RECOGNIZING PALEOINDIAN HIDEWORKING ACTIVITY AREAS ON THE GREAT PLAINS

By

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Abstract

This study utilized information from subject-side (ethnohistoric and ethnographic) and source-side (archaeological) data sources to develop a framework of how bison hideworking might be recognized in the Great Plains Paleoindian archaeological record. Hideworking has particular tool and space requirements and the recognition of these characteristics led to the development of a comparative analogic framework that can be examined using archaeological data. This study used chipped stone assemblages and spatial data from two Folsom/Midland archaeological sites, 14SN106, at the Kanorado Locality, and 41WK21, the Shifting Sands site, to examine the utility of this framework.

Through lithic analysis of both site assemblages, elements of an expected hideworking artifact assemblage, such as endscrapers and their resharpening flakes, which are common at both sites, were identified. Other flake tools also were identified in the chipped stone assemblage. Unfortunately, less durable materials have not been recovered from these sites.

Prior to spatial analysis of the assemblage at each of these sites, the site formation processes that may have impacted spatial patterns at each site were reviewed. Site formation processes at 14SN106 and 41WK21 indicate vertical disturbance is likely extensive; however, horizontal spatial data may yet yield patterns related to the activities that created them.

Using artifact type distributions, kernel density estimates, and cluster analysis, the assemblages at both sites were studied for evidence of hideworking. This resulted in the identification of areas were hideworking likely took place. At 14SN106, the Main Block excavation is confirmed as a hideworking location. A single artifact concentration appears to be a resharpening area. At 41WK21, the southernmost part of the site appears to have been a hideworking area, but five additional areas exhibit evidence of use for multiple activities including hideworking. One area does not appear to have been used for hideworking. These results are discussed in the context of the framework for hideworking including comparisons with other Folsom/Midland sites.

Acknowledgments

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Thanks to the landowners where 14SN106 and 41WK21 are located. They allowed the archaeological investigations reported herein to be conducted on their property. This research was supported by the Odyssey Archaeological Research Program (2004-2015), the Kansas Historical Society Historic Preservation Fund Grant (2006), and the University of Kansas Department of Anthropology Archaeological Field Schools (2006, 2008).

A big thank you to Richard Rose who countless hours over many years at the Shifting Sands site (41WK21) surveying, mapping, and collecting artifacts. Like all archaeologists, Richard's work does not end after he recovers artifacts and he has spent many additional hours cataloging, analyzing, and refitting, and learning from his collection. In addition to his own interest, Richard enjoys sharing his collection with others and his enthusiasm is infectious. Special thanks to him and his wife, Jan, for their hospitability when I visited them.

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I owe a debt of gratitude to my colleagues at R. Christopher Goodwin & Associates, Inc. (RCG&A) who have allowed me to complete this study and have supported me over the past years in a variety of ways. Alan Potter assisted with this work by my answering my GIS questions. His willingness share his extensive knowledge enabled me to produce the maps in this document. Janice McLean has supported, challenged, and encouraged me in her roles as both colleague and friend. Dawn Munger listened patiently to me when I could not keep my mouth shut about each new idea I had. Diane Thomas assisted with entering references. A special thanks to the RCG&A employees who have experienced the joy of sorting waterscreen samples from 14SN106 over the past several years.

To my University of Kansas friends and colleagues, especially Shawna Chapman, Melissa Fillipi, Anne Kraemer Diaz, and Laura Murphy, thanks for your encouragement to finish my dissertation.

As a seventh grade student at South Middle School in Salina, Kansas I participated in "The New Mexico Trip" wherein teachers, led by Mr. John Rathlef, took more than forty middle schoolers on a bus trip to New Mexico. On that trip we visited several archaeological sites and I was introduced to both the field of archaeology and the prehistory of North America. That trip planted the seed in me that I wanted to become an archaeologist.

Finally, I would like to express my thanks to my parents, Tom and Lynda Ryan, who continued to think their daughter was getting a PhD when even she was convinced otherwise. Her desire to make them proud was a strong motivating factor in completing this work. Their encouragement is appreciated, and their love is a blessing.

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Chapter 1. Introduction

Prehistoric and early historic peoples on the Great Plains of North America worked the hides of bison into useful rawhide and tanned skins. Prehistorically, these activities appear to have been practiced in this region as long ago as Paleoindian times. This study uses data from ethnographic sources and archaeological sites to develop a comparative analogical framework for recognizing and interpreting prehistoric hideworking activity areas. The framework is then used to examine data from two Folsom Paleoindian sites, 14SN106 (Rolfe's Endscraper site) and 41WK21 (Shifting Sands site), to assess and identify prehistoric hideworking activity areas. Both 14SN106 in western Kansas and 41WK21 in western Texas have yielded artifacts and spatial patterning indicative of a camp setting. In particular, hide processing is suggested at both sites by the presence of endscrapers and scraper retouch flakes. Using lithic and spatial analysis I examine the composition of these artifact assemblages and the distributions of the artifacts that are potentially indicative of hideworking and associated activities (e.g., butchering).

Early Paleoindian traditions, including Clovis and Folsom groups, occupied North America between ca. 11,500 and 10,200 ^{14}C yr. B.P (Collard et al. 2010; Ferring 2001a; Sanchez et al. 2014). Archaeologists identify and name complexes during the Paleoindian period largely based on projectile points with diagnostic traits; however, projectile points are certainly not the only chipped stone tools Early Paleoindians used. Bifaces, blade and flake tools, and scrapers are all common at some sites. Although they are present at Early Paleoindian sites, endscrapers, which are less diagnostic, have not received as much attention as projectile points. However, several studies of Early Paleoindian endscraper technology, use, and discard have been completed in the last twenty years (Bamforth and Becker 2009; Chambers 2015; Jodry 1999;

Loebel 2013a, 2013b; Morrow 1997; Ruth 2013; Seeman et al. 2013; Shott 1995; Wiederhold 2004). This study contributes to this growing corpus of literature.

Early Paleoindians hunted both large and small animals. In the realm of big game, Clovis hunters killed a variety of animals, including both mammoths and bison. Bison, however, appear to have been the primary animal subsistence resource during the Folsom period. In addition to meat, animals provide a wealth of other resources. Arguably, the most important of these resources is the hide. Historic Native Americans, who lived on the Great Plains where bison were plentiful, used processed bison hides for more than 50 purposes including housing, clothing, and storage (Ewers 1979). Early Paleoindian peoples also required these essentials, and we assume they processed bison and other animal hides for a variety of uses.

Ethnographic and ethnohistoric information is used herein to develop hypotheses about where and how hideworking may have occurred in prehistory. That information, along with comparative archaeological examples of potential hideworking activity areas from other Paleoindian and Upper Paleolithic sites will be considered for this research. To recognize hideworking activity areas at Paleoindian sites, one must hypothesize the tools used in this activity and where the activity took place. Endscrapers were often used to remove the membrane, even, thin, and soften the skin. Overwhelmingly, microwear studies of endscrapers have resulted the conclusion that hideworking was their primary function (Ahler 1979; Bamforth and Becker 2009; Boszhardt and McCarthy 1999; Daniele 2003; Hayden 1979, 1986; Keeley 1980; Loebel 2013a, 2013b; McDevitt 1994; Moore et al. 2016; Root et al. 2000; Seeman et al. 2013; Semenov 1985; Wilmsen 1970). It is important to note, however, that some of the specimens analyzed exhibited wear that indicated they were used and/or reused on harder surfaces such as wood or bone/antler (Loebel 2013a, 2013b; Wiederhold 2004). It is assumed that the endscrapers from

14SN106 and 41WK21 were used in hideworking. This assumption does not preclude their use in other activities as well. Other chipped stone artifact categories that may help identify hideworking activity areas include gravers, bifaces and flake knives, ultrathin bifaces, and scraper retouch flakes. In addition, bone and ground stone tools such as abraders, ochre, fleshers, and endscraper haft elements may be included in this group of hideworking artifacts.

This chapter identifies the study's research questions, provides background information about the study, and outlines the organization of the dissertation.

Research Goals and Questions

Three research goals of this study are to use ethnographic, ethnohistoric, and archaeological evidence of hideworking to develop a model of expected tool types and spatial distributions for prehistoric hideworking activity areas. Activity areas are "places, facilities, or surfaces where technological, social, or ritual activities occur" (Binford 1983:148). Archaeologically speaking, activity areas can be identified by clustered groups of associated artifacts, ecofacts, and/or features in a specific context (Ferring 1984:117). After the model has been developed, I examine the archaeological data from early Paleoindian sites 14SN106 and 41WK21. Finally, observations derived from this examination are used to re-evaluate the model and recommend changes so it may be applied more broadly.

Specifically, the following research questions are addressed to reach these goals:

(1) How can ethnographic analogy and middle-range theory inform our ideas about the identification and use of hideworking areas?

(2) What do we know about hideworking activity areas from ethnohistoric, ethnographic, and archaeological data?

(3) What can we learn from evidence of potential hideworking activity areas at sites 14SN106 and 41WK21?

(4) Finally, how will these data help researchers recognize, understand, and evaluate evidence of hideworking activity areas at other archaeological sites?

To address these questions I use ethnographic and ethnohistoric research, published information from Early Paleoindian (ca. 11,600-10,200 ^{14}C yr. B.P.) and Magdalenian Upper Paleolithic (ca. 11,000 ^{14}C yr. B.P.) archaeological studies, and data from the two study sites. Each of these lines of evidence can inform researchers about the location of, amount of space needed for, and tools used in prehistoric hideworking. Better recognition and understanding of hideworking activity areas can inform our understanding of Early Paleoindian site structure, group composition, the range of activities undertaken, and technological organization.

Ethnographic Analogy and Archaeological Tacking

Analogy is an integral part of most archaeological interpretations and may even be considered integral to human language, learning, and behavior (Edgeworth 2006:49). The history of thought regarding ethnographic analogy in archaeology began with an equation of ethnographically observed cultures with archaeological complexes (see Lubbock 1865). In the beginning, analogies were made without questioning their suitability and modern "primitives" or "savages" were *equated* with prehistoric archaeologically defined complexes (Orme 1974; Wylie 1985). This formal type of analogy resulted in a reaction against the use of analogy in archaeology. Ethnographic data, however, is so informative about the varieties of human lifeways that use of analogy for archaeological interpretation soon resumed.

Throughout the twentieth century, critiques leveled against the use of ethnographic analogy were addressed by attempting to improve how it was used in archaeology. Recently, use of ethnographic analogy in archaeology has included recognition that analogy can generate ideas and hypotheses about the past, but these ideas must then be *evaluated* against the archaeological data rather than *applied* as archaeological explanations (Stahl 1993; Wylie 2002).

Is analogy a useful technique for understanding prehistoric hideworking by Great Plains peoples? I argue analogy is very useful to archaeologists when both source-side (ethnographic or ethnoarchaeological information) critiques and subject-side (archaeological data) evaluation are included to create an analogic model (Stahl 1993). In an effort to improve the use of analogy in archaeology, Stahl (1993) suggested using a comparative approach instead of an illustrative analogy. Illustrative analogy (similar to a formal analogy) is an analogy in which the archaeological data is "mapped on" the ethnographic example, thereby overemphasizing the similarities between the two. In the comparative model, both similarities and differences are taken into consideration (relational analogy) (Stahl 1993). In addition, by partitioning a comparative analogy, one can evaluate specific aspects of the analogy, not just the whole. Partitioning makes it possible for an analogy to hold in one domain but not others (Salmon 1975:461). Partitions of source-side data into subgroups based on geography, subsistence, or other factors can emphasize where the analogy is appropriate (B. Smith 1977:606). The creation and use of a model using comparative analogy requires both the source-side and subject-side data to be expanded and evaluated to improve it (Hofman 1994:Figure 1; Kuznar and Jeske 2006; Ravn 2011; Stahl 1993). Wylie (2002:165) identifies this method of using analogy as archaeological tacking.

There are many ethnohistorical sources that briefly describe the process of hideworking among bison hunting Plains Indian peoples. These documents date from the mid-nineteenth century through the mid-twentieth century and were authored by people with a broad range of perspectives and backgrounds. Collectively, they inform us about women hideworkers who completed a variety of tasks to create rawhide and tanned skins. The steps required to process hides include hide acquisition, fleshing, scraping/thinning, tanning, and softening. In general, the textual data suggest a fairly uniform process, which employed similar tools, throughout the Plains.

In addition to written sources, artists and photographers have documented historic hideworking on the Great Plains. More than 70 images depicting a variety of hideworking tasks show remarkable uniformity in the basic actions and tools used for historic hideworking on the Plains. For example, use of a composite scraping tool while standing on a hide and bent at the waist appears in several cultures of the Plains. Women are dominant in images of hide processing, but men may be involved in the decoration of them. The examination of images allows one to explore aspects of hideworking that were not recorded in historic texts. For example, some images depict the location of hideworking relative to habitations, which is generally not discussed in ethnographic or historical written accounts.

Another source of source-side data for comparative analogy are archaeological remains. By comparing the conclusions of archaeological studies, we are better equipped to recognize the suite of tools employed in hideworking and the relative positions of activities. A variety of artifacts, including chipped stone, ground stone, bone, and wooden items from archaeological sites reveal patterns of use. For example, gravers and endscrapers have been recovered from the same areas at several sites suggesting they were used in the same or associated activities.

Spatial analysis of archaeological sites also informs the recognition of hideworking areas at 14SN106 and 41WK21. Spatial analysis provides methods through which researchers can identify activity areas. Several studies have applied these methods to better our understanding of hideworking at Paleoindian sites such as Aubrey, Bull Brook, Stewart's Cattle Guard, Lindenmeier, Rio Rancho, and Sandy Ridge. Other archaeological data with bearing on this discussion are those with high quality spatial information such as Verberie and Pincevent in France.

Early Paleoindian Lifeways

Early Paleoindian groups, including Clovis and Folsom/Midland, were highly mobile hunter-gatherers who targeted particular sources of high quality lithic material for their stone tools. The Clovis cultural complex is the oldest widely recognized prehistoric culture in the Great Plains region and was first documented during archaeological investigations in the 1930s at several key sites including Blackwater Draw, New Mexico; Dent, Colorado; and Miami, Texas (Cotter 1937, 1938; Figgins 1933; Hofman and Graham 1998; Howard 1935; Sellards 1938, 1952; Wormington 1944). Each of these sites demonstrated the association of distinctive Clovis technology with extinct late Pleistocene animals including mammoth and bison (Grayson and Meltzer 2002). They also hunted small animals and gathered plants to supplement their diet (Cannon and Meltzer 2004, 2008). Recent research suggests that the Clovis complex dates from ca. 11,600-10,800 radiocarbon years before present (^{14}C yr. B.P.) (ca. 13,400-12,700 calibrated years ago [cal. yr. B.P.]) (Miller et al. 2014:210; see also Fiedel 2014a, 2014b; Haynes 2015; Waters and Stafford 2007). Cultural material from Clovis sites includes distinctive fluted projectile points and tools made from bifacial and blade chipped stone reduction techniques. Endscrapers, sometimes made on blades, have repeatedly been recovered from Clovis sites (Agenbroad and Huckell 2007:158; Collins 1999; Ferring 2001a; Loebel 2013a; Rule and Evans 1985; Sain 2012; Waters et al. 2011:123-134).

Folsom also was identified as an Early Paleoindian archaeological culture during the early twentieth century (Roberts 1940). Folsom sites date from ca. 10,820-10,200 ^{14}C yr. B.P. (Collard et al. 2010; Meltzer 2006). The earliest Folsom site appears to have been on the northern High Plains, and the archaeological culture spread throughout the Great Plains and Rocky Mountains of North America from there (Collard et al. 2010). Folsom sites include evidence of bison hunting, camping, lithic material acquisition, and hearth-based activities. The distinctive fluted Folsom projectile point and a similar, unfluted point called Midland co-occur at several sites including 41WK21. Although the relationship of Folsom and Midland points is not completely understood, it does appear the variation is the result of differences within one cultural group (Amick 1995; Hofman 1992, 1998; Meltzer et al. 2006). Specifically, at 41WK21, both Midland and Folsom projectile point types appear to have been used by the same group of people (Hofman et al. 1990; Rose 2011a, 2011b). The choice of Folsom or Midland projectile point production may have been a result of lithic material availability, anticipated land use patterns, limited production time, and/or stylistic preferences (Ahler and Geib 2000; Amick 1995; Hofman 1991, 1992; Hofman et al. 1990). Varying levels of flintknapping skill also has been suggested as an explanation for why some Folsom-era points are fluted while others are not (Bamforth 1991; Lassen 2013; Lassen and Williams 2015). Folsom assemblages do not include blades like observed in Clovis complex assemblages, but they include similar bifacial tools, endscrapers, and other tools. Radial break tools and ultrathin bifaces also are sometimes recorded at Folsom sites (Collard et al. 2010; Frison and Bradley 1980). Unlike Clovis groups who hunted a variety of megafauna and small game, Folsom appear to have developed specialized bison hunting. They did not, however, exclusively hunt bison. Folsom peoples, like later Paleoindians, also hunted smaller animals and presumably participated in gathering a variety of edible plants

(Hofman 1996:59-60; Hollenbach 2005, 2007; Hudecek-Cuffe 1998:67-72; Kornfeld 2007; Kornfeld and Larson 2008).

Paleoenvironment

The Paleoindian period in North American archaeology coincides with the late Pleistocene – early Holocene transition. The late Pleistocene (ca. 20,000 – 11,000 B.P.) was characterized by the retreat of glacial ice sheets and a gradually warming climate (Meltzer and Holliday 2010:3); however, compared to the modern climate, the Great Plains region was cooler and had less seasonality during the late Pleistocene. These factors contributed to higher effective moisture and more sources of surface water including playa lakes in the Great Plains (Holliday 1997:212). Paleoenvironmental evidence indicates the Central and Southern Great Plains were dominated by C_3 grasses during the late Pleistocene. Then, ca. 10,900 – 10,000 B.P., a climate shift towards relatively cooler and drier conditions occurred (Meltzer and Holliday 2010). This period, called the Younger Dryas, impacted most of the Northern Hemisphere including the Central and Southern Great Plains.

Phytolith and $\delta^{13}C$ data indicate vegetation at 14SN106 was open woodland with C_3 grasses until ca. 14,210 cal. yr. BP, the end of the late Pleistocene. At that time, climate change impacted the vegetation with C_4 grasses, consisting of the modern shortgrass vegetation, gradually became dominant (Cordova et al. 2011:95). More detailed information comes from an analysis of the Kanorado paleosol at 14SN106. At the bottom of the buried soil, phytoliths from C_3 grasses and woody plants are common. These phytoliths indicate a cool, wet environment (Cordova et al. 2011:96). In the middle of the buried soil the evidence indicates a more arid environment as C_4 grasses replace C_3 grasses and woody plants. This appears to be evidence of the Younger Dryas. Near the top of the Kanorado paleosol, the phytoliths indicate a shift back to more moist conditions; however, woody plants do not return to the area (Cordova et al. 2011:96, Figures 6 and 7).

There also is evidence of climate change at 41WK21 during the late Pleistocene – early Holocene transition. About 11,000 ^{14}C yr. B.P. the region became warmer and had less available surface water, which led to less vegetation and a destabilization of the landscape (Holliday 2000:7). This "Folsom Drought" was widespread between about 10,900 and 10,200 ^{14}C yr. B.P., the Folsom time period, and eolian sedimentation was significant in the Monahans Dune field where 41WK21 is located (Holliday 2000:7; Rich and Stokes 2011:235). Although this is when Folsom people occupied the site, it seems unlikely that humans would have lived permanently in fully active dune fields (see Mayer 2003), and Holliday (1997:135) found no obvious attractions for humans to the Andrews Dunes during Folsom times. On the other hand, attractions to the 41WK21 area may have included interdunal ponds (Amick and Rose 1990:3) that were important resources in a time of limited surface water, and blowouts, which were sometimes used as bison traps (Frison 2004:76-79, 2013:12; Wheat 1971:25).

Paleoindian Lifeways

In general, Paleoindians were highly mobile hunter and gatherers who utilized distinctive projectile points to hunt bison and game. Factors that appear to have impacted how Paleoindian groups moved include the mobility patterns of bison and other game, lithic material sources, and sources of other specific materials and resources. Clovis and Folsom projectile points are distinctive end-products, and the production sequence of Folsom points is so identifiable that even manufacturing by-products like channel flakes and preform fragments are considered to be reliable diagnostics (Amick 1994:11; Bradley 1993:254-255; Nami 1999; Tunnell 1977). Other chipped stone tools found at Clovis and Folsom sites include endscrapers. There have been some who have identified a "Paleoindian endscraper" and, indeed, they are relatively distinctive (e.g., Wilmsen and Roberts 1978). In addition to chipped stone, Paleoindians used tools made of ground stone, bone, wood, and other perishable materials.

