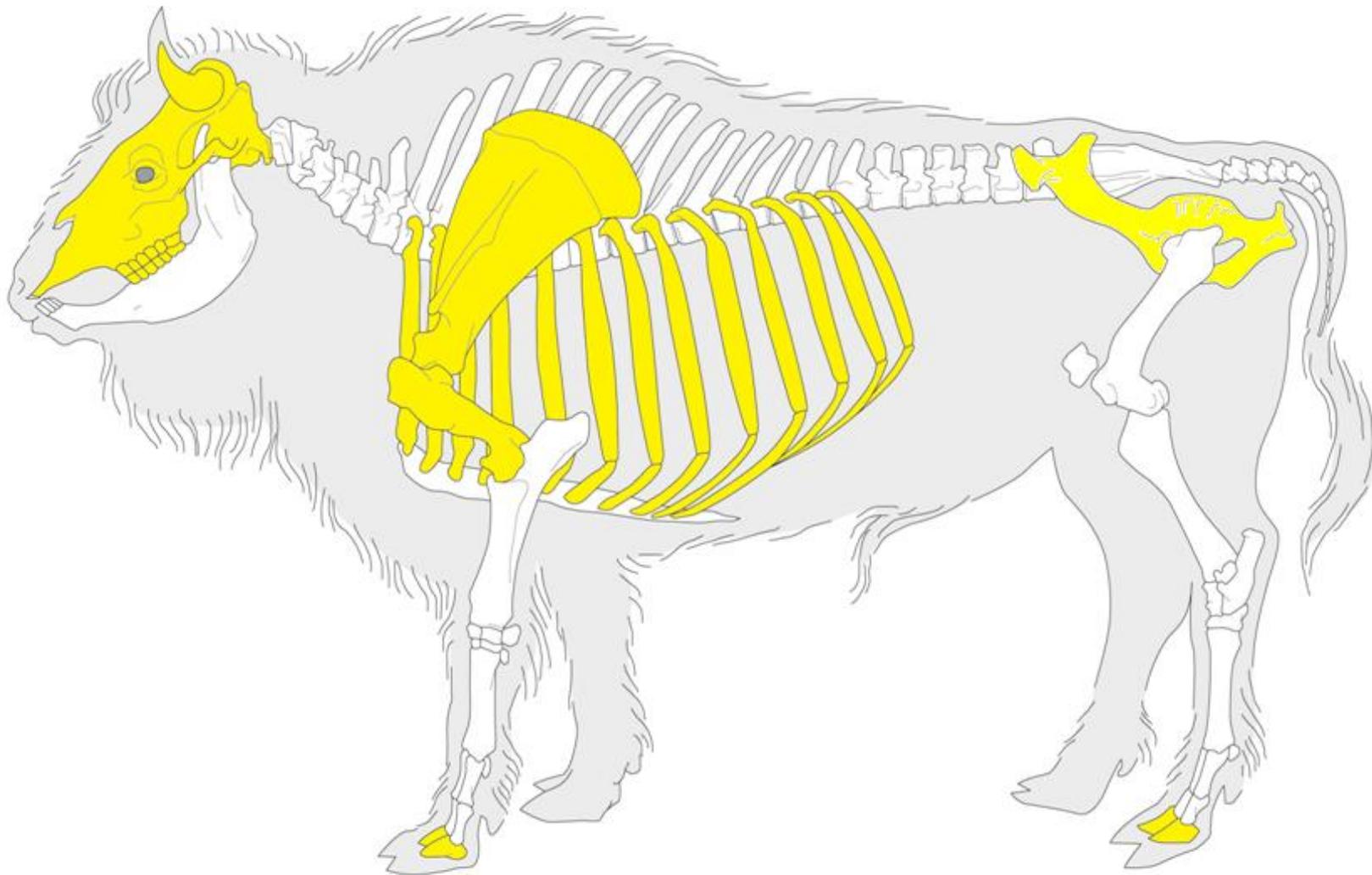


Figure 5. A pictorial representation of the various bison elements found at La Crosse locality Oneota sites. (Base Image Source: www.archeozoo.org/en-article134.html 2010.)