14SN106

Site 14SN106 is the location of Early Paleoindian cultural deposits discovered in the channelized cutbank of Middle Beaver Creek in Sherman County, Kansas (Figure 1.1). At 14SN106, Early Paleoindian cultural deposits are contained in alluvial fill beneath the T-1 terrace of Middle Beaver Creek. This site is near two additional sites that also have buried Early Paleoindian components: 14SN101 and 14SN105. Cultural materials from these sites are attributable to the Clovis and Folsom cultural complexes (Blackmar and Hofman 2006). Together these sites are known as the Kanorado Locality. These locations are loci of hideworking and perhaps other domestic activities, rather than animal kills, although kill sites were likely nearby. Indeed, Folsom era kill sites are typically associated with camp and processing areas (Hofman 1999a:394). Early Paleoindian campsites in well stratified buried deposits like those found at Kanorado rarely have been studied in detail (Hofman and Graham 1998; Kornfeld and Larson 2008; Larson 2009:308-309).

Artifacts at 14SN106 (as well as 14SN101 and 14SN105) have been recovered from the buried Kanorado paleosol. Most tools at 14SN106 are endscrapers, and many of the small flakes are scraper retouch flakes. The remains of a nearly complete Paleoindian age (10,854±40 ^{14}C yr. B.P. [NZA-27348]) bison were excavated from a paleochannel at 14SN106 (Area C). Based on a Clovis-age date of 11,085±20 ^{14}C yr. B.P. (CURL-9009) on a bison astragalus from the Main Block excavations at 14SN106 (Mandel et al. 2005; Cordova et al. 2011) and a radiocarbon soil organic matter age at the top of the Kanorado paleosol at 14SN105 (9240±70 14C yr. B.P. [ISGS-5583]) (Cordova et al. 2011:Table 6), the cultural component in the Main Block is Early

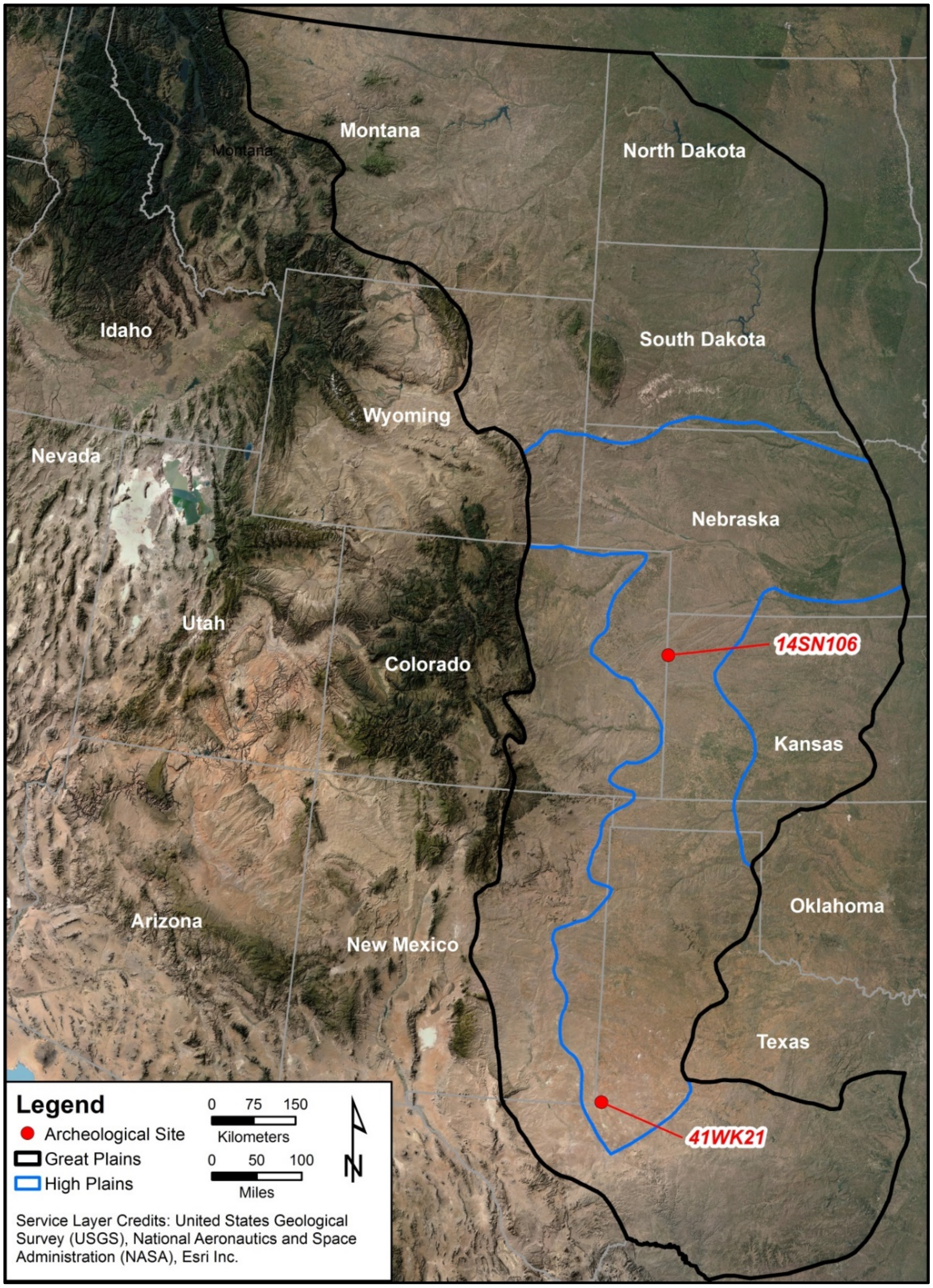

Figure 1.1. Map of the Great Plains depicting the locations of 14SN106 and 41WK21 in the High Plains (Fenneman and Johnson 1946). Map created by Alan Potter and Shannon Ryan.

Paleoindian in age. The chipped stone assemblage indicates it should be assigned to the Folsom period.

In the late 1960s, when Middle Beaver Creek was channelized, during highway construction, an unknown amount of sediment was removed from 14SN106. Although the removal of this sediment and subsequent erosion eventually resulted in the site's discovery, it also had a significant negative impact removing a substantial portion of the cultural deposits. Despite this, there may still be other areas of 14SN106 and other sites in the terrace.

41WK21

Site 41WK21, the Shifting Sands Site, is in Winkler County, Texas (Figure 1.1). It was discovered in June 1981 by Richard Rose who observed Paleoindian-age artifacts in a series of 5-8 m deep blowouts in the Andrews Dunes extension of the Monahans Dunes system (Holliday 1997:133). Because artifacts were recovered from several blowouts in the dune field, the blowouts were assigned area designations; however, it is important to note that these designations are based on modern blowouts and likely have no significance for the understanding of prehistoric site structure (Hofman et al. 1990:236).

Site 41WK21 was buried by eolian, or windblown, sediments. Paleoindian artifacts and weathered bone have been recovered from the lower portion of a layer of interbedded eolian tan sand and reddish clay bands or lamellae and in the soil below it (Amick and Rose 1990; Hofman et al. 1990; Holliday 1997; Rose 2011b). During his many visits to the site, Rose noted in-situ Folsom-aged items eroding from these laminated reddish clay and sandy deposits (Hofman et al. 1990:223). An optically stimulated luminescence (OSL) (central age model) age on sediment from this unit of interbedded sand and clay indicates it formed ca. 10,600±1,200 years ago

(Feathers et al. 2006). Diagnostic artifacts from 41WK21 include both Folsom and Midland points; later artifacts have been recorded from the dune sands that cover the site.

As of June 2010, more than 21,400 chipped stone artifacts had been collected from 41WK21 (Rose 2011b:301). Nearly all of the artifacts are made of Edwards chert, a material that outcrops more than 150 km east of the site. This assemblage includes more than 1,000 tools, most of which have been piece plotted with reference to datums Rose installed or with a global positioning system (GPS). The assemblage includes projectile points, preforms, utilized channel flakes, bifaces, informal flake tools, gravers, drills, notches, denticulates, ultrathin bifaces, and scrapers. More than 100 endscrapers are included in the collection (Rose 2011b:Table 1). Nine ultrathin bifacial knives and a significant number of scraper retouch flakes also have been recovered from 41WK21. Debitage has been consistently collected by blowout area, not individually piece plotted like the tools.

Based on tool proportions and fragmentary faunal evidence, a 1990 article about 41WK21 hypothesized Blowout Area 3 was a bison kill/butchery area, Blowout Area 2 was a chipped stone tool reduction and retooling area, and hideworking took place in the other areas (Hofman et al. 1990:235). Since 1988, many additional artifacts have been recovered from the site and the significantly larger assemblage means a reevaluation of that pattern is necessary.

Organization of the dissertation

The presentation of this research is organized into seven chapters. Chapter 2 presents the ethnohistoric, ethnographic, and archaeological data with which a comparative analogical framework of hideworking activity areas was developed. In Chapter 3 that framework is presented. Chapter 4 details the methods used in the excavation and analysis of the cultural materials from 14SN106 and 41WK21. Chapters 5 and 6 discuss the results of lithic and spatial analysis at 14SN106 and 41WK21, respectively. Finally, a discussion of the results, the model, and areas where the model could be improved are presented in Chapter 7. Appendices A-C present data used in this research. Appendix A provides the metadata for the images used in the ethnographic hideworking study. Appendix B contains basic chipped stone analysis of tools from 14SN106 and Appendix C presents metric data of 41WK21 endscrapers and a summary of other mapped tools from the site.

Chapter 2. A Comparative Analogy for Paleoindian Hideworking

Chipped stone artifacts identified as endscrapers are common at archaeological sites in the Great Plains. They have been recovered from sites dating from the Paleoindian to Protohistoric periods. One of the presumed functions of these tools was to prepare hides for a multitude of uses. Other materials associated with hideworking have also been identified at many archaeological sites throughout the region. A review of written and visual ethnographic and historical data reveals that the process of bison hideworking among nineteenth and early twentieth century Plains Indians was repeatedly observed and documented. The intent of this chapter is to investigate the analogic potential of this evidence for interpreting archaeological data.

First, I explore the history of the use of ethnographic analogy in archaeology. This history allows us to understand the origins of ethnographic analogy and assess the development and validity of its use. After the usefulness of comparative ethnographic analogy has been assessed I examine ethnohistoric, ethnographic, and ethnoarchaeological data pertaining to hideworking. Source-side criticism of this data is explored as well as identifying its potential uses in archaeology. Next, subject-side (archaeological) data about identified hideworking activity areas at North American Paleoindian and European Upper Paleolithic sites are examined. This provides a perspective on the types of evidence we may find at the sites in question. Experimental hideworking also is considered as it can inform our interpretations of both source and subject-side data.

Ethnographic Analogy

Ethnographic analogy is a tool that is used to assist in interpreting the archaeological record. Some scholars contend archaeological interpretation cannot exist without ethnographic analogy (sometimes called ethnographic parallels) (Peregrine 2001:2; Stahl 1993). Indeed, current archaeological publications commonly contain analogies. In the late nineteenth and early twentieth centuries, analogy was applied uncritically. When critiques of ethnographic analogy began, most archaeologists abandoned the method instead of addressing the critiques; however, as researchers learned to modify and examine ethnographic analogy, a resurgence of its use occurred that led to the development of ethnoarchaeology (Wylie 1985). Ethnoarchaeology, like ethnographic analogy, is a tool for generating archaeological interpretations. Both use observations about historical and modern cultures to generate ideas about past behavior and help explain the archaeological record. This summary defines ethnographic analogy, provides a history of ethnographic analogy in archaeology, and discusses how it will be applied in the creation of a model of prehistoric hide processing on the Great Plains.

Analogy is "an inference that if two or more things agree in one respect, then they might also agree in another" (Fisher 1970:243). All analogies imply that there are both similarities *and differences* between the things being compared: if there were no differences the things being compared would be identical, without similarities the analogy would be false (Fischer 1970, 1972). Fischer (1970:243) described analogies not as explanations in and of themselves; but rather, as a tool for finding new explanations. Archaeologists often make analogical comparisons between ethnographically described groups and archaeological complexes. Ethnographic descriptions can include information garnered from written documents and visual materials (e.g., artwork, photographs) and may refer to past or contemporary events. Archaeological complexes, on the other hand, are defined by their material remains. As Spielmann (2005:203) wrote: "The ethnographic record thus cannot be a source of answers for archaeology, but it is a source of ideas about the possible actions of people in the past." This application of ethnographic analogy is described as a relational analogy as opposed to a formal analogy.

The direct historical approach and ethnoarchaeology are other analogical ways of understanding the past. Both are integral to the modern use of ethnographic analogy in archaeology. The direct historical approach involves tracing ethnographic cultures back into protohistory and eventually prehistory (Johnson 1999:190; Steward 1942:337; Strong 1972; Wedel 1938). The premise of the direct historical approach is that the recent ancestors of a group will be similar to the historic manifestation of that group. This approach assumes aspects of a culture have remained minimally changed through time; however, static cultures do not exist and the application of the direct historical approach to prehistoric archaeological remains still requires the use of analogy (Peregrine 2001:2).

Ethnoarchaeology is the study of modern peoples to better understand prehistoric behavior. Modern ethnoarchaeology was developed as a research strategy out of middle-range theory within the context of processual archaeology (Johnson 1999; Lane 2006). Middle-range theory attempts to connect static archaeological remains with the dynamic systems that created them. Lewis Binford (1983:23-24) proposed the only way to study both a dynamic system and static by-products of that system was by observing modern groups and the archaeological record. Conclusions reached through ethnoarchaeological study, like ethnographic analogy, are used to facilitate archaeological interpretations.

Ethnographic Analogy in Archaeology

Since the establishment of archaeology as a scholarly discipline, ethnographic analogy has been utilized by archaeologists; however, it has not always been applied in the same way. Western scholars' ideas about the past were constrained by their limited knowledge of the range of human behavior until the “discovery” of Native Americans and African tribes. The narrow ethnocentric view of the scholars was broadened through knowledge of indigenous ways of life (Wylie 1985:65). Wylie (1985:65) described this new source for analogy as “an antidote to narrow ethnocentrism and as a rich source of insights about ‘varied and heterogeneous reasons or causes’ that may account for otherwise enigmatic archaeological materials.” However, these new ideas did not necessarily mean a better understanding of the past; instead, analogies were made without questioning their suitability, and modern “primitives” or “savages” were *equated* with prehistoric archaeologically defined complexes (Orme 1974; Wylie 1985). This analogy led to a view of cultural evolution that included a hierarchy with the “primitive” at the bottom and European society at the top (Morgan 1907; Tylor 1881; Wylie 1985:67). When used in this manner, ethnographic analogy led to a narrow, ethnocentric view of the past. Archaeologists in the early-twentieth century commonly used this type of comparison, which implicitly supported this view of cultural evolution.

Critics of cultural evolution and ethnographic analogy emphasized that analogies are liable to error, cultures change, arguments from analogy can be circular, and the ideas are not testable (Taylor 1948; Wylie 1985:68). Smith (1955) also contended that arguments by analogy are conjecture; as they cannot be tested, they should not be attempted. In the aftermath of these early twentieth century critiques, analogy and theory in general was unpopular in archaeology. Interestingly, half a century later some of those same critiques were still being leveled at the use of ethnographic analogy. Johnson (1999:60-62) described two late-twentieth century critiques of analogy and middle-range theory in archaeology: (1) analogies do not test or prove anything; and (2) people’s behavior, and thus the archaeological record, is influenced both by function and ideology. Critics argued that, without direct observation and interaction with the people who created the record, archaeologists may not be able to understand the behavior that created it.

During the 1940s, researchers avoided the use of analogy. Instead archaeologists concerned themselves with recording facts and limited their interpretations of that data (Wylie 1985). Critics, such as Kluckhohn (1939; Wylie 1985) and Taylor (1948; Ascher 1961), of a lack of theory in American anthropology and archaeology challenged professionals in those fields because of their unwillingness to interpret data. Eventually scholars developed techniques for using analogy in more limited ways that allowed for a reintroduction of the method to the discipline. In the 1950s and early 1960s, Clark and Ascher both suggested ways of creating more controlled and systematic analogies (Peregrine 2001:2).

Both Clark and Ascher wrote that the best use of analogy in archaeology would be the direct historical approach (Ascher 1961; Wylie 1985). As described above, this approach traces groups back in time with the assumption that related groups are more likely to have similar behaviors. Early proponents of this type of analogy included Plains archaeologists William Duncan Strong, Waldo Wedel, Mildred Mott Wedel, and William Mulloy among others (Duke and Wilson 1995:3; Krause 1998:72-74). The direct historical approach has generally been found to have utility for archaeological interpretations of sites that can be fairly securely traced to ethnographic groups.

For those archaeological sites without a direct historical descendent group (i.e., nearly the entire archaeological record), Clark and Ascher both suggested "new" or "unconnected" analogs be employed (Wylie 1985:71). The theory behind these analogies was that cultures from similar environments and with similar adaptations to that environment may provide the best analogies (Ascher 1961:319; Peregrine 2001:2). Ascher (1961) went on to suggest three ways of improving the use of analogy. He proposed archaeologists develop a systematic method for choosing the best analogy, utilize all available ethnographic evidence in a systematic way, and thirdly, consider that cultures are constantly changing (Ascher 1961:322-324). To choose the best analogy, Ascher (1961:322-323) suggested considering the economies; distances in space, time, and form; and the closeness of fit between the groups being compared because there is not a clear difference in the material culture of the past and present.

Ucko and Rosenfeld (1967) agreed that, within boundaries, ethnographic analogy can be a productive method to archaeology interpretation. They argued that advantages of ethnographic analogy include avoiding an “over-emphasis of one’s own experience” and demonstrating “the range of possible factors underlying human activities” (Ucko and Rosenfeld 1967:153). Contrary to Ascher (1961), they suggested, because cultures are always changing, there is no reason to think that groups with similar technology and in similar environments are better analogs (Ucko and Rosenfeld 1967:156). However, Ucko did agree with Ascher that all available evidence should be used and there is not a real difference between the past and present material culture. This perspective led them to deny that “archaeology and ethnology are separate disciplines” (Orme 1974:210).

Adaptations of analogy by Clark and Ascher did not silence the critics. And the critics had valid reproaches. For example, Wylie (1985) claimed the direct historical approach does not always work because the economy and ecology of a culture change over time and there is no reason to think “that any given contemporary culture will replicate in itself the complex association of attributes distinctive of the prehistoric cultures represented in the archaeological record” (Wylie 1985:73). Wylie (1985) outlined three ways scholars responded to the new critiques: by creating additional restrictions on the use of analogy, attempting to test analogies against the archaeological evidence instead of simply applying them, and by using all of the available ethnographic and ethnoarchaeological research to improve analogies (Wylie 1985:73-77). Still others reacted radically to the use of analogy. They concluded analogy could never reach the level of proper scientific research and archaeologists should avoid using it in archaeological interpretations whenever possible (Freeman 1968; Gould and Watson 1982; Smith 1955).

In the 1960s, additional critiques of ethnographic analogy came from proponents of Processual (New) Archaeology. Processual archaeologists argued for the use of scientific and empirical methods that were explicit and testable. Despite criticisms of the method, analogical reasoning was the source of many of processual archaeology's hypotheses and models (Binford 1968; Wylie 1985:84):

> The 'interpretation' of the archeological record by the citation of analogies between archeologically observed phenomena and phenomena from a known behavioral context simply allows one to offer his *postulate* that the behavioral context was the same in both cases. In order to increase the probability that the postulate is accurate, a number of testable hypotheses must be formulated and tested [Binford 1968:269, emphasis in original].

This is an echo of suggestions made by Clark and others in the 1950s (Binford 1972; Orme 1974). Clark suggested ethnography could help to generate questions and direct the research of the archaeologist (Orme 1974:201). Fischer (1970) also described analogies as tools for finding new explanations. Binford, although critical of the use of ethnographic analogy for interpretation, recognized the utility of ethnographic sources as tools to be used in archaeological theory building. Binford (1967) provided an example of how he thought analogy should be used in archaeology in "Smudge Pits and Hide Smoking: The Use of Analogy in Archaeological Reasoning." In this article, Binford took issue with Ascher's proposition that a systematic analogy can be used for direct interpretation of the past. Ascher's method did not help achieve

Binford's (1967:10) stated goal of archaeology: "explain cultural differences and similarities." For Binford, the key to using ethnographic data was developing a way in which one could use dynamic data to connect with the static archaeological record. He subsequently proposed a method–a frame of reference–that would productively use "ethnographic data in the service of archaeological goals" (Binford 2001:2). Like Binford, others have attempted to "bridge" the static past with the present through ethnoarchaeology (for example Gould and Watson 1982).

In another view of ethnographic analogy, Wobst (1978) argued the ethnographic (as well as the ethnohistoric and ethnoarchaeological) record is limited; and, therefore, using it in the construction of archaeological hypotheses does not provide the full range of behavioral variability, but rather limits it. He argued that analogy allows us only to consider what we have observed ethnographically. By using archaeological data we may be able to contribute hypotheses, especially about regional or temporal trends that have not been observed ethnographically, to anthropological theory (Wobst 1978). In other words, if we try only to fit archaeological data to our known patterns of life we cannot learn anything new from the archaeological record (Hodder 1982; Kuznar and Jeske 2006; Stahl 1993).

In 1985, Wylie published "The Reaction against Analogy" in which she described the history of the use and critiques of analogy in archaeology. In the article, she pointed out analogy is an important tool available to archaeologists and that "most archaeological inference remains analogical" (Wylie 1985:64). Wylie (1985:107) concluded by indicating that analogy, though "liable to error," can be applied to provide new ideas about the past. However, she distinguished between formal and relational analogies. Formal analogies are defined as examining each point of intersection between cultures for similarities and differences while relational analogies are based on a connection between the two cultures that suggests further similarities (Hodder

1982:16; Wylie 1985:94-95). Formal analogies are those that many archaeologists had reacted against, while relational analogies are similar to those suggested by Ascher (1961) where the relevance of the ethnographic material to the archaeological material is considered (Gould and Watson 1982; Hodder 1982; Ravn 2011:720). Hodder (1982) pointed out that these types of analogy can be viewed on a continuum, and formal analogies become more relational the more points of intersection are identified in the analogy. Wylie proposed that to strengthen an analogy one should consider all the possible analogies. This can be done by examining and elaborating the similarities of the two things being compared, but also by identifying and exploring the differences and flaws in the analogy. Wylie (1985:107) also maintained that analogies can be tested using methods developed independent of analogy.

In an effort to improve the use of analogy in archaeology, Stahl (1993) suggested using a comparative approach instead of an illustrative analogy. Illustrative analogy is an analogy in which the archaeological data is "mapped on" the ethnographic example (similar to a formal analogy), thereby overemphasizing the similarities between the two. In the comparative model, both similarities and differences are taken into consideration (relational analogy; Stahl 1993). Both the source-side (ethnographic or ethnoarchaeological information) and subject-side (archaeological data) of ethnographic analogies must be expanded and evaluated to improve the analogy (Kuznar and Jeske 2006; Ravn 2011; Stahl 1993). This idea of using multiple lines of evidence was not new (see Ascher 1961), but Stahl (1993) and Wylie (2002) both expound on how this should be done and argued its usefulness. A number of different lines of evidence must be considered. These include both information within sources and between subject and source (Wylie 2002:167). "[Q]uestions about the adequacy of an interpretative hypothesis are settled when independently constituted lines of evidence converge either in supporting or refuting its central claims about particular past practices" (Wylie 2002:167). Wylie (2002:165) identified this method as archaeological tacking, analogous to sailing a zigzag course against the wind to arrive at a desired location.

Practical suggestions for improving analogy that Stahl (1993:253) proposed include: be critical of the sources used in the analogy, be careful of thinking that ubiquity enhances the value of an analogy, and attempt to "incorporate a temporal dimension into analogical models." She also agreed with the suggestion that both similarities and differences should be considered when using analogy. Finally, Stahl (1993) suggested incorporating archaeological data into the development of the model to be tested.

From the late 1970s to the 1990s, archaeologists who were critical of processual archaeology became known as postprocessual archaeologists. Postprocessual archaeologists have proposed a variety of ways of looking at the past including emphasizing agency and attempting to incorporate thoughts and ideology into their interpretations of the past. Ian Hodder, an acknowledged postprocessualist, was one of those who strongly critiqued Binford's use of ethnographic analogy. In his work, *The Present Past*, Hodder (1982:23) agreed that analogy should be used in archaeology but disagreed with Binford's suggestion of testing the hypotheses against the archaeological record because "there are no data available from the past concerning the relationship between material culture and human activity" so the validity of the prediction is also in question.

Hodder (1982) instead proposed the "proper" use of analogy involved a close examination of both functional and ideological context within relational analogies. He pointed out that ideology can significantly influence archaeological remains but if archaeologists are only looking for functional explanations then ideological ones will be overlooked. Hodder recognized that every context is unique because ideology influenced past behavior. One might suppose Hodder therefore rejected analogy as a pointless endeavor because there will never be an exact analogue for the past. Yet, he does not favor abandoning analogy. Rather, he argues "the proper use of analogy is the central issue of archaeological interpretation" and "the nearest the archaeologist can get to a rigorous method is the careful use of a relational analogy" (Hodder 1982:210, 27). Although he has rejected testing analogies and argued each context in the archaeological record is different, Hodder (1982:25) still considered there to be underlying "principles of meaning and symbolism, which are often used in comparable ways." By identifying these general principles, we may be able to interpret the archaeological record. Also, by identifying the similarities, differences, and uncertain likenesses one may assess which portions of an analogy are relevant (Hodder 1982:25-26).

Today the use of ethnographic analogy is common and even advocated in a variety of postprocessual archaeologies. For example, articles in two recent volumes, *Beyond Subsistence: Plains Archaeology and the Postprocessual Critique* (Duke and Wilson 1995) and *Gender and Hide Production* (Frink and Weedman 2005), use ethnographic sources to help identify women in the archaeological record (Gilmore 2005; Habicht-Mauche 2005; Scheiber 2005; Whelan 1995) and to suggest the symbolic meaning of artifacts and features (Mirau 1995; Warburton and Duke 1995; Wilson 1995). Other examples can be found in *Ethnographic Archaeologies,* in which ethnography is said to have "the power to recover forgotten or marginalized voices and give voice to alternative and emancipatory histories" (Castaneda and Matthews 2008:70).

On the other hand, a postmodern view held by some postprocessual archaeologists provides a warning against using analogy. They argue there is a danger of "not saying that the past of a region was like some particular ethnographically documented group, but merely saying that the past was different from the lives we lead" (Spriggs 2008:542). This approach can lead to archaeologists applying analogies wherever they see similarities between ethnographic and archaeological data without regard for the *relevance* of those analogies (Ravn 2011:721; Spriggs 2008:542). Ravn (2011:717-718) suggested that the postprocessual critique of processualism meant processualists gave "up theoretical interpretations altogether, concentrating on the scientific aspect of data sampling and analysis, while some of those who continued to be interested in interpretative archaeology lost the basic logic involved in analogy."

Another point that Spriggs (2008) made is the lack of acknowledgement in many (or perhaps all) ethnographies about the impact of colonialism on the group being described. He suggests that better analogies for prehistoric complexes in particular situations may be other prehistoric groups. Archaeological analogy is the only option that allows archaeologists to study "modes of life," long term sequences of culture change, and "pre-colonial forms of life" (Spriggs 2008:547-548).

In a response to Spriggs, Roscoe (2009:586) stated "[w]hat Spriggs offers with respect to the analogical value of the…ethnographic record is a counsel of despair when what is warranted is one of caution." He proposed that Spriggs overemphasized the changes encountered by colonialism, did not identify all ethnographies available, did not consider historical sources of information, and restricted the use of ethnographic analogy too far. Roscoe (2009:587) agreed with the processualists who claimed that instead of abandoning ethnographic analogy, it can help generate hypotheses to be tested archaeologically.

In many ways this dialogue is similar to discussions archaeologists have been having for nearly a century about the validity of ethnographic analogy and how it should be used in archaeological research. As a comment on both Spriggs and Roscoe, Ravn (2011) attempted to clarify the meaning of analogy, provide a summary of the history of its use in archaeology, and identify where he thinks analogy can be useful. He is in favor of using ethnographic sources to help researchers identify processes in the past (Ravn 2011:721) and further clarifies that "[o]ne need not account for every similarity between ethnographic sources and archaeological subject, as a single property from one source or number of different sources can be tolerated as long as the *relevance* between analogical source and subject is demonstrated" (Ravn 2011:721, emphasis in original).

Summary

Ethnographic analogy has consistently been used by archaeologists over the past two centuries to help explain and understand the patterns they see in the record. Initially, analogies were made by equating the present and the past; this led to a misguided view of hierarchical cultural evolution and eventually to strong critiques of analogical thinking within archaeology. The critiques said that analogies were liable to error, did not account for culture change, and are not testable. As a response, archaeologists avoided using analogy for a period. With the advent of the direct historical approach, archaeologists once again were thinking analogically. This time, however, they recognized the need to improve their analogies by limiting their applicability. Proposed limits included: restricting the use of analogy, testing analogies against the archaeological record, and using all available research.

In the 1960s, it was proposed that ethnographic data be used as a source of ideas or hypotheses to be tested using archaeological data. Again, critiques of the method were heard: Wobst (1978) suggested that hypotheses would be limited by the ethnographic data. Hodder (1982) proposed that the only use for analogy would be to examine both function *and* ideology. In the early 1990s, Stahl (1993) proposed the use of a comparative approach (relational analogy).

This approach would lead to archaeological tacking consisting of critiques of both source-side (ethnographic) and subject-side (archaeological) data (Wylie 2002). Hofman (1994:343, Figure 1) also stressed the importance of gathering information from both source-side and subject-side sources to identify patterns and measure variability in the archaeological record.

There is an ongoing discussion about how ethnographic analogy and ethnoarchaeology should be used in archaeological theory building and interpretations. This study is situated within that context and argues for the use of a comparative approach and the implementation of archaeological tacking. The history of thought with respect to ethnographic analogy in archaeology is included here because many of the same questions about the application of this tool that were considered in the early twentieth century are still part of the conversation. Today the discussion of the use of ethnographic analogy in archaeology is centered on what limitations should be applied to analogy, which sources should be considered, and how the relevance of an analogy is to be demonstrated.

Source-side Data: Ethnohistoric Hideworking on the Great Plains

Within the past decade, several researchers have used source-side data as tools to study hideworking and trade in hides among prehistoric and protohistoric peoples. However, this use of analogy in the context of archaeological hideworking tools is not a new idea. In his often cited example of the use of a formal analogy (Hodder 1982; Ravn 2011; Wylie 2002; among others), Using an analogy with Inuit ethnography, Clark (1971:10-11) suggested that women were the hideworkers at the English Mesolithic site of Star Carr. This formal analogy was based on the similar environments in which Mesolithic and Inuit peoples were living. Writing in the early 1970s, Clark did not examine the relevance of this analogy to the archaeological material under consideration. Instead he “invokes a weak principle of ecological determinism when he assumes that environmental constraints are the crucial determinants of group size and subsistence regime" (Wylie 2002:166). In contrast to this use of analogy, this project is an effort to approach hideworking using a comparative analogy that is flexible and can be reshaped as new information is gathered.

A Comparative Approach to Interpreting Bison Hideworking on the Plains

Analogy is a fundamental approach to archaeological interpretation. Although analogical thinking will never be foolproof, there are a series of methods that can reduce the uncertainty that comes with this line of thinking. I propose the use of a comparative model developed through archaeological tacking to help interpret prehistoric hideworking on the Plains.

Prior to this research, I knew very little about the steps involved in turning a green hide into a finished, tanned product. Although I have owned leather items, I have neither observed nor undertaken hideworking. By examining both written and visual materials that make up the ethnographic record, I have expanded my understanding of the process and my ideas of the prehistoric signature of hideworking. I also recognize that what I have read about and seen do not constitute the full range of hideworking techniques that are or have been practiced. This attitude is in contrast to what Wobst (1978) suggested ethnographic analogy would do. He indicated that because the record is limited it constricts our ability to understand potential variability in the past. I argue that including ethnographic data in a comparative model that integrates archaeological tacking methods we can surpass Wobst's understanding of the limitations of ethnographic analogy.

As described above, Stahl (1993) argued for the use of a comparative approach to the application of ethnographic analogy in archaeology. Her strategy includes both a critique of source-side materials and an evaluation of subject-side data to develop a comparative model. The method I propose for the development of an analogy for hideworking on the Plains includes (1) deriving relevant hypotheses from ethnographic information, (2) comparing these hypotheses to the archaeological record to identify similarities and differences between source and subject-side data, (3) considering both source-side criticism and subject-side evaluation to refine and develop a comparative analogical model, and (4) considering converging lines of evidence both within sources and between subject and source to form interpretive conclusions.

To derive hypotheses one must consider the relevance of the analogy, especially through source-side criticism. Stahl (1993) proposed three ways our use of source-side materials can be improved. First, source criticism must be considered; this is particularly true for colonized locales such as the Great Plains that experienced significant changes prior to and while ethnographic and historical description was being undertaken. Secondly, one must evaluate the meaning of ubiquity as observed in the ethnographic record. Finally, incorporating a temporal aspect into the model also can be helpful.

During subject-side evaluation, both similarities and differences between source and subject will be considered and archaeological data will be incorporated into the analogue to evaluate and refine it. In some cases the archaeological record (subject-side) also may yield entirely new ideas, which could be tested against ethnographic and ethnoarchaeological sources (Wylie 2002). Through this process of tacking between the source-side and subject-side material, a more informed understanding of the past should emerge.

Before analogs can be developed, however, a working knowledge of the data available is necessary. The next two sections of this chapter provide an ethnographic background for bison hideworking on the Great Plains. First, text-based ethnography is considered; then a sample of artwork and photographs are evaluated.

Text-Based Ethnography of Native American Hideworking on the Great Plains

This summary is based on information from groups who occupied various portions of the Great Plains. The Great Plains region includes tall grass and mixed grass prairies as well as the short grass High Plains of the central portion of North America (Commission for Environmental Cooperation 1997:26). For most groups who occupied this region during the Historic period, bison was a singularly important resource. Bison had many uses; the hide or skin of the animal was one of the most important parts of the animal due to its versatility. The following summary does not include a full discussion of the many uses for bison hides among Plains Indians, but more than 50 uses have been documented (Ewers 1979). Bison were an important resource during the prehistoric period as well. To make a bison hide useable for these many purposes they must first be processed, this discussion focuses on that sequence of steps.

Ethnographic records of hide processing show a sequence of hide acquisition, fleshing, thinning, applying a tanning solution, and softening. Many traditional techniques, crafts, and tools were abandoned after contact with new materials introduced by European and Euro-Americans. For example, flintknapping was largely abandoned in favor of metal tools. Hide tanning and processing essentially had an opposite history. The fur trade encouraged the hunting and processing of hides for sale; additionally, hides continued to be used in some of the same traditional contexts as before contact. In the case of tipis and clothing, however, canvas and western fabrics replaced hides as they became available. All of the sources used in this study were written after contact with Europeans and Euro-Americans, in some cases 100s of years after contact. It is difficult to gauge the extent to which the fur trade and contact with European and Euro-American goods changed the methods of hide processing employed by Native peoples (Wallace and Hoebel 1986:93; Wissler 1910:65). Certainly some of the items formerly made with hides were made with different tools and with new materials. On the other hand, it appears the basic steps required to process a hide did not change much as a result of Euro-Americans contact.

Based on archaeological remains, it is hypothesized that people have been processing hides since long before they arrived in the New World. For Plains peoples in particular, the bison has been the most important animal and they used essentially every part of it. Hides had many and diverse uses, and processing varied depending on the intended use. The term rawhide indicates skin is not tanned, but fleshed and thinned. Rawhide is very strong and tough; it also shrinks as it dries (Verbicky-Todd 1984:189-190). For this reason, it could be employed as a binding agent. Other uses for rawhide include parfleches (containers), moccasin soles, and rope. Tanned hide (buckskin), on the other hand, has been chemically altered and is soft and pliable. Among the Native peoples of the Great Plains, tanned hides were used for clothing, blankets, and a variety of other necessities.

When the hide was taken, the type and sex of the animal also influenced how the hide was processed. For example, the Blackfoot used the hide of a bull bison for rope because of it was tough and heavy (Ewers 1979:73). Thicker skins procured in the winter meant the hides were better for making items where the hair was left on including robes, winter moccasins, gloves, and bedding. Hides taken in the winter also were processed as robes for the fur trade. During the spring and summer the hides were thinner and better for making items such as tipi covers, lightweight clothing, and ropes (DeMallie 2001:6; Verbicky-Todd 1984:185). Generally young heifers were preferred for their hides, but older bulls were taken if skin was required for a new tipi (Kavanagh 2008:84). The thicker hides were used for items required to be more rugged such as shields and parfleches (Dodge 1877:357).

In general, the hide processing sequence across the Great Plains, specifically with groups who processed bison skins, is similar (Gilmore 2005:17; Verbicky-Todd 1984; Wissler 1910); however, some interesting differences also exist. All of the groups mentioned in this discussion also processed the skins of animals other than bison, but this review and research focuses on bison processing. Several descriptions of deer processing are present but that process is only touched on below (see Hilger 1951; Kavanagh 2008:376-377). The following discussion is a step by step description of the hide working process using text-based ethnographic and historical resources; discussion of variations in hide processing is included. This information provides a context for examining images described in the next section and evidence from the archaeological record.

Methods for Examining the Written Ethnographic Record

Many of the mid to late nineteenth and early twentieth century texts written about Plains Indians include a description of Native American hide processing. The authors were primarily, but not exclusively, men and included ethnographers, fur traders, historians, photographers, and artists. The descriptions of hideworking range from a couple of sentences to several pages. This research began with summaries of the hide working process on the Plains found in Verbicky-Todd (1984), Klek (2008), and Gilmore (2005). The bibliographies of these and other references, keyword searches, and my personal library were consulted to identify descriptions of the process. Keyword searches of “Plains Indians” “hide” and “skin” were accomplished online, at the University of Kansas Library, and the Lawrence Public Library. The Human Relations Area Files, Inc. (eHRAF World Cultures) database also was consulted (OCM code 281, “work in skins”).

Who were the Great Plains Bison Hideworkers?

Schneider (1983:104) stated "the division of labor in Plains Indians societies was not hard and fast, but depended upon a number of variables." She pointed out that researchers should not assume that women in every tribe did a task because those in one did. Gilmore (2005:16) emphasized this saying that, although hideworking was "perceived as woman's work, this did not mean that the entire process was left exclusively to women. As was the case for most tasks, certain realistic concessions were made." Despite these caveats, among the Native people of the Great Plains and adjacent areas who processed large animals, source after source indicates women typically, if not exclusively, worked the hides. Only in special cases men did tan hides or assist women (Schneider 1983:105). When men needed a skin for their own particular use (e.g., to make a shield, lariat, or rope) or when there was a particularly large hide and the woman required the strength of another person to help stretch it, men have been documented in hideworking (Haley 1997:100; Opler 1996:376; Schneider 1983:105; Wilson 1924:185, Figures 25-29). In other cases men would tan the hides of particular animals. Among the Pawnee, both men and women knew how to process hides, but the women apparently processed bison hides while the men concentrated on deer and elk skins (Weltfish 1965:372). Among the Assiniboine, many of the non-bison hides for the fur trade were delivered to market as rawhide and these were processed by men and boys (Denig 1930:541).

In general, it appears girls were taught the process of hideworking after they had their first menses, during their early teenage years (Hilger 1951:129; Michelson 1933:599; Weitzner 1979:253). The girl's mother, older sisters, and paternal aunts would teach her about the process (Michelson 1933:599). Among the Pawnee, boys also learned the skill (Weltfish 1965:372).

Limited information exists to tell us about the length of time it took to process a bison hide, but it likely varied based on the skill of the processer and the amount of time per day she could spend on the task. Denig (1930:541) stated it took a woman of average skill about three days to process a robe for the fur trade. On the other hand, Wallace and Hoebel (1986:95) suggested that a woman may take ten days or more to tan a hide. Moore (1999:60) specified that the Cheyenne needed a week or more of continuous work to process bison hides, but he was likely referring to numerous hides procured during a large hunt. A woman alone could prepare, on average, 20 robes a season while still completing her other duties; however, when women worked together their productivity increased (Neithammer 1977:112). Women, during the "height of the buffalo culture spent most of her [their] time dealing with the enormous amount of meat and hides her husband provided" (Neithammer 1977:111).

Hide Acquisition/Butchering

Men are more likely to have been the hunters in large game kills, but in some cases women participated in hunting large game (Weist 1980:257). Woman more often contributed to the acquisition of animal products for the household through participating in group hunting or snaring/trapping small animals (Gilmore 2005:17). If the kill took place far from home the men were often alone and would butcher the animals; however, if the kill took place near the village or if the woman had accompanied the men on the hunt, other men and women would join the hunters to assist them in butchering (Klek 2008:104; Neithammer 1977:113). In either case, a knife was an essential tool for the butchering and skinning process. During the equestrian period, men often hunted bison in groups and few women participated in this process (Gilmore 2005:17). Hans (1907:157-158) described the skinning and butchering as woman's work among the Sioux. Niyah, a Comanche informant, reported that the men would butcher and skin their kill, but once the materials was returned to camp it became the women's responsibility (Kavanagh 2008:84); however, Wallace and Hoebel (1986:93), also reporting about the Comanche, stated that women were the ones who skinned the animals. In all likelihood, both of these situations occurred.

Sometimes a bison hide was taken in one piece, other times it was halved or even quartered. A decision about how the skin was removed was influenced by the intended use of the finished hide. For example, if the hide was to be used for a bull-boat, it would not be cut (Wilson 1924:252). Pawnee and Hidatsa accounts describe removing the hide in two pieces by making a long cut down the back and belly of the animal (Klek 2008:106). Other groups, including the Assiniboine and Omaha, sometimes separated bison hides in a similar manner (Denig 1930:540-541; Dorsey 1884:311). The process of taking the hide in one piece is described in accounts of the Plains Cree, Omaha, and Sioux (Klek 2008:107). Bison were generally skinned in similar ways, but some variety in skinning techniques around the head have been noted (Klek 2008:108). Hides were generally processed before being further divided into a size required for their intended purpose, but among several tribes, skins being prepared to be rawhide ropes were cut to the approximate length and width of the rope before processing began (Ewers 1979:73; Kroeber 1908:150; Wilson 1924:185-187). A hide that was cut to make a rope would be staked only at either end as it was too narrow to be staked all the way around.