Table 2. Scraper-to-point ratio of the eight sites with bison remains at the La Crosse locality, the site chosen for residue analysis (Northern Engraving), and the site chosen for comparative purposes (Dixon).

Site	Scrapers	Points	Ratio	Source
State Road Coulee	123	230	53	Anderson et al. 1995
Krause	73	131	56	Dowiasch 2010
Ot	71	100	71	Hollinger 1993
Valley View	39	44	89	Stevenson 1985
Dixon	73	53	138	Fishel 1999
Northern Engraving	21	12	175	Holtz-Leith 2010
Armstrong	194	51	380	Savage 1978
Midway Village	93	24	388	Gibbon 1970
Pammel Creek	101	24	421	Theiler 1989

bison remains using the MGUI is inconclusive with respect to whether or not the Oneota of the La Crosse locality conducted seasonal bison hunting.

Scraper-to-Point Ratio

The scraper-to-point ratios of the La Crosse locality sites as well as the Dixon site can be seen in Table 2. The scraper-to-point ratio concept was used to investigate data obtained from the La Crosse locality sites to help determine how important scrapers were at the Northern Engraving site (Table 2). The results of the scraper-to-point ratios not only provides an idea as to how important the scraper was at the site, but when used in conjunction with protein residue analysis, it can provide a link between scraper importance and function at a given site.

It has been suggested that the abundance of scrapers found at La Crosse locality sites may have been due to their use as a tool for processing bison hides obtained during the winter hunts (Boszhardt 1999; Theiler and Boszhardt 2003). As can be seen Table 2, the scraper to point ratio at the Northern Engraving site rests in the middle of other sites in which non-scapula bison remains were found. Although no non-scapula bison remains have been identified as of yet at

Northern Engraving, this ratio becomes important because some of the scrapers recovered from this site were also used for protein residue analysis.¹ Because this ratio displays the relative importance of the scraper at Northern Engraving, we can assume that residues left on said scrapers are an indication of activities of relative importance at the site. It is also interesting to note that the Dixon site (13WF8) actually has a scraper-to-point ratio that is less than the one of the Northern Engraving site, implying a less reliance on the function of the scraper at this site.

Protein Residue Analysis

Finally, the eight positive results of the protein residue analysis conducted on 12 scrapers and two points from the Northern Engraving site (47Lc164) can be seen in Table 3. This analysis was used in the hopes of providing a direct link (or lack thereof) between the scraper and bison at La Crosse locality sites. The protein residue analysis on the scrapers and points of the Northern Engraving site (47Lc164) provided both unexpected and expected results. Firstly, it should be noted that no scrapers or points sent in for analysis returned a positive result for the family Bovidae.² While conclusions drawn from a single site should be determined with caution, the results, or lack thereof, should be taken into account when considering both seasonal bison hunting and the processing of bison hides at La Crosse locality sites. From the results of this analysis, an alternative function of the scraper at La Crosse locality sites needs to be explored. Whether or not the archaeologist can find the evidence that links the two together is one that can only be answered through additional research. As the rock art found at sites such as Gullickson's Glenn, La Moille, and Bell Coulee would suggest, some sort of relationship with bison did exist with the Oneota at the La Crosse locality. The results of this study would suggest that it is not the abundance of scrapers found at Oneota sites.

¹ Assemblage not completely identified as of writing.

² Bison are a member of the family bovidae and therefore no residues of bison were found.

Table 3. A table displaying the positive results from the protein residue analysis of lithic tools from the Northern Engraving site (47Lc164). Possible Animals represented are derived from Theler (2000). The asterisk next to the species listed under trout indicates that neither of these species have been found at Oneota sites.