In some cases the hide may have been initially processed at the location of the kill before being hauled back to camp (Fletcher and La Flesche 1992:2:342-344). Whether initially processed or entirely green, the hide was used to assist in moving the meat back to the camp (Klek 2008:108). Klek (2008:108-109) cited the Pawnee, Sioux, Comanche, Arapaho, Hidatsa, and Gros Ventre as employing this method by forming a bag, a container to be carried by a horse, or a bull boat with the hide. In addition to hauling meat, green hides could be used for warmth in the event of a storm, or a vessel for gathering marrow (Klek 2008:109).

Staking or Racking

Staking or racking was usually the first step in the hideworking process. Staking or racking is done to stretch the hide as well as to provide a good working space. Before staking or racking, the fresh hide must have small holes cut along the edges, and then it is stretched and staked to the ground using wooden pegs or latched to a wooden frame with rope. As the skin dries, it shrinks and the holes expand; if the hide continues to be staked or racked it will need to be adjusted to keep it in a tight position. In some instances museum pieces still have evidence of these holes, but in other cases the edges with the holes have been cut off (Klek 2008). The hide was first staked with the hair facing the ground. One source reports the Cheyenne would stake the hide several inches above the ground with "chokecherry pegs which had a notch near the top to hold the hide in the proper position" (Moore 1999:60). This type of staking was utilized to help avoid causing damage to the hide in case it caught on something on the ground and tore a hole.

Many ethnographic sources describe staking (Dodge 1877:357; Dorsey 1884:310; Ewers 1945; Kavanagh 2008; Nye 1962; Wissler 1910), while others describe racking or combination of both techniques (Boller 1868:301-302; Hans 1907:159; Mandelbaum 1940; Schultz 1962:32; Weitzner 1979). Usually if both methods were used, the hide was staked out during the fleshing and racked during the tanning and softening process (see Fletcher and La Fleshe 1992:2:342, 345; Weltfish 1965:39-370). Among some groups, staking was used in the summer and racking employed in the winter because the frozen ground prohibited driving stakes into it (Denig 1930:540; Weitzner 1979:254). Racks also were used if the hide was being processed indoors; no reports describe processing of large hides in tipis, but it is discussed among the Northern Plains groups who lived in earthlodges. The Northern Shoshone apparently staked bison and elk but hung up deer hides to be worked (Lowie 1909:175). Hans (1907:162) submited that working on a staked bison hide is "easier" than one on a rack and this may be another explanation for the choice of technique. Writers describing the Arikara and Hidatsa include mention of hide drying racks or frames, which were especially used when the camp was in the woods (Weitzner 1979:253-254).

In 1942, Weasel Woman (aka Uta Wiaś aka Jeanette Little Crow) demonstrated the processing of a calf hide for Hiller (1948) to observe. Weasel Woman did not stake the hide but used her weight to hold it in place during the early steps of processing, later, for squeegeeing and graining, it was racked. Racks were described as being made of excess tepee poles and the stakes used to pin hides to the ground were the same ones used to stake down tipis (Ewers 1945; Gilmore 2005:18; Schultz 1962:32). Sinew or rawhide was used to attach the hide to the rack. Based on museum pieces, Klek (2008:111) maintained that the holes created by staking are generally larger and more widely spaced than those created by racking a hide. Throughout the process of hideworking, the hide would both shrink and stretch so the pegs or the rope holding the hide to the rack were adjusted as required (Ewers 1979:73).

Generally stretching via staking or racking is the first step in the process of hideworking. An exception is described among the Assiniboine and Gros Ventre; these groups appear to have hung the skin on an upright post or tripod where fleshing was accomplished "by hoeing down with the instrument" (Denig 1930:540). After fleshing, the hide was staked or racked (Denig 1930:540; Kroeber 1908:150).

Fleshing

When the hide has been stretched, it is ready to be fleshed. This process removes any remaining meat, fat, membranes, and coagulated blood from the hide. This step is essential to keep the hide from spoiling and is best done as soon as possible after skinning the animal (Dorsey 1884:310; Klek 2008:114; Wemett 1927:137). In contrast to other sources, Wilson (1924:247) reported his informant Buffalo Bird Woman said the hide should be fleshed on the second day after it is taken. After fleshing is completed, hides can be stored for additional processing later (Kavanagh 2008; Klek 2008). Fleshing has to be completed before the hides dry too much; as hides dry the tissue begins to tighten (Klek 2008:116). If the hide is drying too quickly before fleshing, water may be applied to keep them moist (Battey 1875:187; Klek 2008).

Women are described as fleshing with their right hand while on their knees next to or on the hide (Ewers 1945:10). Weltfish (1965:217-218) described White Woman as standing over the hide and fleshing it. To remove the adhering meat and fat the women used "short, vigorous blows of a sharp-toothed, fleshing tool" (Ewers 1945:10). Bone fleshers were employed using a motion towards the agent (Wedel 1936:84). A bone tool, commonly made from the leg bone (a metapodial or sometimes a tibia) with the distal epiphysis cut or broken at an angle and small teeth cut in the end of it, was usually employed to remove this material. The bone may be from a bison, elk, or another species of large mammal (Dorsey 1884:310; Hilger 1951:128; Matwychuck 1980; Steinbring 1966; Weltfish 1965:369). Fleshers varied in length between about six and twelve inches and usually had a serrated end (Battey 1876:187; Wedel 1936:84; Wissler 1910:Figure 34). A hole was drilled at the thick end of the bone and a piece of a tanned hide (or rope) was passed through it and wrapped around the person's arm at the wrist or just above the wrist (Dorsey 1884:310; Steinbring 1966; Weltfish 1965:369). Alternatively, this thong may be tied around the flesher and then placed around the wrist (Moore 1999:Figure 3.8). The thong allowed for more pressure to be placed on the tool.

Other types of tools used in fleshing include a hand held prepared stone tool (Grinnell 1972:214; Hoebel 1988:66; Wissler 1910:66) or a metal flesher (Gilmore 2005:19; Grinnell 1972:214; Kavanagh 2008:84; Kroeber 1902:26). Opler (1996:376) and others described metal fleshers with serrated bit ends similar to bone fleshers. A variety of metal items, including an iron pipe and a gun barrel with a flattened end, were described as being used as fleshers (Lehmer 1971:154-155; Mandelbaum 1940:194; Weitzner 1979:253). In addition to fleshers, knives were used during this task to cut off the more sizeable chunks of meat, etc. Schultz (1992:343) states "at least ten ethnographic accounts record the use of the L-shaped scraper for fleshing bison hides," but those groups are not identified. My research does not suggest groups used these composite scrapers (described below) during the fleshing process, but both Schultz (1992:343) and Wiederhold (2004:76) reported it was an effective fleshing tool in their experiments. In contrast, other researchers conducting experiments determined it was not a useful fleshing tool (see Schultz 1992:343).

Usually the hide was staked during fleshing, but sometimes the hide was hanging from an upright post or pole (Denig 1930:540). Comanche informants mention using the dried abrasive skin of a bison tongue to roughen and prevent the hide from hardening during this step (Kavanagh 2008:309; Wallace and Hoebel 1986:94). Steinbring (1966) described the ethnographic manufacture and use of moose bone fleshers on racked hides among the Black River Band of the Ojibwa in Manitoba, Canada. After fleshing the hide was left to dry and bleach in the sun for a few days (Ewers 1945:10; Mails 1996:210; Moore 1999:62; Wissler 1910:64). Sources do not describe removing the hide from its staked position, and presumably it stayed staked during this curing before being removed for the subsequent scraping process. During winter, a small fire was sometimes built to assist in drying the hide (Denig 1930:540). However, there was some variation about how much the hide is dried at this stage. Wissler (1910:64) described the Blackfeet as periodically wetting the skin down during this time so it did not dry too much.

According to Fletcher and La Fleshe (1992:2:343) the work of fleshing a hide took two to three hours, but Weltfish (1965:369) described the process as significantly faster (a half hour), and Weitzner (1979:255) wrote that it would take a day to flesh two half hides. This discrepancy may have been due to the time it took to rack or stake the hide, which may have been included in Weitzner's estimate.

Klek (2008), a modern hide processor who has studied traditional techniques, suggests that a step that is often not included in ethnographic accounts but was no doubt employed was an initial cleaning of the hide. Indeed, there were probably still signs of blood and other material after fleshing was accomplished. Washing of the hide may have taken place either before or after fleshing. Fletcher and La Fleshe (1992:2:342) make mention of this step: "First, the green skin was washed in order to remove all evidences of the slaughter." Other groups may have considered a fleshed hide clean enough without washing or circumstances may have made washing unfeasible.

Scraping/Thinning

For a bison hide to be properly tanned it must be thinned first. The skin of bison and other large mammals is thicker in some areas than others; scraping the hide can help to even the thickness of the hide. A skin of a more consistent thickness will tan more evenly. The quantity of hide thinning varied based on what portion of the hide was being thinned and the intended final use; however, observers recorded it being thinned between one half and one third of its original thickness (Denig 1930:540; Dodge 1877:358; Hans 1907:162; Schultz 1962:32). To complete this task for one hide took approximately a half a day (Denig 1930:540; Weltfish 1965:370). During the thinning process, one might check the thickness of the hide in a particular area by pinching the skin to see its thickness (Moore 1999:62-63). If an area of the hide became too thin wide angle V-shaped gashes were created (Klek 2008:119). "The skill of this process is in so directing and tempering the blows as to cut the skin, yet not cut through it, and in finally obtaining a perfectly smooth and even inner surface and uniform thickness" (Dodge 1877:358).

Several sources described women standing on a hide and bending over at the waist to apply pressure while scraping or thinning a hide with a composite scraping tool (Denig 1930:540; Ewers 1945:10-11; Hiller 1948:7; Mandelbaum 1940:194; Wissler 1910:64). This position allowed women to move around the hide easily, to put more weight behind the scraping, and to better control her motions (Hiller 1948:7; Kehoe 2005:137). The tool was used "with hoelike motions to scrape the hide through" (Kavanagh 2008:288). Weltfish (1965:369) described this process in detail: the woman held "the elbow-scraper [composite scraping tool] crosswise with her left hand on the handle end and her right hand on the elbow so that she could push it across the skin. She removed hair, chips, and shavings, striking and pushing upon the skin and scraping with a sidewise motion toward the left." Although this and other sources describe the use of two hands for scraping (Denig 1930:540; Weltfish 1965:369), Wallace and Hoebel (1986:94) and Hans (1907:161) both mention the composite scraper could be used with one hand. The scraping bit was essentially perpendicular to the hide in order to easily remove the inner and outer layers of skin and the hair (Hiller 1948:7; Wissler 1910:66). Despite owning an elk horn composite scraping tool (Wilson 1924:283), Buffalo Bird Woman described removing the hair from a skin using an “ax” and her son, Goodbird, drew a picture of this activity with such a tool (Wilson 1924:270, Figure 94). She also described using a “scraping motion” and a stone to make sure all the hair was removed. By “ax” Buffalo Bird Woman may have been referring to a composite scraping tool, no other sources describe using an axe in this process.

The composite scraping tool, consisting of an elk antler or wood handle with a chipped stone or iron scraper tool, was used to both thin the hide and to remove the hair from the hide if desired. This tool is described as similar to an adze (Ewers 1945:10; Kavanagh 2008; Lowie 1983:76). Scraper handles from North America have an approximately 90 degree bend on the end that holds the bit. Those made of wood are worked to have this 90 degree angle if they do not already have it (for an example of this see Jones 1969:75). The section of the elk antler that was chosen had a spike that branched at this angle; it was cut to size and the inner side of the short portion was flattened so a bit could be attached (Hiller 1948:7). Ethnographically collected scraper handles are between 10 and 15 inches in length and average 12 inches (Bushnell 1922; Hilger 1951; Hiller 1948; Jones 1969; Wedel 1936:82; Wissler 1910). The bit was lashed to the inner or underside of the handle with the beveled edge toward the short side of the composite scraper (Hiller 1948:7; Wedel 1936:82). Based on ethnographic data, it appears this type of endscraper handle was used throughout the Great Plains.

The elk antler handle of the scraping tool was important to Native American women. It is documented as a curated item among many Great Plains groups (Baillargeon 2005:145,147; Grinnell 1972:214-215; Hans 1907:162; Hiller 1948:7; Hoebel 1988:67). In other instances the tool was buried with the woman who owned it (Liberty 2007:89). Incised lines or patterns on the handles can have a variety of meanings: they may be purely decorative (Hiller 1948:7), show the number and age of children (Grinnell 1972:215), the number of hides processed (Kroeber 1902:26; Schneider 1983:115), or be a count of war achievements of the owner's husband.

If the hair is to be removed from the hide, the skin side is scraped first, and then it is turned over and the hair removed (Ewers 1945:10). Bison skins with the hair still attached were desirable for some purposes, such as robes and blankets, especially for the fur trade. The hair may be removed with the scraping tool described above, a knife blade, or by pounding the hairy side using a stone hammer (DeMallie 2001:6; Ewers 1945:10; Kroeber 1902:26; Wissler 1910:66). Wood ash, water, and lime were sometimes applied to assist in removing the hair (Catlin 1973:45 [1943]; Dodge 1877:357; Wallace and Hoebel 1986:93). Although some Comanche sources indicate the wood ashes used in this task were wet (Wallace and Hoebel 1986:93), one Comanche informant, Howard White Wolf, stated that dry wood ashes were rubbed into the hair before removing it (Kavanagh 2008:288). The use of ash apparently opens the hair follicles and made the hair easy to remove, but this method was not universally employed even among the Comanche (Kavanagh 2008:310). Wallace and Hoebel (1986:93) mentioned the tool was scraped against the grain to remove the hair. When making rope the process of hair removal appears to have been different. Rope makers observed by Ewers (1979:73-74) softened the hide with a rough stone after it was staked and dried, next they removed the hair with a rock or by running it back and forth through the eyehole of a bison skull. When the hide has been thinned and de-haired it may be re-staked and allowed to dry to make rawhide, or the processor can continue with the tanning process described below.

Beaming, the use of a bone or wood tool with a metal or stone blade set into the middle, to soften and roughen a hide appears not to have been applied to bison hides. This step accomplished the same goal as the fleshing and scraping described above. The beamer tool was rubbed across the hide while it was slung over an inclined beam of wood or hung on an upright post. Wissler (1910:69-70) described beaming tools made from the leg of a deer or other medium mammal, a rib bone, or a curved wooden stick with metal blade in the middle. Several ethnographic and historical sources describe this process on deer hides and, to a lesser extent, elk and antelope (Gilmore 2005:19; Haley 1997:100; Hilger 1951:130; Kroeber 1902:26-27; Opler 1996; Ritzenthaler and Ritzenthaler 1983).

Applying the Tanning Solution

Tanning permanently alters the skin by altering the protein fibers in it. Ingredients in the solution used by Plains Indians varied, but usually included brains (often from the same animal whose hide is being worked), liver, and fat. In some cases no other ingredients were added, but bone marrow, the spleen, broth from boiled meat, urine, or sour milk also sometimes were included in the solution. Plant materials sometimes incorporated into the tanning solution included sage, soapweed root, prairie tea, and basswood or elm bark (Carlson and Jones 1939:539; Grinnell 1972:216; Hoebel 1988:67; Moore 1999:63; Wallace and Hoebel 1986:94; Weltfish 1965:369; Wemett 1927:138). More recently, “lard, baking flour, and warm water” were used as a tanning solution among the Blackfeet (Wissler 1910:64). Both the tanning solution and the water used during this step should be warm.

The tanning mixture could be applied fresh by rubbing it into the flesh of the hide or preserved for later use (Belitz 1973:9; Hiller 1948:8; Klek 2008; Fletcher and La Fleshe 1992:2:345). The application of the tanning solution was undertaken using hands, an applicator, or both. Documented applicators included clumps of sage (Fletcher and La Fleshe 199:2:345; Hiller 1948:8), a piece of bark (Weltfish 1965:370), or a stone (Belitz 1973:9; Dodge 1877:358; Ewers 1945:11; Hans 1907:162; Wallace and Hoebel 1986:95; Wissler 1910:64). The applicators also were rubbed on the skin to roughen it before and during the application of the tanning solution (Moore 1999:63). The heat generated during the application of the solution assisted in helping it soak into the hide (Ewers 1945:11; Klek 2008). A squeegee tool is sometimes mentioned in this step: “The solution was now pressed in and rubbed from the top downward with a special tool resembling the blade of an iron hoe” (Weltfish 1965:370). Weasel Woman, a Hidatsa, used such a tool during her demonstration. Hiller (1948:8) called this tool a “slime scraper.”

The next step in the process varied slightly among different groups and perhaps within a group depending on if the hide retained its hair and its thickness. Some sources describe leaving the tanning solution on the hide and rolling it to store it either overnight or for several days, which allowed the tanning solution to fully soak into the hide (Denig 1930:541; Grinnell 1972:216; Mails 1996: 210; Mandelbaum 1940:194; Schultz 1962:32). But most of the sources suggest the skin should be sprinkled or soaked with water either immediately after tanning or after it has partially dried in the sun (DeMallie 2001:6; Ewers 1945:11; Wallace and Hoebel 1986:94). This wash was designed to remove any remnants of the tanning solution (Moore 1999:63). The hides which were only sprinkled, not soaked, may have still had their hair. Soaking a hide with the hair on can cause the hair to fall out (Belitz 1973:10). Among the Comanche, the hide was sometimes put in a bag before being placed in water overnight (Kavanagh 2008:309-310), and the Omaha and Hidatsa would place it in a stream for one to two days (Dorsey 1884:311; Fletcher and La Fleshe 1992:2:345; Hiller 1948:8). After the hide was soaked, it was wrung out, “often by wrapping it around a stick and twisting until the water was driven out” (Gilmore 2005:19-20, see also Lowie 1909:176). Whether the tanning solution is washed out immediately or after some period of time the next step is the same: the hide must be stretched and rubbed as it dries.

Softening (rubbing/roughening/stretching)

Next the hide is stretched and rubbed to break down the collagen fibers to make it its original size and soften it; additionally, the heat generated during this process helps to dry the hide (Klek 2008:126). Stretching the hide was necessary during this step because hides shrink during the tanning process, and stretching can keep the fibers loose and flexible. Stretching was accomplished without any special equipment with the hands and feet (Ewers 1945:11). The softening task has been described as the most difficult work in the process of tanning a hide because the skin had to be worked for many hours through rubbing, graining, and stretching until the whole thing was soft, thin, and pliable (Kavanagh 2008:288; Moore 1999:64; Schultz 1962:32). The heat generated during this process helped move the softening and drying along. Denig (1930:541) indicated that the Assiniboine would pause the softening process every few minutes and hold the hide to the fire to assist the drying.

As part of the softening process, the hide was rubbed back and forth on a rope made of sinew or rawhide attached vertically to an upright beam or strung horizontally between two posts (Denig 1930:541; Ewers 1945:11-12; Grinnell 1972:216; Lowie 1909:176; Schultz 1962:32; Wallace and Hoebel 1986:95; Weltfish 1965:370). If an upright beam was needed, an extra tipi pole was used. Some authors described this rope as being five or more feet from the ground suggesting the worker stood to work it (Dorsey 1884:311); others describe it as slanting down from five and a half feet to two feet strung between two posts (Weltfish 1965:370); and Grinnell (1972:216) describes the woman using it as kneeling. When using a rope strung between two posts, Weltfish (1965:370) states that two women may work on one hide together. Wissler

(1910:64) also described two women working together to rub large hides. In some cases a bison scapula with a hole in it or a sapling was used as the abrader (Moore 1999:64; Neithammer 1977:113-114). During the historic period, metal straps such as barrel hoops or old scythe blades were used for this purpose (Klek 2008:128). They were attached to beams making a D-shaped arc. As in the other steps, the process of making rope was slightly different. "In order to soften them [new ropes], they were covered with manure, or tied to a horse that dragged them over the ground until they became pliable" (Kroeber 1908:150).

At this point in the process some hides required additional thinning. For thinning now a graining tool was used on a racked hide (Gilmore 2005:20). This step made sure the hide was of equal thickness and no stray fibers remained (Belitz 1973:11; Wemett 1927:139). The graining tool was anything from a rough stone (pumice or scoria) to the cancellous portion of a bone or a metal tool (DeMallie 2001:6; Denig 1930:541; Ewers 1945:11; Hiller 1948:8; Kavanagh 2008; Lowie 1983:76). "These pieces, which were flattened and scored with numerous cross incisions on the porous polishing side, were rubbed against the hide much as we use sandpaper" (Hiller 1948:8).

The process of applying the tanning solution and softening would sometimes need to be repeated (Hiller 1948:8); the steps do not have to be completed in the order described above. Klek (2008:124) wrote that three to four applications of the tanning solution were needed to make the hide pliable when it dried. The re-application of solution and drying affected the amount of time this step took. The process of softening could take place over a period of several days when each day the worker would dry the hide and then stretch and rub it for a period of time (Wallace and Hoebel 1986:95). In other cases this was a continuous process whereby one person was spelled by other members of the family or visitors (Lowie 1909:176). Sometimes white clay, selenite, or flour was added to whiten the hide as it dried. Rarely prairie chicken or sage hen scat (Voget 2001:699) or a fungus (McClintock 1910:230) were used as a whitening agent. The absorption characteristics of some of these additives may also have assisted in drying the hide. When the hide had dried and was soft and pliable it was completed. "Finally, it was laid outside in the dew overnight and rubbed with a rock [round stone] in the morning for a final polish" (Kavanagh 2008:310).

Repairing Holes and Trimming

Some holes occur during the tanning process, they may be repaired by sewing the hide back together either from the flesh or hair side (Klek 2008; Wemett 1927:139). After tanning was completed, the hide was trimmed; holes created to stretch the skin, areas that were too thick or thin, and improperly tanned areas all were removed (Denig 1930:541; Lowie 1922:217; Moore 1999:60; Weltfish 1965:371).

Smoking (optional)

Smoking a hide is a final step; it preserves the tanned hide and keep it soft and pliant even after it gets wet (Catlin 1973:45-46 [1841]). To smoke the hide, a hole, approximately one foot in depth and two feet in diameter, was dug, and a frame of sticks was created around it or a wooden tripod, from which the hide is suspended, was created. Then a low flame, high smoke, fire was created and the skins were placed securely on the willow frame allowing little room for any smoke to escape. The hide may be staked to the ground to assure no smoke escapes (Lowie 1909:176). Sometimes the hide was sewed into a cylindrical shape with one end closed for smoking (Belitz 1973:14; Catlin 1973:45-46 [1841]). Other times another hide was placed on top, and the hides are left there, with periodic checking for about a half of a day or more to see if they are the right color (Ewers 1945:12-13). This step in the process turns the hide brown or golden. Ewers (1945:12-13) described the hair side as in towards the smoke. Belitz (1973:16) stated that the former hair side was usually a deeper brown on smoked hides. However, if a different color was desired, some materials could be added to the fire to dye it. Roots, bark, and walnuts all were used during smoking to create different colors (Mails 1996:210).

Despite the advantage of smoking, not all tanned hides were smoked (Gilmore 2005:20). Klek's (2008:129) research has suggested that Native Americans may have smoked hairless bison skins, but not haired ones. Among the Crow, Lowie (1922:217) claimed bison hides were never smoked; but, as hides used for clothing often were smoked (Verbicky-Todd 1984:191), this seems unlikely. Mails (1996:210) reported most Native groups smoked the skins they were going to use as moccasins. According to Ewers (1945:12), the Blackfeet thought smoking hides would help repel moths and mosquitoes. Hides to be used for tipis were not usually smoked at this stage because they would be smoked naturally over time through use (Gilmore 2005:20; Wallace and Hoebel 1986:95).

Sewing and Decoration

Bone awls and sinew thread were used to sew up bison hides that had been originally separated for ease of processing (Verbicky-Todd 1984:190). These items also were used in the manufacture of a variety of other hide items including clothing, moccasins, and bags. Methods of decorating hides include dying the hide (Weltfish 1965:371-372), patterned scraping (Lowie 1983:79 [1935]), quilling, beadworking, and painting. Painting is discussed below in more detail.

Tipi covers required a great deal of work and several hides were needed for one cover. The number of hides required for a lodge ranged from 8 to 30 depending on the desired size (Hoebel 1988:67 Nye 1962:124; Voget 2001:700; Weltfish 1965:371). Often the woman who required a new tipi cover would prepare the hides required before inviting close friends and relatives to help with its construction. Multiple ethnographies describe the use of an expert in tipi construction who would take the lead during this "sewing bee" (Hoebel 1988:67; Kroeber 1908:150; Nye 1962:124; Schneider 1983:114; Wallace and Hoebel 1986:96; Weltfish 1965:379). The assistants and forewoman all received food and gifts for their assistance (Hungrywolf 2006:185; Weltfish 1965:379-380). Among Plains groups, women usually owned the tipis. This holds true for the Cree where men had to get the women's permission before painting them (Mandelbaum 1940:211, 286). Commonly men were the painters of tipi designs (Mandelbaum 1940:286); however, sometimes, at least among the Omaha and Blackfeet tribes, women and/or children assisted (Schneider 1983:108). Nye (1962:125), writing about the Kiowa, claimed that some tipi covers were made with the hair on to provide more warmth in the winter.

Painting of parfleches was sometimes undertaken by women, and other times by men (Kavanagh 2008:311). The Blackfeet would sometimes paint their parfleches prior to removing the hair on the opposite side. When the paint had dried, the hide was turned over and the hair removed. The advantage to this was that "[p]ounding the outside of the hide with a rock made the unpainted portions of the rawhide a whitish color" (Ewers 1945:17).

Image-Based Ethnography of Native American Hideworking on the Great Plains

Beginning with Coronado's 1540-1542 exploration into the Great Plains, Native Americans were periodically visited by Europeans and Euro-Americans. By the late 1700s, the lives of all tribes on the Great Plains had been dramatically changed by the acquisition of the horse, and other European influences (Hämäläinen 2003). Europeans, like horses, were an increasingly common sight on the Plains during the 1700s with the beginnings of the North American Fur Trade. In 1803, the United States purchased a large swath of the Great Plains from the French in the Louisiana Purchase. The perceived availability of this land led to a more intensive fur trade and visitors to the region from all walks of life. George Catlin, an American artist who toured the Great Plains beginning in 1830, was the first artist to record the Native occupants of the Plains where they lived (Dippie 1992). Other artists followed shortly thereafter. The earliest photograph, the daguerreotype, was developed in 1839; photography, then, was a relatively new field in the 1860s when it was first used to document Native Americans on the Great Plains (Mitchell 1994; Southwell and Lovett 2010).

Images convey an impression or moment of time and they can enlighten what we read in written sources about activities taking place. This study culled through 1,000s of images printed in published materials and available online looking for images that enlighten the process of bison hideworking among Native Americans on the Great Plains. A total of 94 images, showing all aspects of this process, were identified. The following discussion describes the methods, results, and archaeological implications of this research.

Methods for Examining the Image Based Ethnographic Record

The Native peoples of the Great Plains attracted a lot of attention from artists and photographers as well as authors. Indeed, the iconic image of the Native American became that of the Plains Indian due to this widespread obsession (Hill 1998). Consequently, many images of these peoples exist, but it was not known to what extent hideworking is represented in these collections. All Plains groups practiced hideworking; but, as described above, this activity was usually undertaken by women. To what extent were women and hideworking photographed and what can we learn from these images? A systematic study of ethnographies, histories, and books about image makers available at the University of Kansas Library, the Lawrence Public Library, and my personal library was made to begin to answer these questions. The bibliographies of these books, the *Great Plains Indian Illustration Index* (Van Balen 2004), and the *Guide to*

Native American Ledger Drawings and Pictographs in United States Museums, Libraries, and Archives (Lovett and DeWitt 1998) also were examined for additional images available in published materials. Approximately 30 images were identified through this process.

The other major source of images for this study came from searching resources available on the Internet. In recent years, many institutions have begun digitalization projects that make images in their collections available to the public online. Other online resources come from individuals, sometimes Native people, who have an interest in disseminating these images. In particular, the Denver Public Library Digital Collections (http://cdm16079.contentdm.oclc.org/cdm/), Digital Horizons: A Plains Media Source (http://digitalhorizonsonline.org/), and the Archives, Manuscripts and Photographic Collections, made available through the Smithsonian Institution Research Information System (SIRIS) (http://www.siris.si.edu/) were three of the databases that yielded images for inclusion in this study (accessed between June 2012 and April 2016).

In the indexes of books and in the search box of websites a series of keywords were used to locate images of interest. In the beginning of my research the word "hide" was used as a keyword. It became apparent; however, that this word did not catch all the images I was looking for, so additional keywords were included. Additional keywords searched were: woman/women and camp. Occasionally, "tipi" (and variations on the spelling) and "skin" also were searched. In books I also looked under buffalo or bison to see if bison hideworking was mentioned. In my experience most photographs do not include the type of animal being processed, and this was not a helpful way of online searching for images. When an image was located in an online database an effort was made to examine other items cataloged in a similar way to see if other photographs that were taken at the same time are available. This allowed me to identify several series of photos. This is an advantage of databases and archives. If we only look at published sources we only see what the author or editor wants you to see. Of course, at all times we are limited by what the artists or photographer wants us to see. Finally, some of the artists and photographers, known to have produced images of the sort I was looking for, were searched online to see if additional images could be found. Forty-three images were gathered through this process; several of the images originally found in published materials were located online as well.

In some cases exact duplicate images were observed in multiple locations; only one copy of the image was retained in the database. The version with the highest resolution and least cropping apparent was retained. Modern works of art, drawn to illustrate books, were excluded. All images in which hideworking was taking place were retained. If the hide was in use after having the entire process completed it was not included in the data. Although images showing the working of bison hides were prioritized, the animal was indeterminate in some images and in others it appeared to be medium mammal sized. As long as the group represented by the image hunted bison the image was not discarded. In another case a series of images was taken showing Weasel Woman processing the hide of a calf (Hiller 1948). The context of these images is clear: the woman was recruited to demonstrate her hideworking method; and, as such, they were retained.

Ideally, the original negative or sketch of each image would be consulted in this type of study; images can and were manipulated (Margolis 1988). To do this, visits to the images repositories may be required; on the other hand, some of the images garnered from online sources are direct scans of the negatives making such a visit superfluous. Another advantage to visiting the repositories of these and other images would be to look for additional images that have not been scanned or used in publications. However, the advantage to the type of study reported on here is that repositories from all over the United States can be scanned for potential data without the cost and time of traveling. This study has identified repositories where there is potential for additional Plains hideworking images and a further step in the study would be to visit those archives, museums, and libraries.

When the images for this study had been gathered, they were closely examined and described using a textual description and answers to a series of questions (Table 2.1, Appendix A). This information was entered into an Excel database for ease of data manipulation. Metadata about the source of each image, the date and artist or photographer (if available), and similar images also was entered into this database (Appendix A).

Table 2.1. Type of information collected for the database. In additional to this information about the content of the image, information about the source was recorded.

Database Column	Description
Tracking Number	Each image was assigned a number for this study. Numbers were assigned as images were added to the database.
Tribe/Group	This is the tribe or group as identified by the source.
Hideworking Task	Which task associated with hideworking is represented.
What activity (my words)	A text description of the image in my words.
What activity (caption/text/website)	A text description of the image from the source.
Focus or Incidental?	Is the hideworking depicted the focus of the image or incidental to it?
Agent	Is a person actively participating in hideworking? If so, what is their sex?
Other people?	Are other people visible in the image? If so, who?
Location	Where is the hideworking activity taking place?
Material culture used in hideworking	What types of material culture were observed in use during hideworking?
Time of year	Season of the year, if identifiable.
Type of hide	Types of animal hide, if identifiable.
Evidence of Euro-American material culture influences	Listing of identifiable Euro-American material culture visible.
Tipi visible/material	Is a tipi visible in the image? If so, is it made of canvas, hide, or indeterminate?

Similar images were noted during both the gathering of images and entering the data. These images are not duplicates but were taken at the same time as others. For example, as mentioned above, Weasel Woman was photographed processing a calf's hide; six images of this process were observed.

After all 94 images were entered in the database all similar images were identified. Similar images accounted for 49 of the 94 images in 15 sets. I then culled the similar images so that only one of those depicting an activity was retained. Therefore, in the case of Weasel Woman, one image of her scraping the hide was retained, and two were culled. The other images of Weasel Woman depicted her engaged in other hideworking activities and were kept. As a result of this process, 20 images were discarded. One additional discard should be noted here. One image, of three Shoshone women who "prepare animal skins" was included in the database but is both outside the geographical region of study and obviously posed. It is not included in the following analysis, but is mentioned in a short discussion of photography and Native Americans which follows. This process left a total of 73 individual images from which the following analysis derives.

Results

The sample includes images from the 1830s through the 1940s. No images more recent than 1950 were included. Four of the images had no date information and they were recorded as unknown. One third (n=24) of the images are from the nineteenth century; slightly more than a third (n=32), are from the 1900s and 1910s; and a minority (n=8) are from 1920-1942. The date of the remaining images was unknown or was a range of more than a decade. The earliest of the 61 photographs is from 1869, and all of the 12 drawings and paintings are from the nineteenth century.

The creators of these images include more than 25 artists and photographers. For 18 of the images the creator is listed as unknown. Nearly all of these creators were men with the notable exception of Julia E. Tuell and possibly Elizabeth C. Grinnell. Although no photos in this database are attributed to Elizabeth Grinnell, she assisted her husband, George Bird Grinnell, in the field and took some of the photos attributed to him (National Museum of the American Indian Archive Center 2012). Julia E. Tuell also took some of the images attributed to G. Grinnell. Three images in this sample are attributed to G. Grinnell; two others are attributed to Tuell. Charles Murphy (Nakoim' eno/Bear Wings, Cheyenne), Squint Eyes (Tichematse, Cheyenne), Stephen Stubbs (Kansa), and an anonymous Arikara artist, all Native artists, each have an image included in the database.

The majority of the drawings, paintings, and photographs are of Northern Plains tribes. A significantly smaller sample from the Central and Southern Plains are included. This disparity may be the result of uneven availability of images on the Internet. Nearly 20 different groups are represented in the sample, but for many there are only one or two images. The Blackfoot, Crow, and Sioux each have more than 10 images and are the best represented in the sample. Where noted, characteristics distinctive of a particular group are noted in the discussion below. By enlarging the sample size, one could better understand differences and similarities within and between groups.

Each image was evaluated to determine who, if anyone, was preforming a hideworking task. No agent or activity was actively taking place in 12 of the images. In three cases the agent or agents were present, but their sex and age was ambiguous. A woman (young, middle aged or old) was the agent(s) in 58 of the images and in *no* image was a man or child preforming any of the tasks associated with hide production. The primacy of women in hide production is not surprising, but it is interesting to note that the visual image evidence supports reports that women performed these tasks almost without fail. In most of the images in this sample (n=54) the hide or hideworking task is the focus of the image; in the others (n=18) it is generally a part of an overall camp scene and included only incidentally. With one exception, the images of hides and hideworking as the focus have an agent present, whereas several of the images in which the hide is incidental no agent is present.

The images were divided into categories based on what part of the hideworking sequence they depicted. Below is a discussion of each step in the process as seen through images in this sample. Images showing butchering and hide acquisition were not included in this database. Images of hides staked and/or racked, fleshing, scraping, tanning, and softening were all observed. Several images of drying hides also were included as this is an important part of the process. No images showing the sewing or removal of the holes from staking or racking were identified, but images of the finished product with these holes removed were observed. One image of a woman smoking a hide was included; several other images of women smoking hides were observed, but they were generally of deer or other medium sized mammals (not bison) and were therefore not included. Images of sewing and decoration of hides were selectively included as this is part of the process to finished product. Images were not selected for their depiction of the use of hides; however, several of the images illustrate how worked hides were used. Those images, which include multiple tasks, are discussed below under all tasks depicted in the image. In other cases, the exact action of the agent was unclear; these images are not included in the discussion below. After the discussion of individual tasks some thematic topics are explored.

Staking

Four photographs from the sample depict the action of either inserting or removing wooden pegs in the ground to stake out a hide. These include: a photograph by Edward Curtis, one by Tuell, and two images by an unknown photographer. The two unknown photographer images are of the same woman who is pounding the stakes into the ground with a metal axe in one image (Figure 2.1) and removing them in another. Two of the images depict women using metal axes to pound the stakes. Of those depicted in the action of staking, one was sitting and two (one in two photographs) were kneeling. Although the use of a rack to stretch a hide is represented in this sample, none of the images depict the act of stringing or removing the hide from the rack.

Figure 2.1. Photograph shows a Siouan woman kneeling to pound stakes into the ground around the edge of a hide. She is using a metal axe as a hammer (Photo courtesy of State Historical Society of North Dakota (00270-107), "Fleshing a hide," scanned from a photograph print, 1910-1915, Electronic document, http://digitalhorizonsonline.org/u?/uw-ndshs, 5799, accessed May 9, 2016).

Ethnographic sources describe the stakes used for hideworking as the same type used for pinning down the edge of a tipi. Visual inspection of images confirms this statement: the stakes resemble those used on hides in size (approximately 1 inch in diameter and averaging about 1 foot in length) and appearance. Anywhere from 17 to 40 pegs were observed holding a single large hide or half hide to the ground. In a couple of photos there appeared to be small pieces of hide draped over some of the stakes. These could indeed be small pieces of hide that have detached from the rest of it; alternatively, they may be some of the meat, etc. that has been removed during fleshing.

Moore (1999:60) reported the Cheyenne staked the hide several inches above the ground and used pegs with a "notch" near the top to hold the hide in position. In this sample of images there are a few that appear to have notches as Moore described (Figure 2.2); however, only one hide being fleshed is staked off the ground. Other hides staked off the ground are all apparently being painted. Neither the fleshed hide nor those in the process of being painted are being held up by the notches. All of the images with the notched pegs are from the Blackfoot, Crow, and possibly Northern Cheyenne groups.

Figure 2.2. This photograph by Richard Throssel shows two women sitting under a shade painting a hide staked to the ground. Based on the designs visible on the hide, they appear to be painting parfleches (Photo from the Collections of American Heritage Center, University of Wyoming, "Women preparing a hide," scanned from an original glass plate negative, 1902-1933, Electronic document, http://digitalcollections.uwyo.edu, accessed June 26, 2012).

Fleshing

Fleshing of the hide was undertaken to remove all excess bits of meat, fat, and membranes. Seventeen of the images I examined depicted this important step in the process. Because hides will rot and dry out if they are left without fleshing, we know that this activity took place within days, if not hours, of the kill. Nearly all of the women in these images are kneeling next to the hide and holding a flesher in their right hand (Figure 2.3). One is using her left hand to hold the flesher, and four are paintings of dubious validity. Most of the fleshers are too indistinct to see the material of which they are made, but the tool visible in Figure 2.3 appears to be metal based on a close examination. All observed fleshers had thongs attached to them.

Figure 2.3. In a photograph by Edward Curtis we see a Crow woman fleshing a hide during winter. The hide is staked to the ground in front of a tipi (Photo courtesy of Library of Congress Prints and Photographs Online Catalog, "Hide scraping – Apsaroke," scanned from a black and white film copy negative, 1908, Electronic document, http://www.loc.gov/pictures/item/2002722311/, accessed May 9, 2016).

George Catlin painted more than 500 pieces of art during his travels on the Great Plains. Four of them that depict fleshing are included in my sample. All four of these images illustrate camp scenes among the Sioux, Comanche, and Comanche/Kiowa. They all show tipis with several people visible; three of them depict meat drying racks, and all four of them show hideworking being conducted both on the ground (staked) and on a rack (Figure 2.4). In each case at least one of the people (presumably a woman, but it is not clear in the painting) working the hide is facing away from the viewer, looking at a hide. In three of the images two women are fleshing or scraping the hide. Based on their positions, kneeling or on all fours, and the fact the hides are staked, I imagine they are fleshing. In the fourth image a single woman preforms this task. Given the similarities between these images, the biases of the time, and knowledge of a stereotypical type (the drudge-on-a-hide) employed by Catlin (Dippie 2008; Gifford-Gonzalez 1993), the reliability of these images as accurate historical documents comes into question. Likely Catlin did witness women working hides; nevertheless, these artistic renderings should be considered in their historical context and may not be accurate. Catlin (1973 [1841]) described and drew a stretching rack in use by the Crow, but Lowie (1922:219) observed that he had never seen a rack in use by that group. This lends additional support to the idea that Catlin was using a "typical" camp scene for several of his paintings.

Figure 2.4. An oil on canvas painting of a Comanche village by Catlin. In the right foreground two women are working on a staked bison hide. Another woman is near them working on a racked hide (Image courtesy of Smithsonian American Art Museum, "Comanche Village, Women Dressing Robes and Drying Meat," digitized oil on canvas, 1834-1835, Electronic document, http://americanart.si.edu/collections/search/artwork/?id=4011, accessed May 9, 2016).

Scraping/Thinning

Twelve of the images in this sample portray the action of scraping or thinning the hide. One additional image included in this group is of a woman standing on a hide holding a composite (elbow-shaped handle and bit) scraping tool and looking behind her. Although she is not scraping in the image, one gets the impression she has just been interrupted from that task. One of the photographs in this group shows "a woman removing the hair from a rawhide with a rounded waterworn pebble…She struck hard glancing blows and at each stroke removed a small bunch of hair" (Wissler 1910:66) (Figure 2.5). The woman is sitting next to a hide that is not staked to the ground holding a stone larger than her hand. Wissler (1910) wrote about this Blackfoot woman and her use of a stone to remove the hair because it was out of the ordinary. He hypothesized that this method was utilized to preserve the pigmented layer of the skin or reduce the thickness of the hide and discusses one other similar stone he was able to secure (Wissler 1910:66).

Figure 2.5. A woman sitting next to a hide is using an implement to strike a hide to remove hair (Photo from Wissler 1910:Plate I, cropped).