Sample #	Feature #	Positive Result	Possible Animals Represented
2009.0610.06	3	Bear	Black Bear (<i>Ursus americanus</i>)
2009.0508.05	6	Trout	Brook Trout (<i>Salvelinus Fontinalis</i>)* Northern Pike (<i>Esox lucius</i>)*
2009.0509.07	6	Trout	
2009.0476.01	6	Trout	
		Trout	
2009.0613.160	9	Chicken	Greater Prairie Chicken (<i>Tympanuchus cupido</i>) Ruffed Grouse (<i>Bonasa umbellus</i>) Wild Turkey (<i>Meleagris gallopavo</i>)
2009.0579.01	78	Turkey	Blue-winged Teal (<i>Anas discors</i>) Bufflehead (<i>Bucephala albeola</i>) Canada Goose (<i>Branta canadensis</i>) Common Merganser (<i>Mergus merganser</i>) Green-winged Teal (<i>Anas crecca</i>) Hooded Merganser (<i>Lophodytes cucullatus</i>) Mallard (<i>Anas platyrhynchos</i>) Northern Shoveler (<i>Anas clypeata</i>) Redhead (<i>Aythya americana</i>) Ring-necked Duck (<i>Aythya collaris</i>) Trumpeter Swan (<i>Cygnus buccinator</i>) Wild Turkey (<i>Meleagris gallopavo</i>) Woodduck (<i>Aix Sponsa</i>)
2009.0638.01	84a	Sturgeon	Lake Sturgeon (<i>Acipenser fulvescens</i>) Shovelnose Sturgeon (<i>Scaphirhynchus platyrhynchus</i>)
2009.0638.05	84a	Deer	American Elk (<i>Cervus canadensis</i>) Moose (<i>Alces alces</i>) White-Tailed Deer (<i>Odocoileus virginianus</i>)

The lithic tools that produced positive results revealed residues of trout (four instances), sturgeon, bear, "chicken," turkey, and deer (See Table 3 for artifact number and associated residue and Appendix B for pictures of the tools). This wide range of species supports previously held notions that the Oneota relied on riverine resources, as well as exploited other available species in addition to their corn, bean, and squash agriculture.

White-tailed deer (identified in sample 2009.0638.05 in Table 3) have been shown to be one of the most utilized and economically important mammals at the La Crosse locality throughout all prehistoric traditions (Theler 2000). This positive result implies a variable habitat, although most likely one with forest edges. Deer would have been important for their meat, hides, antler tools, as well as other uses (Stevenson 1985). This sample may also represent other members of the Cervidae family such as elk and moose, as their remains have also been found at Oneota sites (Theler 2000).

Meanwhile, the turkey has shown to be the most highly represented bird at the La Crosse locality, with bones from the wing tips being most prevalent (Theler 2000). A very useful bird to Native Americans, the turkey provided food, bone for tools, and prized feathers for clothing, baskets and fans. Turkeys that were roosting may have been most vulnerable (Stevenson 1985). Samples 2009.0613.160 and 2009.0579.01 may have had residues of turkey, although other animals in the Phasianidae and Anatidae families may have left the residue on these tools. Species in these families that have been found at other Oneota sites include trumpeter swan, Canada goose, Wood duck, Green-winged Teal, Blue-winged Teal, Mallard, Northern Shoveler, Redhead, Ring-necked duck, Bufflehead, Common Merganser, Hooded Merganser, and Greater Prairie Chicken (Theler 2000).

The positive result for bear (2009.0638.05) is interesting in that remains from this animal are much more rare than deer, turkey, or fish remains. The only bear species found at Oneota sites is the Black bear. This species is found in heavily wooded areas, brushy areas, and wooded swamps. They are active mostly from mid-march through November and are dormant throughout winter. Even though they are vulnerable during this time, they are difficult to find as they usually den below an overturned tree or in other sheltered spots (Stevenson 1985).