The eleven other images in this group are fairly similar. They show a woman standing on a hide and bent over at the waist (Figure 2.6). She holds the end of a composite scraper handle in one hand while the other is holds it at the bend. In some cases the woman holds her left hand on the bend and in others it is her right hand. In some of the images, another piece of material (e.g., bark, rawhide) is visible under the hide protecting it from the ground. Three of these typical scraping images described above are drawings, the others are photographs. Two of the drawings are by Native Americans. The drawing by an anonymous Arikara person illustrates a Native woman using a composite scraping tool on a hide near a tipi (Figure 2.7). The tipi is decorated and meat is showing drying on a rack behind it; children are playing in front of the tipi. There are stakes in the tipi and the meat drying rack, but not the hide. The lack of stakes at this stage in the hideworking process is consistent with the other visual imagery.

Figure 2.6. Weasel Woman standing on and scraping a calf hide that is lying on the ground. Note her hide moccasins and the observer (another photographer) at photo right. Images of this activity are attributed to Monroe P. Kelly by Hiller (1948), but this photo indicates there were multiple photographers present (Photo courtesy of State Historical Society of North Dakota, "Jeanette Little Crow scraping hair from hide," scanned from a photograph print, 1942, Electronic document, http://digitalhorizonsonline.org/cdm/singleitem/collection/uw-ndshs/id/6575/rec/4, accessed May 9, 2016).

Figure 2.7.This image of a native woman scraping a hide with a composite scraper was drawn by an anonymous Arikara man. The woman is standing, bent at the waist in the typical hide scraping position. The tipi is decorated and meat is drying behind it. Children are playing nearby. There are stakes in the tipi and the meat drying rack (Image courtesy of SIRIS, "Anonymous Arikara drawing of woman tanning hide next to painted tipi, with meat drying rack in background and playing children in foreground, ca. 1875," graphite and colored pencil, mounted on paper, ca. 1875, Electronic document, http://siris-archives.si.edu/, accessed May 9, 2016).

Applying the Tanning Solution

Despite the attention ethnographers and historians gave in their written accounts of tanning hides, few images of this appear. In fact, only one image in my sample shows a woman applying a tanning solution. In this image a woman is kneeling next to a hide with a metal pan next to her (Figure 2.8). In Wissler's (1910:Plate IV) ethnography of the Blackfoot he published a cropped version of this photograph with the caption "Rubbing in the Fat." A similar image, titled "Applying the Fat," was included in his report (Wissler 1910:Plate III). As the application of the tanning solution required no special equipment, this task's archaeological signature is probably rather limited.

Figure 2.8. A woman is kneeling beside a hide rubbing the tanning solution into it (Photo from Wissler 1910:Plate III).

After a hide has been fleshed, thinned, and tanned, it was usually soaked either for a day or two. One image of a woman soaking a hide in a metal container is presented in DeMallie (2001:11:Figure 4, center left). Because this image was taken in 1973 it was excluded from the sample. After soaking, the hide was wrung and/or squeegeed. Wringing and squeegeeing the skin are both ways of softening the hide while removing the remnants of tanning solution and excess water. Figure 2.9 is the only example of wringing in the sample. It shows an Assiniboine woman wringing a hide in the manner described by ethnographers. It is tied to an upright post and a stick is used to twist and squeeze the hide. The woman stands to complete this task. Another image (Figure 2.10) illustrates two women standing at a partially racked hide. One appears to have a squeegee tool (left) while the other has a round tool, perhaps a graining tool. This drawing is taken from a series by Cheyenne artist Charles Murphy. Two other images, both photographs of Mandan, Hidatsa, and Arikara women, show the squeegeeing process. The hides in both of those images are hung from the top on a rack or horizontal beam while the woman stands to complete the task.

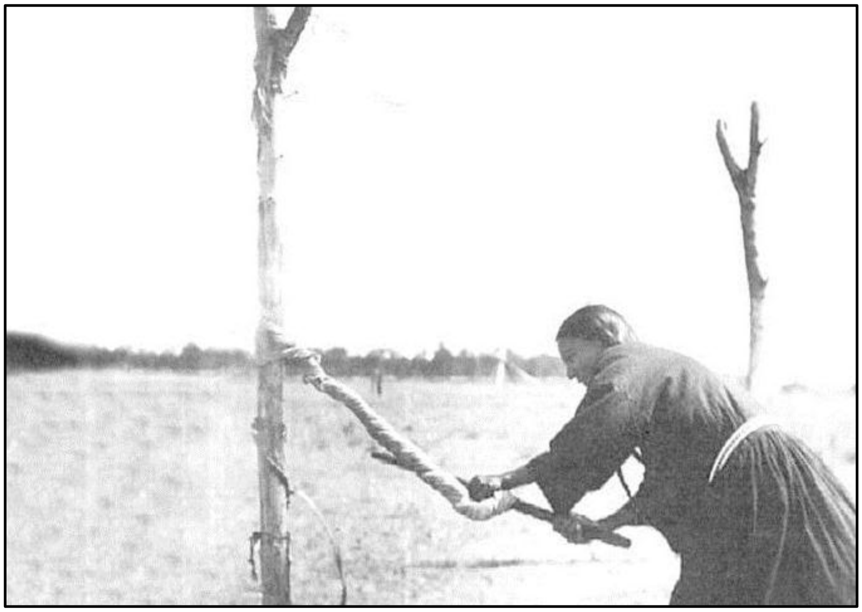

Figure 2.9. A standing woman is wringing out a hide during the tanning process. The pole she is using likely doubled as a meat drying rack. Note the metal hide softening loop visible below where she is wringing out the hide (Photo from DeMallie 2001:Figure 4).

Figure 2.10. In this drawing of two Cheyenne women, Charles Murphy depicted squeegeeing and graining of a racked hide (Cropped image courtesy SIRIS, "Charles Murphy drawing of women engaged in various stages of hide processing, ca. 1904-1906," graphite, colored pencil, and ink, ca. 1904-1906, Electronic document, http://siris-archives.si.edu, cropped, accessed May 9, 2016).

Softening and Graining

After tanning, the hide requires stretching, rubbing, and sometimes graining to soften it. All of these softening methods are represented in fourteen pictures relating to these tasks. Four of these images are the same Catlin paintings discussed before. The people standing and kneeling in front of a racked hide in those images were likely using a squeegee or graining tool; as it is not possible to determine exactly what they are doing, the activity is listed as indeterminate. The remaining ten images depict women standing, bent over, kneeling, and sitting while softening and graining hides. In some of the images the hide is racked or partially racked; in none of the images is the hide staked.

Stretching the hide helps to loosen it and make it softer and more pliable. One image in the sample shows a woman standing on the end of hide and pulling the other end up stretching it. According to ethnographic sources, rubbing the hide against a tree or rope also can help achieve a soft and pliable hide. Seven images in the sample demonstrate this task. For such a small sample, there is quite a bit of variability in this activity: some of the women are standing (n=2); others are kneeling (n=3); and still others are sitting (n=2). In all but one of the images, the abrader is attached to an upright post; in the final image the post is inclined and appears to be a spare tipi pole. Some of the upright posts were obviously used for other purposes as well (Figure 2.11). Even the abrading material varies; both rope (n=5) and metal (n=2) were observed in this sample. Another example of a piece of metal used for this purpose can be seen at the bottom of Figure 2.9.

Finally, evidence for graining, or further thinning and roughening the hide, can be found in four of the images in the sample. One woman is kneeling; one standing and bent over at the waist; and two are standing and working on hides that are partially racked. Weasel Woman's hide graining tool, an abrasive bone fragment (Hiller 1948), is clearly visible in Figure 2.12. The graining tool in Figure 2.10 is ambiguous. The graining tool is not clear in the other two photographs.

Figure 2.11. A kneeling woman softens a hide on a rope that is attached to a wooden pole that is part of a tent (Photo courtesy of Beinecke Rare Book and Manuscript Library, Yale University, "Old Woman tanning hide," image from glass negative, 1904, Electronic document, http://beinecke.library.yale.edu/dl_crosscollex/brbldl_getrec.asp?fld=img&id=1089832, accessed May 9, 2016).

Figure 2.12. The bone graining tool is clearly visible in this image of Weasel Woman working a calf hide (Photo courtesy of State Historical Society of North Dakota, "Jeanette Little Crow graining hide," scanned from a photograph print, 1942, Electronic document, http://digitalhorizonsonline.org/u?/uw-ndshs,6562, accessed May 9, 2016).

Smoking (optional)

As described in the ethnographic sources, smoking was not commonly applied to bison hides. Indeed, few images of hide smoking were identified during my research. One, which was included in the sample, is a Crow woman sitting next to a smudge fire with a hair on hide that is attached to a horizontal beam that allows it to hang over the fire (Figure 2.13). Presumably this beam is attached to trees or upright forked posts, but the image does not show us. Other images of smoking hides were observed during research; however, they came from tribes who did not occupy the Great Plains and are not included here.

Figure 2.13. This photograph by Robert H. Lowie shows a Crow woman sitting on the ground smoking a hide with the hair on. The hide is suspended from a pole over a smoking pit (Photo from DeMallie 2001:Figure 4).

Drying

Although this step is not given a separate heading in the ethnographic section above, the several images that show hides drying are noted here. All hides that were drying, whether in the midst of processing or the finished product, are included under this heading. This part of the process does not require an agent and does not have to include the use of any material culture, but can give us a better idea of what villages may have looked like as well as how the finished rawhide or tanned hide appeared. Many of these images are of camps that also happen to show hides. Eight of the images show hides that are staked; presumably these are not yet finished products. Based on other images in the sample, staking was employed at the beginning of the process for fleshing and later for painting. In three of the seven images with staked hides, they appear to be staked for fleshing; one shows painted parfleches drying, and the others are at an indeterminate stage in the process. Five photographs of hides that are not staked and are at an indeterminate place in the processing sequence are included. One image of hides included in this section is the drawing of Stephen Stubbs depicting tipi designs. This artwork shows six tipis with a variety of painted designs along with three hides, which appear to be staked (Figure 2.14). It is difficult to determine in which images we see a completed product unless it is already in use. One image stands out as having completed bison robes ready for use or trade (Figure 2.15). In this stereograph image we see two hides lying on the ground side by side. The finished hides have been trimmed of the holes that were used to stake them.

Figure 2.14. This is an image of a drawing by Stephen Stubbs (Kansa). It depicts six tipis, each with a different design, along with three large hides. The hides appear to represent buffalo hides with the tails intact staked to the ground (Image courtesy of SIRIS, "Stephen Stubbs drawings of Kansa warfare and tipi camp, ca. 1882," pencil and watercolor, ca. 1882, Electronic document, http://siris-archives.si.edu, accessed May 9, 2016).

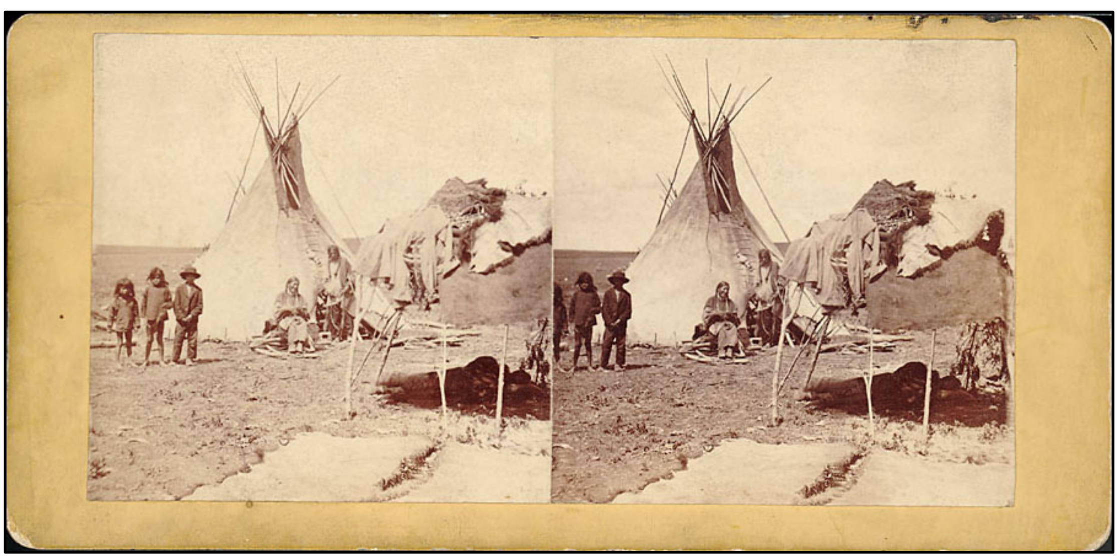

Figure 2.15. Buffalo hides with the hair on are lying outside near an arbor and tipi in this Stanley J. Morrow print. A woman is sitting outside the tipi, another person stands beside her, and three children stand at photo left. A man is lying down under an arbor; the arbor is covered with western clothes and buffalo hides (Image courtesy of SIRIS, "Yanktonite (Sioux) tepees, Fort Rice, D.T.," stereograph, ca. 1868-1878, Electronic document, http://siris-archives.si.edu/, accessed May 9, 2016).

Sewing, Decoration, and Use

A small number of images showing women sitting together and sewing new tipi covers and one of a woman sewing a smaller hide were observed, but not included in this sample (Beinecke Rare Book & Manuscript Library 2013; McClintock 1910:232; Liberty 2007:88-89). Decorative techniques including quillwork, beadwork, and painting were applied to hides. Based on the images I identified, to paint parfleches the hide was staked to the ground in the same way it was for fleshing (Figure 2.2). Three of these images were included in the sample for comparative purposes. One other image in the sample shows a woman who appears to be painting a hide; the type of painting is indeterminate. Unlike other steps in this process, in which only women are depicted as participating, the photographs support the idea that both men and women participated in painting hides. As mentioned above, images show women painting parfleches. Other images from the Walter McClintock Collection (Beinecke Rare Book & Manuscript Library 2013; Grafe 2009:Plates 48-50; McClintock 1910:) and Farr (1984) show both men and women engaged in painting tipi covers. DeMallie (2001:1043, 1063) includes two photographs of men painting hides with drawings of "war deeds."

No effort was made to identify images that showed finished hide products in use; however, several of the images still reflect the pervasive use of leather products. Some of the tipis observed in the earlier photos are made of bison hides; and, even after they were commonly made of canvas, the photographs indicate the doors were often still constructed of a hide. Even though only one or two of the people in these photographs are wearing any kind of hide clothing, moccasins were observed on the feet of several of the women doing the hideworking. In one of the sample images, hides were observed in position up against the side of the tipi for insulation.

It is difficult to tell what material the thongs attached to the fleshers in these images were made from, but at least some of them appear to be leather or rawhide.

Discussion

The preceding discussion of ethnographic text and visual information can help archaeologists develop hypotheses about the location of hideworking activity and the tools used, how colonialism impacted hideworking, and impacts seasonality might have on how hideworking was conducted.

Location of Hideworking Activity

Each image in the sample was evaluated to determine the location of the hideworking activity relative to the camp/village. Locational information could not be determined for two of the images, and 16 of them had no other evidence of human activity (these were described as "in a field"). One image shows a stand of trees with evidence of an outdoor camp in the background and in another image an arbor, but no structure is visible. In the remaining 53 images a structure of some kind was observed. These were categorized into three groups: far from the structures (n=1), an intermediate distance from structures (n=8), and near structures (n=44).

Although the types of structures in these images ranged from wooden houses to earthlodges to tents, the overwhelming majority of the structures were tipis. Hideworking was observed taking place behind lodges, directly in front of them, left of the door when facing the tipi, and in a couple of cases on all sides of the tipi. In only one case, Catlin's painting of a Crow tipi, does the hide appear to be staked to the right of the door when viewed facing the tipi.

This pattern of hideworking to the left of the door when viewed from outside the tipi should be further explored in the context of gender associated areas of tipis. Historically, the tipi was nearly always set up with the door facing east. This means, viewing a tipi head on, the area to the left of the door would have been south. Commonly, upon entering a tipi, the etiquette was for women to go to the left (south) and men to the right (north) (Laubin and Laubin 1977:110-111; Wilson 1995:185). If this pattern is born out, it could support an interpretation of those gender associated areas extending outside the lodge.

European and Euro-American Material Culture

A thorough examination of each image for Euro-American material culture was included in this analysis. In the sample photos women were nearly always dressed in cloth clothing, which was introduced by Europeans and Euro-Americans. Both Mails (1996:214) and Chronister (2000) indicate that, by the mid nineteenth century, Plains Indians had access to and commonly wore this western style cloth dress. Despite this widespread acceptance of cloth, women (perhaps men as well, but they are not featured as often in the sample images) appear to have preferred moccasins to shoes. Although the feet of a kneeling or sitting figure are usually not visible, several of the images showing women standing to scrape a hide clearly show moccasins (Figure 2.6). A historical recognition of this persistence of the moccasin is recorded among the Blackfoot (Wissler 1910:63), and Chronister (2000) described the dress of Kiowa women based on historical photos much like this study. In addition to moccasins, jackets and gloves were often still made of hide after most of the clothing was cloth (Hilger 1951:130).

Perhaps the second most pervasive evidence of European and Euro-American interaction in the sample images was another material that replaced a traditional use of hides. Of the 30 photographs with visible tipis, only three were identified as being made of hides. All three of these images were taken in the 1870s. Nearly 20 appeared to have identifiably canvas tipi covers. Given the amount of energy and time that went into the making of a hide tipi cover, it is, perhaps, not surprising that canvas would be quickly adopted for this purpose. This would allow the women more time to tan hides for trade.

A variety of metal items including fleshers, hoes, axes, pans, scythe blades, guns, basins, and unidentifiable items were observed. Several of these artifacts were visible in this set of images because they were used in the hideworking process. Other evidence of interaction included the presence of horses, a wooden chair, blankets, wheeled transportation vehicles, and log and wood frame structures in the images.

The images with less evidence of this interaction tended to be the earlier paintings, whether this is a product of artistic license or the earlier era in which they were produced is debatable. However, in several of these paintings the horse is the only observable evidence of interaction.

Seasonality and Hide Working

From about 10,500 years ago until the late nineteenth century the native keystone animal species for the grassland ecosystems of the Great Plains was bison. As documented through archaeological, historical, and ethnographic sources, native peoples throughout the North American Great Plains relied on bison for sustenance as well as much of their material culture. Aside from food, the most versatile part of the bison was its hide; bison hides were used in every facet of life, from clothing and weapons to toys and ceremonial objects (see Wilson 1917, 1924; Ewers 1979:150-151 for partial lists of items made from bison hides). For bison hides to be used, they must first be processed. Few historic reports or images lend themselves to assisting our understanding of the impact the seasons had on the hideworking process; however, the type of bison hide required and the climate both influenced the nature and intensity of hideworking activities throughout the year. As described below, these factors influenced when people chose to hunt bison as well as when and how the hides were processed.

Bison respond to cold weather by growing a thick winter coat; in the spring and summer the winter coat is shed. As a result of this yearly cycle, a hide taken during the winter was more appropriate for some functions than others. For example, thicker skins procured in the winter meant the hides were better for making items that required the hair on the item. These items included winter moccasins, gloves, and bedding. Thicker hides, from male bison all year and on all bison during the winter months, also were used for items required to be more rugged such as shields and parfleches (Dodge 1877:357). During historic times, many hides taken in the winter were processed as robes for the fur trade. Spring and summer hides were thinner and better for making items such as tipi covers, lightweight clothing, and ropes; however, they also were more likely to have holes created by flies and other biting insects (Brink 2008:69; DeMallie 2001:6; Verbicky-Todd 1984:185). Calf and fetal hides were preferred for some clothing items and bags due to their pliability (Ewers 1979:150-151).

Historic Native American bison hunters are often described in two groups: those that hunted bison throughout the year and those who were semi-sedentary and participated in spring and fall bison hunts. Brink (2008) describes fall and early winter as ideal times for kills that yield the greatest amount of fat, but recognizes there are reasons to kill bison throughout the year. For cultures who only hunted bison at certain times of the year, the intensity of hideworking would certainly increase at those times.

Another important aspect of the yearly cycle on hideworking was the climate. The climate of the Great Plains is continental. The range of daily, seasonal, and yearly temperatures is significant (Rosenberg 1987). The Great Plains has hot summers and cold winters. Most precipitation falls from April to September; generally fall and winter are drier seasons (Rosenberg 1987). As rains can damage meat and skins, Jodry (1999:238) hypothesized Folsom hideworkers would have processed more hides during the late summer and early fall. Precipitation across the Great Plains generally decreases from east to west (Rosenberg 1987). In the northern Plains, the winters last significantly longer than the southern Plains. Although it is recognized the climate has changed through time (Mandel 2006a) and would have impacted Native American use of hides, a through discussion of that variation is beyond the scope of this chapter.