The residue found on sample 2009.0638.01 produced a positive result for sturgeon. Lake sturgeon and Shovelnose sturgeon are two types of sturgeon found at Oneota sites in the La Crosse locality (Theler 2000). Lake sturgeon are extremely long lived and are most common in the deepest parts of large rivers, such as the Mississippi river (Stevenson 1985). They were probably most vulnerable during their spawning period, which is in late April to early May. Spawning occurs in smaller tributary streams or along shallow edges near stream banks (Stevenson 1985).

The residue of trout found on samples 2009.0508.05, 2009.0509.07, and 2009.0613.160 is somewhat of an enigma as no remains from the family Salmonidae have been recovered from Oneota sites at La Crosse. Several factors may be in play with this situation. First, contamination of the samples may be a factor. However, this is unlikely as the soil sample sent in from feature 6 resulted in no false positives. According to Becker 1983, the Brook trout is the only member of the Salmonidae family that is native to Wisconsin. This species however is rare to uncommon in the southern half of the state. Finally, the last possibility of this positive result is that the Salmonidae family is extremely close in relation to that of the Esociformes (pike) family. Pike remains are common at Oneota sites (Theler 2000), and have been recovered from the Northern Engraving site (Leigl 2010).

It should be noted that the positive results for trout and sturgeon may also be a representation of "fish glue" that the Oneota used to help haft a lithic tool to a handle.

Collagen is the structural fibrous protein of tissues in humans, animals, and fish. It gains adhesive properties when degraded into gelatin by treatment (prolonged boiling) with hot water (Rots 2008). A semitransparent, whitish, and very pure form of gelatin, called isinglass, can be prepared from the air bladders of various species of sturgeons. Glue made from fish skins and heads were used as hafting material by some California tribes. For instance, the Maidu of the Sierra Nevada Mountains made sinew-backed bows of yew with the sinew attached with salmon skin glue (Justice 2002).
[As cited in Yost 2010:5]

This is an example of what may be occurring with sample 2009.0613.160, which returned positive results for both trout and chicken.

CONCLUSIONS

In conclusion, the results from the comparison of bison elements found at the Dixon site (13WD8) in Iowa to those of the La Crosse locality Oneota sites using an adapted form of Binford's (1978) modified general utility index displayed a high rate of bison elements that have uses as artifacts. The exception in this case is that of the humerus, which may have been due to a butchering technique that incorporates the scapula. The scraper-to-point ratio of the Northern Engraving site (47Lc164) proved to be close to average when compared to other sites in which bison remains were recovered. While protein residue analysis on the lithic tools from this site (mostly scrapers) demonstrated a variety of animal species hunted by the Oneota, no protein residues from bison were identified, indicating that the function of the scrapers at Northern Engraving did not include the processing of bison hides or remains.

Several interpretations may be made from this research. For instance, the scraper as a tool may hold more functions than had been previously thought. Instead of having a one-

dimensional use for the scraping of hides, it may have demonstrated several different forms of use throughout its life, on several different substances. In addition, the function of the scraper may have changed during the course of its life as wear and retouching altered the edge angles.

Meanwhile, the puzzle of bison and their remains at La Crosse locality sites becomes only slightly more clear. The research presented here indicates that the bison remains at La Crosse locality sites are mostly regarded as artifacts, but how these objects arrived at La Crosse is still unclear. It is my interpretation that the abundance of bison scapulas at La Crosse locality sites in comparison to the lack of other bison elements implies that trade may have been more of a factor in procuring these items than that of seasonal hunting. If seasonal hunting was the main source of the bison elements at La Crosse locality sites, I would expect the ratio of other bison elements to be close to that of the scapula, especially in the case of other bison elements that are used for artifacts. Preservation is an obvious factor in this interpretation, but the amount of bison scapulas in comparison to that of bison elements at the La Crosse locality is staggering. An obvious mystery in all of this are the bison images on cave walls at La Crosse that are probably of Oneota origin. This is another piece of the puzzle that is difficult to define within the research questions, and perhaps will only be answered through additional research.

FURTHER RESEARCH NEEDS

Further research is needed to determine if the Oneota of La Crosse locality were conducting seasonal hunting of bison. This is a difficult question to answer, and one that might only be solved through the recovery of a bison kill site linked contextually to the Oneota of the La Crosse locality. While the modified general utility index provides some insight into this question, it lacks the "smoking gun" aspect to reach a definitive answer on the issue.

Meanwhile, the question as to whether or not the abundance of scrapers at Oneota sites correlates to the processing of bison hides is one that can be easily tested with further protein residue analysis. Of particular interest, it may prove informative for residue testing to be conducted on lithics from an earlier Oneota phase, such as the Brice Prairie phase. This is because the Northern Engraving site is mainly composed of Pammel Creek and Valley View phase artifacts (Holtz-Leith 2010)(Appendix A). In addition, the type site for the Valley View phase was one that appears to have been defended with a palisade (Stevenson 1985), and therefore interaction with western regions may have been limited during this phase. The problem with this research lies in a Brice Prairie phase site being found, as most artifacts previously recovered from sites of this phase have been washed, thus eliminating chances of a proper residue analysis.

APPENDIX A

<i>Feat. No.</i>	<i>Type of feat.</i>	<i>Depth/ profile shape</i>	<i>Plan shape (Dimension cm)</i>	<i>Phase based on pottery Vessels</i>	<i>Comments</i>
3	Deep basin	81 cm Basin	Circular (133x127)	Valley View phase	Five zones containing two scapulas, shell, fish bones, three scrapers, one point, charcoal, FCR, an abrader, and half of a Valley View vessel with fish bones.
6	Shallow basin	20 cm Basin	Circular (111x106)	Pammel Creek	Artifacts include pottery sherd clusters in eastern half & lithic flakes, points, FCR, & a knife in the western half.
9	Deep basin	118 cm Basin	Circle (140x130)	Probable Pammel Cr	Artifacts were found in varying concentrations, but mostly concentrated towards the center of the feature.
69	Shallow basin	24 cm Basin	Circle (108 x 100)	Valley View	This feature was heavily concentrated with artifacts, especially bones, pottery, and lithics.
78	Deep basin	88 cm Basin	Oval (168 x 92)	Pammel Creek	7 zones identified. Zones A & B most organically enriched & most artifacts. Cluster of pottery, including mini pot fragments, found in southern half of Zone B. Charcoal & nut shell fragments found in Zones A, B, & possibly C. Upper zones disturbed by rodents, especially northern half of feature. Lithics, primarily Cochrane, found in upper zones.
84A	Shallow basin	15 cm Basin	Oval (120 x 80)	Probable Valley View	See Feature 84 description. F.84 & 84A were excavated together as one 15cm level. Cultural materials in F. 84A include two Madison Triangular points, a end scraper, abrader fragment, 150+ lithics, & 100-200 shell tempered pottery sherds.

Appendix A. This appendix displays the descriptions of the features in which lithic tools were selected for protein residue analysis. (Holtz-Leith 2010).