Nearly all written and image-based resources consulted for this research describe bison hideworking as an outdoor activity. The process of hideworking, as described throughout the Plains, required an area large enough to stretch a hide for fleshing. This could be accomplished either by staking it to the ground or by lacing it to a rack. In general, staking, rather than racking, was the preferred method for fleshing. Although some bison hides were split before working, bison are large animals and the space for this activity would have been significant. Limited space was available within a habitation; this means that in some situations the ability of the people to process hides was hindered during bad weather and when the ground was frozen. Among some groups, staking was used in the summer while a rack was employed in the winter because the ground was frozen (Denig 1930:540; Weitzner 1979:254). Racks also were recorded as being used if the hide was being processed inside an earthlodge; no reports describe hide processing of bison hides in tipis. Within a habitation it would be important to be able to move the hide out of the way when other activities were taking place. All of the sources that describe hideworking adaptations to winter conditions come from the northern Plains.

The hideworking process needs to be initiated shortly after the hide is gathered. The first step, fleshing, must accomplished before the hide dried too much; as hides dry the tissue begins to tighten making them harder to work (Klek 2008:116). However, after fleshing is completed, hides can be stored for processing at a convenient time (Kavanagh 2008; Klek 2008). Scraping, tanning, and softening could be completed at a later date. This means those activities could be put off until the weather improved or the processed hide was needed. Although it is not usually stretched during scraping, the examples for the historic period do show the hide spread out, a process that process required more space than might be available indoors. Tanning and softening, on the other hand, may have been undertaken throughout the year, relatively unaffected by seasonal changes. Therefore, although the climate would have affected hideworking, it did not dictate it.

The intensity of hideworking was likely greatest soon after a kill of multiple animals. Among groups who participated in spring and fall bison hunts, those times would have been correlated with work related to hide processing. The intensity of hideworking could also be determined by factors unrelated to seasons such as the needs of the people or demand of the fur trade; these fluctuations were usually not dependent on the climate. For example, the construction of a new tipi cover often required the work of several women all participating in hideworking and sewing over a short period. This would was required when a woman decided she needed a new tipi and had gathered enough hides.

My research included an examination of 73 images of historic native peoples on the Plains related to hideworking. One category included in the database was “time of year,” for instances when the season of the year could be recorded. Contextual archival information as well as the presence of snow, flowers, and trees all provided clues about the season during which the photo was taken. For more than half (n=41) of the images in the sample, no interpretation of seasonality could be made. Most of the others could be narrowed down only to half or three quarters of the year. Twenty images were from spring, summer, or fall; two were from or fall, winter, or spring; and one was from spring or summer. In only nine images could the season could be identified with any degree of confidence: four were from the summer and five from the winter. These data indicate historic Great Plains hideworking activities took place throughout the year.

Hideworking activities among Native American groups on the Great Plains fluctuated depending on when kills took place, the type of hide desired, and the climate. During winter the climate limited some hideworking activities, but did not stop them entirely.

Critiques of the Ethnohistoric Data

Thus far, I have provided a historical context of ethnographic analogy in archaeology, described in detail text-based information available about Native American hideworkers on the Great Plains, and evaluated a sample of historical images for the information they can contribute to the discussion of hide working in that region. Acknowledging and learning from the long history of critiques of ethnographic analogy can lead to stronger hypotheses as well as methods for improving analogies. Proposals for improving the use of ethnographic analogy in archaeology include addressing the relevance of the analogy, drawing on multiple sources, and using a comparative approach to select and evaluate analogies (Stahl 1993; Wylie 1985).

The relevance of an analogy can be assessed by identifying the goodness of fit between an analogue and archaeological data and by applying source-side criticisms. Instead of only identifying how an ethnographic culture is similar to an archaeological complex or site, this method suggests examining both similarities and differences to improve analogies.

There are stereotypes and biases inherent in source-side data that cannot be overlooked. Despite significant differences between historic groups and Early Paleoindian peoples, historic cultures can still provide useful contributions toward building a model for identifying and interpreting the prehistoric processing of hides. Specifically, an evaluation of the source-side data can reveal information about the types of tools that may be used in this process, the tasks required to complete the task, who was participating in the activity, where hideworking took place and how large an area was employed, and the position of the person completing the task. The partitioned archaeological data can then be used to modify or support aspects of the comparative analogic model. Using this type of analogy, the aspects of hideworking mentioned above can be assessed independent of specific cultures. Therefore, a model developed using this methodology may be generalized to be made relevant to hunters of other large game in a variety of archaeological contexts.

We know the ecological conditions of the Great Plains have varied in the past 12,000 years, but the environment has been roughly comparable throughout the Holocene. Historic people hunted bison and processed their hides for use in a variety of ways. Based on the archaeological data, we infer prehistoric peoples on much of the Great Plains and for much of prehistory were relatively mobile; historic bison hunters also were mobile hunters following herds. Finally, archaeologists have identified evidence of hideworking in the archaeological record based on material culture such as fleshers and chipped stone scrapers. These are the kinds of points of intersection a formal or illustrative analogy might employ. To make this a comparative approach we also consider differences between prehistoric and historic Plains peoples.

Without suggesting there was one Plains Indian culture or that the multitude of groups on the Plains had static cultures prior to the coming of Europeans, Europeans began significantly impacting the lifeways of Plains Indians before they ever came in direct contact. Prior to the eighteenth century, horses were not present on the Great Plains. The introduction of the horse significantly changed the region's economic, social, and political norms (Ewers 1979; Hämäläinen 2003; Wissler 1914). For example, the acquisition of the horse by Plains groups meant they could travel further distances in a shorter amount of time, and transport larger amounts of goods (Klek 2008).

When Euro-Americans arrived on the Great Plains, the demand for hides of all types, including bison, increased. In particular, the fur trade of the late eighteenth and nineteenth centuries created a significant demand for bison robes. As a result, Native Americans may have processed more bison hides than prior to this trade; however, there was a trade-off in that with the procurement of European and Euro-American cloth the Plains Indians themselves probably used fewer hides. Similar to the horse, the fur trade changed all aspects of life, from the economy to social and political life. Changes to social organization created by the increased demand for hides have been discussed by a number of authors (Habicht-Mauche 2005; Holliman 2005; Perkins et al. 2008; Sundstrom 2002). Other studies have considered ethnography to learn about the function of artifacts and agency at prehistoric sites (Gilmore 2005; Scheiber 2005).

European and Euro-American material culture was introduced to Plains Indians primarily as a product of the fur trade. Trade goods have been found at several protohistoric archaeological sites. The availability and adoption of trade goods meant that the variety of material culture of the Native peoples was greater. The tools employed in hide production, which formerly included bone, antler, stone, and sinew tools could now also make use of metal. Metal fleshers were observed in the sample images and described by ethnographers; iron bits in composite scrapers were common; and metal scythes or barrel hoop fragments replaced the sinew used to soften hides.

All of these colonizing European and Euro-American influences created identifiable differences between prehistoric and historic groups despite the fact that they lived in the same environment and hunted the same animals. Specifically, the production of bison hides was significantly different because the number and type of hides being produced and the material culture used to process them was modified. Presumably other differences, which are not as readily observable, occurred.

Source-side data, including both written and visual material, should be evaluated to improve our analogies. Stahl (1993:247) points out that this activity is even more important given the influences of Europeans and Euro-American culture on Native peoples. By exploring the stereotypes regularly held and perpetuated by ethnographers, historians, artists, and photographers we can both critique the source-side data and propose how it should be used. The idea that the Native Americans were a "Vanishing Race" and the motifs of Indian women as a "beast of burden" and a "drudge-on-a-hide," are directly relevant to this study.

Among both authors and artists of the nineteenth and early twentieth centuries there was a view that the cultures of Native Americans were being lost and Indians belonged to a "vanishing race." George Catlin, Edward S. Curtis, and Walter McClintock, all of whom produced images in the sample I used in this study, each approached their work from the perspective of the imminent loss of Indian cultures. The term "vanishing race" comes from a romanticized photograph of Navaho people riding away from the viewer. The phrase suggests that the Native people were simply disappearing; it does not suggest any action on the part of the

Indian or white. This concept was strengthened by the ideas of Manifest Destiny and Social Darwinism and extended beyond producers of images (Beck 2001). Some ethnologists also believed there was only a small window of time wherein they could record these cultures before they disappeared.

In an effort to record the *original* culture, Curtis, for example, would routinely costume his subject in traditional attire and is known for removing evidence of Euro-American influence from his images (Lyman 1982). In his 20 volume set *The North American Indian* Curtis published over 2,000 images. Five images by Curtis are included in the sample evaluated for this study. Two of them are of the same Crow woman who is staking and fleshing a hide in front of her tipi during winter (Figure 2.3). A third image is a close-up of a Blackfoot woman fleshing a hide; a woman is graining hides in the fourth image; and the fifth is a view of a camp without people in it. In both of the images of fleshing, the women are wearing western dress, and there is no evidence they have been staged or posed. Despite Curtis' shortcomings, these images are two of the highest quality and most clear examples of fleshing taking place.

McClintock carefully selected his subjects for photographs often excluding white people, Euro-American structures (including the nearby Browning Indian agency), and the nearby transcontinental railroad (Grafe 2009:88, 106-109). In addition, he is known to have manipulated images to remove items such as wagons or backgrounds that he considered "superfluous" (Grafe 2009:109).

According to Weist (1980:256) there were two prevailing views of Plains Indian women: one held by ethnographers and one found in the observations of "19th century fur trappers, aristocratic travelers, missionaries, Indian agents and the like." A third view of the Indian "princess" also was popular (Dipple 2008). Ethnographers generally described women in their traditional roles of wife, mother, and hideworker while the others commonly depicted women as slaves, drudges, or beasts of burden (Albers and Medicine 1983; Weist 1980, 1983).

Weist (1980:257) goes on to describe how some writers completely left women out of their descriptions and even the ethnographers often spent a limited amount of space documenting women; this information must be pieced together to get a better idea of women's lives. Hideworking was a visible activity and most fur traders and ethnographers, as well as artists and photographers, appear to have at least mentioned the activity. This appears to be in contrast to other women's activities, especially those commonly done inside the home.

The paucity of information about women as well as the stereotypical view of them has been described as the result of male ethnographers interviewing male informants using male language and the strong and dramatic stereotype of the male Plains Indian (Weist 1983:256). In fact, other explanations for the limited data on women may be more mundane:

> I found greater difficulty in photographing women than men. I was at a loss to understand the cause of my trouble, until I discovered that they were unwilling to have their pictures taken dressed in their ordinary clothes, as I usually found them while pursuing their daily avocations. But they took an entirely different view of the matter when dressed in their finery. I was told, however, that some women believed that the machine had magical power, and were afraid of it. This belief was started by a medicine man who was jealous of his wife's frequent visits to a photographer's place. But he effectually stopped them when he explained to her that, by means of the camera, the white man was able to see through her clothes [McClintock 1910:231-232].

Weist's (1980:265) commentary on early photographs of women: "Women have probably not been intentionally overlooked, but they are seen – as in the early photographs of reservation life – either pursuing their traditional tasks or providing a hazy background to noteworthy male performances." This strikes me as not quite right: women in the photographs I examined are sitting with other women, holding babies, posing with men, and performing all of the tasks they do every day. Based on my study of early photographs of Plains women, they are depicted doing a wide range of activities. Despite this, the tasks that took place inside the home are less well represented. On the other hand, many of the images depicting women at work were never published and consequently are not widely available.

Scheiber (2005) describes woman as a hideworker as a pervasive image in photographs and art depicting Plains women. I agree with this characterization, I observed more images of women as hideworkers than perhaps undertaking any other activity in my survey of images. However, her characterization of the typical image was not what I observed. “These images usually portray multiple women sitting on the ground scraping a stretched-out hide, with tipis and hanging dried meat in the background” (Scheiber 2005:60). My observations were that the images showed either one or multiple women, and if they were actively fleshing the hide they were kneeling. In nearly every case women stood and bent over at the waist to scrape bison hides.

The Plains Indian woman hideworking, either in written descriptions or images, is one possible origin for the drudge-on-a-hide motif described by Gifford-Gonzalez (1993). But, as Scheiber (2005:60-61) is right to point out, in contrast to illustrations that place women in this position, “these eyewitness photographs and illustrations show women in the foreground using actual tools and participating in social events.” These women are preforming tasks essential to the economic health of the group, and the images display these activities. In my sample, when an agent was shown working on hides she is the focus of the image, not a person in the background who is incidentally included in the image. We must be careful not to infer subjugation of women just because they are portrayed as kneeling at their task.

The images consulted for this study were selected for the activities being undertaken and as such cannot provide a commentary on the range of photographs of mid to late nineteenth and early twentieth century Native American women; however, they do provide a starting place for a broader discussion of the drudge-on-a-hide motif (Gifford-Gonzalez 1993).

The drudge-on-a-hide is an "often faceless woman on all fours, scraping or preparing to scrape a hide" (Gifford-Gonzalez 1993:34). This figure was identified during the study of illustrations depicting Cro-Magnons but can also be seen in the pages of *National Geographic* (Solometo and Moss 2013) and in Catlin's paintings of camps on the Plains. As described above, three of the images in my sample all show hideworking being conducted on both the ground (staked) and on a rack. In each of these images the person (presumably a woman, but of ambiguous gender) working the racked hide is facing away from the viewer (Figure 2.4). The other people (also presumably women) are kneeling or on all fours on or near the staked hide. In a fourth image one probable woman on her hands and knees is hideworking. Given the similar construction of these images, the biases of the time, and the drudge-on-a-hide motif (Dippie 2008; Gifford-Gonzalez 1993), these paintings cannot be relied upon as accurate historical documents.

As demonstrated through the review of both written and visual sources, the sequence of historical hideworking on the Plains was ubiquitous: groups from the southern, central, and northern Plains all describe a similar sequence of tasks using the same tools to process bison hides. Gilmore (2005:21) maintains the "similarities in the way tools are made and the way they are used (leg bone flesher, antler hafted scraper, sinew/rawhide rope), suggests that the basic process has great antiquity." He proposes that the basic process of hideworking that was observed in historical times could have originated prior to the colonization of the New World.

Stahl (1993), on the other hand, warns this kind of analogy should also be subjected to source-side criticism. Just because a practice is widespread does not mean it is necessarily old. In an example from Africa, Stahl (1993:249-250) demonstrates that a ubiquitous practice can be relatively recent in origin. In her example it was a change initiated by colonial powers at quickly became pervasive. The invasion of North America by Europeans displaced many Native groups including the Cheyenne. The Cheyenne were living near the Great Lakes before moving onto the Plains and Grinnell (1972:52) describes how Cheyenne oral tradition said they learned the practice of tanning bison from other groups:

> When the Cheyennes first found the buffalo they had no knowledge as to how to dress hides. Later, the Sioux on the east side of the Missouri showed them how to cut hides in two, dress them, and sew them together again. These they used as robes. After they had reached the Black Hills the Kiowas and Comanches taught the Cheyennes how to dress buffalo-hides in one piece, and also showed them the use of a mixture for softening the hide [Grinnell 1972:52].

It seems unlikely the Cheyenne had no knowledge of hideworking prior to entering the Plains; however, it is possible they had never encountered bison hides before. It appears then, that among the historical Cheyenne, bison hideworking in the manner described was a relatively recent result of diffusion.

Evidence for curated composite scrapers, oral tradition, and archaeological data support Gilmore's (2005:21) claim that the basic Plains hideworking process extends into prehistory if not his supposition that it could be ancient. Composite scraper handles were curated among many tribes; Grinnell (1972) reported that one of the handles he documented could be traced back 120-150 years and had been in use that whole time. Oral tradition also extended to the bits of composite scrapers. During the historical period these were metal, but ethnographic descriptions from several tribes indicate that prior to the introduction of metal they were made of chipped stone (Gilmore 2005:21). There is some archaeological evidence for bone fleshers, composite scraping tools, and wooden pegs (Brink 2008; Lehmer 1971; Wedel 1936; Wood 2001:Figure 5). This kind of evidence is discussed below.

Source-side Data: Ethnographic and Ethnoarchaeological Studies of Hideworking

The examination of the lifeways of modern peoples can be another type of source-side data to use in comparing archaeological material.

Cross-Cultural Studies

Anthropologists, including archaeologists, commonly use cross-cultural studies to examine activities or traits among cultures for similarities and differences. In her 2013 dissertation, *Woman's Toolkits: Engendering Paleoindian Technological Organization*, Susan Ruth describes her study of the *2002 Revised Ethnographic Atlas* data on "work in hides" (Variable #46). Ruth (2013) examined data on 340 groups from across the world for which there is information about the "dressing of skins." She found hideworking is rarely conducted equally by men and women. In groups where hunting and fishing is important to subsistence, woman overwhelmingly do the hideworking (Ruth 2013:61). Although climate impacts who completes hideworking tasks, "in cooler climates where biomass is bound up in larger-sized animals, even when reliance on hunted foods is not high, women still do the bulk of the hide-work" (Ruth 2013:61). From this research, Ruth (2013:61) argues the ethnographic data suggests if Paleoindians were reliant on large game for at least half of their subsistence, even though gathering also supplemented their diet, women were likely the primary hideworkers. Keeley (2010) came to a similar conclusion using ethnographic data to investigate if men or women were more likely to have been Magdalenian hideworkers. He concluded "worldwide, where dressed hides were in high demand but where it was a domestic production…almost always women performed this vital task" (Keeley 2010:232).

In sum, cross cultural studies indicate people of both sexes participate in hideworking but rarely do they participate in the activity in even proportions. In general, women do more hideworking when groups are more reliant on hunting and fishing; they also do more of the hideworking in cooler climates.

Culture Specific Studies

Ethnoarchaeology is the study of modern peoples to better understand prehistoric behavior. Modern ethnoarchaeology was developed as a research strategy out of middle-range theory within the context of processual archaeology (Johnson 1999; Lane 2006). Middle-range theory attempts to connect static archaeological remains with the dynamic systems that created them. Binford (1983:23-24) proposed that the only way to study both a dynamic system and static results of that system was by observing modern groups and the archaeological record they create. Conclusions reached through ethnoarchaeological study, like ethnographic analogy, may be used in archaeological interpretations by means of model building and testing.

Ethnoarchaeological studies have included descriptions of the manufacture, use, and discard of hideworking tools. Of particular interest for this study is the information these researchers provide about where manufacturing, resharpening, and discarded tools are located.

Several researchers have undertaken ethnoarchaeological work among Ethiopian groups where people still employ stone tools in hideworking (e.g. Beyries and Rots 2008; Gallagher 1977a, 1977b; Sahle et al. 2012; Weedman 2000, 2002, 2005, 2006, Weedman Arthur 2008). One study of particular interest is that of Gallagher (1977a, 1977b) who recorded the actions of hideworkers from three ethnic groups who made and used stone endscrapers. He documented where the scrapers where manufactured, resharpened, and discarded. The hideworkers he observed knapped the tools in or adjacent their house and knapped over a container (e.g. woven basket, wooden or pottery bowl) to catch the debitage (Gallagher 1977a:410-411, 1977b:253, 256). When tools required resharpening, that activity was completed where the hide was being worked but, again all flintknapping debris was collected in a container (Gallagher 1977a:411, 1977b:269). In one case no container was used, but the floor was swept clean directly after the hide was processed (Gallagher 1977b:286). In an effort to keep the area clean so people were not stepping on debitage and being injured, "[e]ven the smallest chips are carefully picked up" (Gallagher 1977b:257).

Gallagher (1977b) observed that knappers disposed of the debris and exhausted tools by depositing them in a dump, usually one devoted only to chipped stone items between 10-100 m behind their house. The dump area may contain piles above the ground or pits dug into the ground (Gallagher 1977b:257). Similar to Gallagher's observations, hideworkers in another Ethiopian group, the Gamo, commonly had discard locations 10-50 m from their household (Weedman 2000:138). According to Gallagher's (1977a, 1977b) observations, the evidence of the manufacture, use, and discard of scrapers and the debitage associated with their manufacture and use will usually, if not always, be found in a dump, not where the activity took place. Weedman (2005:184) noted piles of scrapers in thorn bushes in a Gamo village where male hideworkers discarded scrapers; other items were not discarded in these piles. Thus, the absence of other artifact types in a discard area does not indicate it is not a dump.

Gallagher's observations indicated that hideworking may be conducted in or adjacent to houses. Based on his own ethnographic observations, Binford (1983:172) stated that hideworking of one or two hides may be done near a shelter; however, when more hides are being worked the activity is peripheral to the central camp areas. This view is consistent with images of bison hideworking on the Great Plains (see above; Ruth 2013). He also mentions that relatively flat ground is chosen for hideworking and the area may be cleared of debris (Binford 1983:172). Other ethnographic evidence suggests that tasks that take up a lot of space tend to be located away for a central area (Carr 1984:127).

In addition to the hideworker removing debitage and exhausted tools from their manufacture or use areas, the materials may be moved by other people, including children, or site formation processes. Site formation processes are discussed in detail below; here I want to mention the potential children have for reorganizing artifacts. Weedman (2000:118) noted that she observed Gamo children playing with discarded scrapers, but does not explore the implications of that activity. Children likely played with stone tools that were rejected or lost by adults throughout prehistory. By doing so, they were participating in a form of recycling. At the conclusion of their play, children may have replaced the tools where they found or redistributed. In addition to moving stone tools after adults lose or discard them, the presence of a child apprentice or novice may affect the distribution of chipped stone (Hawcroft and Dennell 2000; Roveland 2001). For example, adults may use a cloth and remove debris if children are present but be less concerned if they are not present.