APPENDIX B



Figure B1. Sample number 2009.0476.01. Scraper



Figure B2. Sample number 2009.0508.05. Bifacial Scraper



Figure B3. Sample number 2009.0509.07. Biface Tip



Figure B4. Sample number 2009.0579.01. Scraper



Figure B5. Sample number 2009.0610.06. End Scraper



Figure B6. Sample number 2009.0613.160. Side Scraper

APPENDIX B CONTINUED

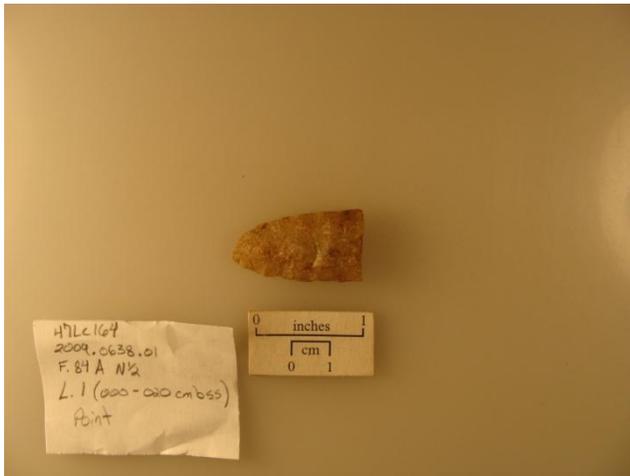


Figure B7. Sample number 2009.0638.01. Point



Figure B8. Sample number 2009.0638.05. End Scraper

Appendix B. This appendix displays the pictures of the lithic tools that produced positive results.

APPENDIX C

Element	Dixon Site	La Crosse
First Phalanx	13	2
Second Phalanx	6	
Third Phalanx	11	
Humerus	12	3
Ulna	3	
Radius	8	
Tibia	7	
Femur	12	
Rib	12	2
Cranial	2	
Molar	2	1
Metatarsal	8	
Metacarpal	3	2
Astragalus	3	
Vertebra	6	
Scapula	42	66
Incisor	2	
Metapodial	1	
Calcaneus	1	
Mandible	3	
Nasal	1	
Tooth	2	
Cuboid	3	
Sesamoid	3	
Footbone	1	
First and second phalanges	1	
Premolar	1	
Frontal	1	
Innominate	1	1
Patella	1	
Sternum	1	
Horn cores		3

Appendix C. This appendix displays the bison elements recovered at both the Dixon site as well as the La Crosse locality sites. The highlighted elements were not included in the MGUI analysis.

BIBLIOGRAPHY

Anderson, Adrian, Allan Westover, Terrance J. Martin, Mathew L. Murray, Susan M.T. Myster, Barbara O'Connell, and L. Anthony Zalucha
1995 The State Road Coulee Site: 47Lc176. *The Wisconsin Archeologist* 76:48-230.

Andrefsky, William Jr.
2005 *Lithics*. Cambridge University Press, New York.

Arzigian, Constance M., and Robert F. Boszhardt
1989 Introduction, Environmental setting and History of Investigations at the Pammel Creek Site. *The Wisconsin Archeologist* 70: 1-40.

Arzigian, Constance M., Robert F. Boszhardt, James L. Theler, Roland L. Rodell, and Michael J. Scott
1989 Human Adaptation in the Upper Mississippi Valley: A Study of the Pammel Creek Oneota site (47Lc61), La Crosse, Wisconsin. *The Wisconsin Archeologist* 70:1-281.

Barnard, H., S.H. Ambrose, D.E. Beehr, M.D. Forster, R.E. Lanehart, M.E. Malainey, R.E. Parr, M. Rider, C Solazzo, and R.M. Yohe II
2007 Mixed Results of Seven Methods for Organic Residue Analysis Applied to One Vessel with the Residue of a Known Foodstuff. *Journal of Archaeological Science* 34:28-37.

Becker, George
1983 *Fishes of Wisconsin*, University of Wisconsin Press, Madison, WI.

Berres, Thomas Edward
2001 *Power and Gender in Oneota Culture*. Northern Illinois University Press, DeKalb Illinois.

Binford, Lewis R.
1978 *Nunamiut Ethnoarchaeology*. Academic Press, New York.

Blaine, Martha Royce
1979 *The Ioway Indians*. University of Oklahoma Press, Norman.

Boszhardt, Robert F.
1994 Oneota Group Continuity at La Crosse: The Brice Prairie, Pammel Creek, and Valley View Phases. *The Wisconsin Archeologist* 75:173-236.

1998 Oneota Horizons: A La Crosse Perspective. *The Wisconsin Archeologist* 79(2):196-226.

- 2000 Turquoise, Rasps, and Heartlines: The Oneota Bison Pull. In *Mounds, Modoc, and Mesoamerica: Papers in Honor of Melvin L. Fowler*, Edited by Steven R. Ahler, pp 361-404. Scientific Papers, Vol. 28. Illinois State Museum, Springfield.
- 2003 *Deep Cave Rock Art in the Upper Mississippi Valley*. Prairie Smoke Press, Saint Paul Minnesota.
- Boszhardt, Robert F., and Joelle McCarthy
 1999 Oneota End Scrapers and Experiments in Hide Dressing: An Analysis From the La Crosse Locality. *Midcontinental Journal of Archaeology* 24:177-199.
- Cattaneo, C., K. Gelsthorpe, P. Phillips, and R. J. Sokol
 1993 Blood Residues on Stone Tools: Indoor and Outdoor Experiments. *World Archaeology* 25:29-43.
- Downs, Elinor F., and Jerold M. Lowenstein
 1995 Identification of Archaeological Blood Proteins: a Cautionary Note. *Journal of Archaeological Science* 22:11-16.
- Dudzik, Mark J.
 1997 Visions in Stone: The Rock Art of Minnesota. *The Minnesota Archeologist* 54:99-108.
- Fishel, Richard L.
 1999 *Bison Hunters of the Western Prairies*. The University of Iowa, Iowa City.
- Gerlach, Craig S., Margaret Newman, Edward J. Knell, and Edwin S. Hall
 1996 Blood Protein Residues on Lithic Artifacts from Two Archaeological Sites in the DeLong Mountains, Northwestern Alaska. *Artic* 49:1-10.
- Gibbon, Guy E.
 1970 The Midway Village Site: An Orr Phase Oneota Site in the Upper Mississippi River Valley. *The Wisconsin Archeologist* 51:79-162.
- 1972 Cultural Dynamics and the Development of the Oneota Life-Way in Wisconsin. *American Antiquity* 37:166-185.
- Glenn, Elizabeth J.
 1974 *Physical Affiliations of the Oneota Peoples*. Report 7, Office of State Archaeologist, The University of Iowa, Iowa city.
- Harvey, Amy E
 1979 *Oneota Culture in Northwestern Iowa*. Report 12, Office of the State Archaeologist, The University of Iowa, Iowa City.
- Hollinger, Ronald Eric
 1993 The OT Site (47 Lc-262). In *The OT Site*, Vol. 1, edited by Jodie O’Gorman. pp. 73-89. State Historical Society of Wisconsin, Madison.

Holtz-Leith, Wendy

2010 *Preliminary Results of the 2009 Phase III Archaeological Excavations of Portions of the Lower Sand Lake Site (47Lc45) and the Northern Engraving Site (47Lc164) for Proposed Elmwood Meier Farm East Development La Crosse County, Wisconsin.* The Mississippi Valley Archaeology Center Reports of Investigations Number 814. Available at the Mississippi valley Archaeology Center, La Crosse Wisconsin.

Hyland, D.C., J.M. Tersak, J.M. Adovasio, and M.I. Siegel

1990 Identification of the Species of Origin of Residual Blood on Lithic Material. *American Antiquity* 55:104-112.

Justice, N. D.

2002 *Stone Age Spear and Arrow Points of California and the Great Basin.* Indiana University Press.

Kooyman, Brian P.

2000 *Understanding Stone Tools and Archaeological Sites.* University of New Mexico Press, Albuquerque.

Leigl, Megan E.

2010 *A Faunal Analysis of the Northern Engraving Site and Comparison to the Pammel Creek and Jim Braun Sites.* Unpublished B.A. Thesis, Department of Sociology and Archaeology, University of Wisconsin, La Crosse.

Loy, Thomas H.

1983 Prehistoric blood residues: detection on tool surfaces and identification of species of origin. *Science* 220:1269-1271

1993 The Artifact as Site: An Example of the Biomolecular Analysis of Organic Residues on Prehistoric Tools. *World Archaeology* 25:44-63.

Loy, Thomas H., and E. James Dixon

1998 Blood Residues on Fluted Points from Eastern Beringia. *American Antiquity* 63:21-46.

Loy, Thomas H., and Andree R. Wood

1989 Blood Residue Analysis at Eayonu Tepesi, Turkey. *Journal of Field Archaeology* 16:451-460.

McCarthy, Joelle

1995 *Oneota End Scrapers: Form and Function in the La Crosse Area.* Unpublished B.A. Thesis, Department of Sociology and Archaeology, University of Wisconsin, La Crosse.

Odell, George H.

2004 *Lithic Analysis.* Kluwer Academic/Plenum Publishers, New York.

Rots, V.

2008 Hafting and Raw Materials from Animals: Guide to the Identification of Hafting Traces on Stone Tools. *Anthropozoologica* 43(1):43-66.

Salzer, Robert J.

1987 Introduction to Wisconsin Rock Art. *The Wisconsin Archeologist* 68:277-286.

1997 Wisconsin Rock Art. *The Wisconsin Archeologist* 78:48-76.

Sasso, Robert Francis

1989 Oneota Settlements Practices in the La Crosse Region: An Analysis of the Coon Creek Drainage in the Driftless Area of Western Wisconsin. Unpublished Ph.D. dissertation. Department of Anthropology, Northwestern University, Evanston.

Savage, Howard

1978 Armstrong: Faunal Analysis. *The Wisconsin Archeologist* 59:118-145.

Scott, Michael

1994 Faunal Remains from the Midway Village. *The Wisconsin Archeologist* 75:393-421.

Seeman, Mark F., Nils E. Nilsson, Garry L. Summers, Larry L. Morris, Paul J. Barans, Alaine Dowd, and Margaret E. Newman

2008 Evaluating Protein Residues on Gainey Phase Paleoindian Stone tools. *Journal of Archaeological Science* 35:2742-2750.

Staeck, John P.

1995 Oneota Archaeology Past, Present, and Future: In the Beginning, Again. In *Oneota Archaeology: Past, Present, and Future* Edited by William Green, pp 3-6. Office of the State Archaeologist. Report 20. The University of Iowa, Iowa City.

Stevenson, Katherine

1985 Oneota Subsistence-Related Behavior in the Driftless Area: A Study of the Valley View Site Near La Crosse, WI, Unpublished dissertation at the University of Wisconsin Madison, Madison, Wisconsin.

Styles, Bonnie W. and Karli White

1993 Analysis of Faunal Remains. In *The OT Site*, Vol. 1, edited by Jodie O’Gorman. pp. 99-116. State Historical Society of Wisconsin, Madison.

Theler, James L.

1989 The Pammel Creek Site Faunal Remains. *The Wisconsin Archeologist* 70:157-241.

1994 Oneota Faunal Remains from Seven Sites in the La Crosse, Wisconsin, Area. *The Wisconsin Archeologist* 75:343-392.

2000 Animal Remains from Native American Archaeological Sites in Western Wisconsin. *Transactions* 88:121-142.

Theiler, James L., and Robert F. Boszhardt

2003 *Twelve Millennia*. University of Iowa Press, Iowa.

2006 Collapse of Crucial Resources and Cultural Change: A Model for the Woodland to Oneota Transformation in the Upper Midwest. *American Antiquity* 71:433-472.

Thomas, Cyrus

1894 Report on the Mound Explorations of the Bureau of American Ethnology. *Annual Report (1890-'91) of the Bureau of Ethnology to the Secretary of the Smithsonian Institution* 12:3-730.

Wedel, Mildred Mott

1986 Peering at the Ioway Indians through the mist of time: 1650- circa 1700. *Journal of the Iowa Archeological Society* 33:1-74.

Winchell, Newton H.

1911 *The aborigines of Minnesota*. The Minnesota Historical Society, St. Paul.

Yost, Chad

2010 Protein Residue Analysis of Lithics From Site 47LC164, Onalaska, Wisconsin. *PaleoResearch Institute Technical Report 10-09*.