Source-side Data: Experimental Archaeology and Hideworking

A variety of experiments have assisted archaeologists in understanding the process of hideworking, the kinds of tools utilized, and the wear on those items. Although many hideworking experiments have been conducted, relatively few have specifically used bison hide as the material being worked (Pelton and Boyd 2015; Schultz 1992; Wiederhold 2004). A discussion of the use-wear on experimental hideworking tools is presented in another section where archaeological tools are examined; here experiments about the process of hideworking and the tools used are discussed.

The number of scrapes required before a tool becomes dull or too dull to use has received a good deal of experimental study. Ruth (2013:Table 6.1) summarized the results of these studies, which are quite variable. Most experiments measured the amount of work completed before resharpening by recording the number of strokes undertaken. Researchers indicate that a scraper can be used between 60 and about 1,500 strokes before the tool's use is adversely affected enough that resharpening is required (Ruth 2013:Table 6.1). Wiederhold (2004:Table 1) concluded that significantly more (1,300-3,900) strokes could be taken before an endscraper requires resharpening

Sahle et al. (2012:390), in an ethnoarchaeological study, observed hideworkers who resharpened their tools after many fewer scrapes – "between less than 10 and greater than 100." Indeed, several ethnographic studies have found low scrape counts before resharpening compared with experimental studies (Weedman 2000:158).

Pelton and Boyd (2015) also have examined the rate at which one needs to resharpen an endscraper. They determined that, given unlimited access to lithic materials, a scraper would be resharpened once every 675 scrapes; however, with limited access to additional tools (lithic materials) prehistoric peoples likely increased the amount of time between resharpening episodes (Pelton and Boyd 2015). In addition to access to lithic materials, the type of lithic material may make a difference in how often the tools requires resharpening (Weedman 2000:144).

Schultz (1992) used an endscraper to scrape a bison hide. Instead of the number of scrapes before resharpening, he reported he had to resharpen the scraper more than 100 times to completely scrape the hide; it could flesh or scrape an area of about 2,000 square centimeters before requiring resharpening. The number of times he resharpened his tools may help explain why Schultz's (1992) tools did not exhibit the same evidence of use-wear as other studies. He resharpened the scraper consistently to keep a sharp edge, but did not factor in the limited access prehistoric peoples had to additional tools.

Based on their experiments, Pelton and Boyd (2015) argued that a *Bison bison* hide could be entirely scraped with one to two endscrapers. This estimate is similar to that proposed by Seeman et al. (2013:428) who stated that a caribou hide of "modest" size could be processed with a single endscraper. The rate at which scrapers are reduced appears to have been about 2 mm each time it is resharpened (Morrow 1997:78). This amount of length reduction per resharpening is supported by ethnoarchaeological data (Shott and Weedman 2007; Sahle et al. 2012).

Critiques of the Ethnographic, Ethnoarchaeological, and Experimental Data

One of the most common critiques of using ethnographic data is that the conditions, including the environment, economy, and material culture, are significantly altered or just dissimilar from prehistoric groups being investigated. Indeed, there is no ethnographic data about bison hideworking on the Great Plains. Therefore, as with the ethnohistoric data, comparisons and analogy derived from ethnographic data must be treated as data to consider rather than facts that should be applied to prehistory.

Experimental archaeologists must strive to strike a balance between a controlled environment that will yield understandable data and a realistic experiment. In some cases this balance is very difficult to obtain, and experiments yield results that are not understood properly or are unrealistic. Caution must be taken when applying experimental results as there may be multiple ways to achieve the same conclusion. Therefore, archaeological data that look like the results of an experiment may mean they were created in the same way, but this is not always the case.

Subject-side Data: Understanding Hideworking through Archaeology

To identify hideworking activity areas at Paleoindian sites, one must hypothesize the tools used in this activity and where the activity took place. To do this, this section examines other archaeological efforts to understand hideworking.

Archaeological site assemblages can inform our understanding of the types of artifacts that may have been associated with hideworking activities as well as where those activities took place. Ruth (2013:Table 7.3) provides a list of the hideworking tools that archaeologists might discover: utilized flakes, bifaces, stakes, fleshers, abraders, endscrapers and associated haft, scraper resharpening flakes. Other artifacts that are potentially associated with hideworking activities include gravers, hide processing stones, ultrathins, side scrapers, and ochre. Archaeologists have identified several types of potential hideworking tools, often in association with one another. Those tools and their potential uses are explored in this section.

Chipped Stone Tools

The identification of Paleoindian hideworking activity areas requires identifying the types of artifacts that may be found in these areas and an understanding of how those tools were produced, utilized, reused and discarded.

Endscrapers

Endscrapers are steeply retouched tools that are usually unifacial and exhibit a planoconvex cross section; they are typically made from flake blanks (Morrow 1997:71; Odell 1996:384). Endscrapers are found at most Paleoindian sites and also are common during other prehistoric periods. They have a variety of outline shapes and sizes. Because chipped stone is inherently reductive, differences in the size of endscrapers is primarily a result of the number of times an endscraper has been resharpened (Boyd 2015; Brumm and McLaren 2011; Morrow 1997:77-78; Seeman et al. 2013; Shott 2009). It appears that the length of endscrapers often changes dramatically over the life of the tool while the width changes a little, and thickness remains relatively constant (Morrow 1997:78; Ruth 2013:316; Shott and Seeman 2015). The tendency for only slight variations in width and thickness may be because the endscrapers were designed to fit particular hafts (Ruth 2013). A recent study of 546 complete endscrapers from 12 Folsom/Midland sites, including 41WK21, found similar rates of high retouch intensity at each site prior to discard (Boyd 2015). Despite these differences, it has been proposed that all endscrapers were used for the same purpose. In an attempt to test this hypothesis, several researchers have conducted microwear studies of endscrapers.

Use-related wear is created when the friction and abrasion between a tool and an object modifies the tool surface (Dubreuil and Grosman 2009:936). Analysis of this modification on experimental and archaeological endscrapers, both macroscopically and under low and high powered magnification, is a common analytical practice in archaeology. Systematic studies of microwear on endscrapers began in the middle of the last century when Semenov (1985) completed experiments using chipped stone tools and then compared the use-wear on those items to artifacts from the Upper Paleolithic period. He concluded the archaeological specimens were used to work hides (Semenov 1985:85-93). Since that study, many microwear studies of endscrapers have concluded that hideworking was their primary function (Ahler 1979; Bamforth and Becker 2009; Boszhardt and McCarthy 1999; Daniele 2003; Donahue and Fischer 2015; Hayden 1979, 1986; Keeley 1980; Loebel 2013a, 2013b; McDevitt 1994; Moore et al. 2016; Root et al. 2000; Seeman et al. 2013; Wilmsen 1970). Generally, these studies identified edge rounding and smoothing, edge pitting, and polish as evidence of hideworking (Boszhardt and McCarthy 1999:186).

Despite the preponderance of data that suggests endscrapers were used in hide processing, it appears some endscrapers also were used on other materials. Microwear analysts, in addition to identifying wet and dry hide use-wear, have observed wood and bone/antler (hard surface) use-wear on endscrapers (Brink 1978; Loebel 2013a, 2013b; Wiederhold 2004). In the largest Paleoindian endscraper microwear study to date, Loebel (2013b) identified fresh hide wear on 157 specimens, dry hide on 76, and bone/antler and wood on only seven samples each. Several of the scrapers he identified as having bone/antler and wood wear also had hide wear. Leobel (2013a, 2013b) indicates the bone/antler and wood wear was the result of discarded scrapers being repurposed as tools to work other materials. In some analyses of endscraper use it appears that, in addition to the bit, spurs and lateral edges were utilized (Wiederhold 2004).

Use-wear analysts recognize that lithic material can have an influence over the appearance of the wear (Brink 1978; McDevitt 1994). If so, two studies that may prove most interesting to this study are by Bamforth and Becker (2009) and Wiederhold (2004). Bamforth and Becker (2009) report on the Hell Gap collection, which is primarily made of Hartville Uplift chert while Wiederhold's (2004) archaeological data is from the Gault site, and the lithic materials he describes compare favorably with Edwards chert. Edwards chert dominates the assemblage at 41WK21, while Hartville Uplift chert makes up more than half of the 14SN106 assemblage.

One study that used experimental tools to work bison hides and compared the damage on those items to archaeological specimens, did not identify hide use on any of the archaeological specimens (Wiederhold 2004). Schultz (1992:345) used low-power use-wear and identified flake scars and abrasions on the scrapers he used in a bison hide experiment, but did not compare these to archaeological specimens. In contrast to other studies, he did not observe significant rounding or polish (Schultz 1992:345). The difference in wear between Schultz's tools and others may be because he consistently stopped his experiment to resharpen his tools. Wiederhold (2004) examined 12 endscrapers from the Gault site in Texas. The results of his study indicated that directly before discard the endscrapers were not used on hides, but rather a harder (drier and more rigid) material.

Another line of evidence that indicates most endscrapers were used on hides may be blood residue analysis. Five of the seven endscrapers from the Folsom age Mitchell Locality at Blackwater Draw that were tested for blood residue tested positive indicating those tools were used on animals, it is not much of a reach to infer their function in hide processing (Boldurian 1990:75).

Scraper Retouch Flakes

Scraper retouch flakes are artifacts that are identifiable as having been removed from steeply beveled chipped stone tools. They include both late-stage production flakes and resharpening flakes meant to rejuvenate a working edge (Shott 1995:64). Scraper retouch flakes, despite their name, may originate from non-scraper artifacts; however, this is the exception. This type of debitage was initially noted by Witthoft (1952:474) and then described in more detail by Jelinek (1966), Frison (1968), and Shafer (1970), who created a typology for the different varieties of scraper retouch flakes he observed.

Because they are small, difficult to recover, had no further use, and generally would not have impeded other activities, scraper retouch flakes are unlikely to have been moved from the location where they were produced (Frison 1968:154; Hull 1987; Metcalfe and Heath 1990;

Newcomer and Karlin 1987:35-36; Simms and Heath 1990; Ullah et al. 2015; Vance 1987). It is possible that some scraper resharpening flakes were gathered in a hide, cloth, or basket and dumped elsewhere; however, ethnographic studies have indicated this secondary disposal is more common with larger items (Metcalfe and Heath 1990:781-782). It is assumed then, that concentrations of scraper retouch flakes would be expected where the tools were resharpened. In some cases, scraper retouch flakes also may be created during the actual use of the tool (van Gijn 1989:28). Therefore, they may be a good indicator of hideworking activity areas.

At the Sandy Ridge site in Ontario, scraper retouch flakes were clustered around hearths and associated with scrapers (Jackson 1998). This may indicate the scrapers were used at the hearth, or may have been created when people brought their tools there to be resharpened. Witt (2005) also used the distribution of scraper retouch flakes to indicate scraper use areas.

Gravers

Gravers are “flaked stone tools having one or more short, finely retouched, projecting spurs produced on an edge” (Maika 2012:3). These tools also have been called borers and micro-piercers (Maika 2012:1). At several sites these tools have been identified in associated with endscrapers suggesting they may have had a use in the hideworking process. In addition, the projections on endscrapers have been identified as utilized spurs. These tools may have been used in the same manner as gravers. The hypothesis that gravers were used in hideworking and/or butchering activities has been around since the mid-twentieth century (Wendorf and Hester 1962:166).

At the Culloden Acres site (AfHj-90) in Ontario, excavations have revealed a concentration (Area A) that consisted almost entirely of endscrapers, scraper retouch flakes, and gravers (Ellis 2007; Ellis et al. 1991). This is in contrast to Area B at the Culloden Acres site, which yielded predominantly biface and channel flakes (Ellis et al. 1991). At the Lanning site (5GN151), a Folsom site in Colorado, archaeologists have identified an apparent short-term animal processing site where scrapers and gravers/awls were found clustered in an area that also yielded a lot of debitage (Andrews 2010:285-287). Andrews' (2010:285-287) summary of the work at this site does not give any details about the type of debitage observed in this area. At the Bull Brook site, a Gainey/Bull Brook (Early Paleoindian) site in Ipswich, Massachusetts, excavators recovered artifacts from discrete areas with sterile areas between them. Within the endscraper dominated areas of Bull Brook, gravers and wedges were found to be correlated (Robinson and Ort 2013:114). Analysis of the assemblages at these sites suggests that gravers were used in the same activity as endscrapers.

Microwear analysis of gravers has indicated they were used for a variety of purposes, of which hideworking is one (Daniele 2003:13; Maika 2012:30-38). Researchers have concluded that gravers were used on bone, antler, hide (including both dry and fresh), meat, tendons, shell, and wood. Some gravers only had one type of use-wear while others were found to have been used on a variety of surfaces (Maika 2012:37). In her study of Paleoindian gravers from Ontario, Maika (2012:116) found gravers were most commonly used for graving bone, fresh wood, and "moderately resistant animal substances" (hides and meat). More evidence of meat or hide use occurred among gravers from the Gainey phase than from two other Paleoindian groups (Parkhill and Crowfield) (Maika 2012:116-117). Daniele (2003) examined 13 gravers and spurs on six endscrapers from the Folsom Barger Gulch site in Colorado for microwear. He identified use-wear on two of those gravers, on one he observed wear associated with dry hide or wood polish and on the second he found use similar to dry hide (Daniele 2003:42-43; Kornfeld 2013).

Bifaces and Flake Knives

Bifaces and flake knives could all be used during butchering and hideworking for cutting. Flake knives are expedient tools that exhibit evidence of utilization and/or retouch that forms a thin very thin and sharp working edge. Bifaces are formal tools with invasive retouch on both sides. Both of these kinds of tools would work well for removing the hide from the carcass, as well as cutting the hide and meat.

Several site studies document utilized flake knives in association with endscrapers. Chambers (2015:89) includes bifaces in his potential hideworking assemblage. At the Mitchell Locality, Boldurian (1990:75) identified an area with a cluster of endscrapers, utilized flakes, and debitage as a potential hideworking area. At Verberie, use-wear analysis indicated utilized blades were used in hideworking (Audouze 2010:155-156).

Ultrathins

Ultrathins are a specific kind of biface; they are thin with ovate to bipointed outlines (Jodry 1998; Root et al. 1999:151). Jodry (1998, 1999) observed that ultrathin bifaces are often recovered from camps and stone quarries, not kill sites or kill/initial processing activity areas. She hypothesized this is because they were women's tools used to cut long, thin pieces of meat for drying. This hypothesis is consistent with microwear analysis of ultrathins, which indicates they were hand held knives used in butchering and occasionally on hard materials such as bone and antler (Jodry 1999:204, 206; Root et al. 1999:161, 164). As Jodry (1999:211) pointed out, similar beveled knife tools from the Late Prehistoric period have been hypothesized to be hide cutting or skinning tools (Sollberger 1971:218, Creel 1991:44-45). Ultrathin bifaces may be comparable to Cody knives from later Paleoindian sites. Like ultrathins, Cody knives are typically found in non-kill contexts (Blackmar 1998). Although more than one researcher has repeated Jodry's hypothesis, no studies of the association of ultrathins with other hideworking tools or areas has been undertaken.

Side Scrapers

Side scrapers have steep unifacial retouch along one or more long edges of the tool. Some of the side scrapers from the Stewart's Cattle Guard site were identified as stretching and softening tools used during hideworking (Jodry 1999:247). At Bull Brook, on the other hand, side scrapers were evenly associated with either endscraper dominated or biface dominated groups of artifacts (Robinson and Ort 2013:114). Few use-wear studies have been complete on side scrapers. Those that have been undertaken have identified multiple uses for these tools, including hideworking, bone and antler working, and woodworking (Grace 1990:10; Osipowicz 2014). Unlike endscrapers, there does not appear to be a preponderance of use-wear evidence that side scrapers were used primarily in hideworking. Therefore, it is not clear if or when they should be included in an archaeological hideworking assemblage, and I have not included them in my analyses.

Other Stone Tools

Abraders

Hide abraders may be made of bone or ground stone and were used to break down the hide fiber, apply tanning solutions, raise the nap, and apply color (including ochre) or whitening (Adams 1988:313, 2002:97, 2014; Dubreuil and Grosman 2009). Hide-processing stones are hand held ground stone artifacts that were usually employed in a reciprocal to circular motion (Adams 1988:313). Historically, some of these stones may have been incorrectly categorized as manos; however, according to a Hopi informant, manos were about twice as long as hide-processing stones (Adams 1988, 2002). Hide-processing stones from one Southwestern collection ranged from 8-16 cm long, 5-10 cm wide, and 4-8 cm thick (Adams 2002:96). Although Adams (1988, 2002) has written about examples of hide processing stones from the Southwest and Dubreuil and Grosman (2009) have identified them in the Middle East, there also is mention of both bone and stone abraders in the Plains ethnohistoric record of hide processing and archaeological examples have been identified (Dubreuil and Grosman 2009:Table 2). In a Folsom level of the Agate Basin site in Wyoming, a ground stone artifact with calcite crystals on one side may have been used as a hide-processing stone or "hide-finishing tool" (Frison 2014:69). For additional archaeological examples of hide-processing stones from the Plains, see Schultz (1992:342).

Under magnification, hide-processing stones exhibit individual grains that are smoothed, accentuated, and left in high relief (Adams 1988:313). Experimental use of a stone on deer and elk hides revealed similar results. Although the hide-processing tool becomes smoothed, it is not leveled and even without magnification the worked surface of a hide-processing stone may exhibit a sheen (Adams 2014:134). Thus far, no hide-processing stones have been recognized at 14SN106 or 41WK21, but some "abraders" are included in the 41WK21 assemblage, and there are many mapped rocks from 14SN106 that should be examined for this kind of wear.

Fist-Sized Cobbles

At the Cooper bison kill site in Oklahoma, Bement (1999:78, Figure 28) identified fist-sized cobbles in the bonebed. Although similar to hide-processing stones, they are separated here because these cobbles have been specifically suggested as tools used to pound the hide from the carcass and/or break open bones for access to marrow. Additional research would be required to determine the use of these stones, but this is an interesting possibility.

Red and Yellow Ochre

Ochre is a mineral that contains iron oxide, the category includes both red (hematite) and yellow (limonite) varieties (Rifkin 2011:133). Several uses for ochre have been documented ethnographically and archaeologically (Rifkin 2011:132). In Africa, ethnographic sources identify ochre used as a desiccant, preservative, and colorant in the hideworking process as well as a preservative after the hide has been tanned has been reported (Dubreuil and Grosman 2009; Rifkin 2011:149). This information and the presence of ochre on tools recovered from archaeological sites led some to suggest it was used in hideworking. Both Rifkin (2011) and van Gijn (1989) conducted experiments wherein red ocher was mixed with a tanning agent. Through this, Rifkin (2011) documented red ochre has preservative utility in hide processing; however, his results suggest the same advantages are not provided by yellow ochre. In van Gijn's (1989:30) experiments, red ochre and liver resulted in a bright polish on the tools that was not seen with any of the other types of use-wear.

Archaeologists have hypothesized that ancient people used ochre in hideworking as early as the Middle Stone Age (285,000-22,000 years ago) in South Africa (Rifkin 2011). At Component 2 of the O.V. Clary site in Nebraska, analysts documented 15 endscrapers, nine of these scrapers exhibited red ochre on their bits (Hill et al. 2011:764). In addition, some 9,600 fragments of red ochre were excavated in this area (Hill et al. 2011:759). Keeley's (1980:170-171) examination of Magdalenian endscrapers led him to identifying red ochre on at least one of the specimens.

Bone Tools

Bone tools used in hideworking take a variety of forms. Hide-processing bones, or grainers, have been observed in the ethnographic and archaeological record and were used similarly the stone abraders mentioned above (Schultz 1992:341; C. Smith 1977:109). Scapulae also have been identified as hide processing tools in archaeological assemblages (Bell 1971; Hofman 1980). These items exhibit polish and damage consistent with their use as a tool to run a hide through to soften it (Grinnell 1972:216; Hofman 1980).

Fleshers

Ethnographic reports describe the metapodial of an animal or a metal item being used to flesh hides. As described above, fleshers were usually made from the metapodial of a large mammal such as bison. To create a fleshing tool, the distal epiphysis of the bone was cut or broken at an angle and usually small teeth were cut in the end of it. Wissler (1910:68-69) identifies a large area where this type of tool was used ethnographically. Subsequently, prehistoric and early historic archaeological examples of fleshers have been recovered from throughout the Great Plains and adjacent areas (Hofman 1975; Lehmer 1971; Mason 1891; Schultz 1992:340; C. Smith 1977; Steinbring 1966; Wedel 1936; Wood 2001:Figure 5). Nearly all of the archaeological examples of fleshers date after ca. A.D. 900 on the Northern Plains and after ca. A.D. 1500 on the Southern Plains (Hofman 1975; Lehmer 1971; Matwychuck 1980). There have, however, been reports of a few earlier examples from the Woodland (Wedel 1961:91) and Late Archaic (Freeman 1966; Zejdlik 2015:149) periods. Indeed, metapodial fleshers may extend back to Paleoindian times in North America. An archaeological example of such a tool has been recovered from the Folsom level of the Agate Basin site; a second similar tool from the Agate Basin site was out of place and what level it came from could not be determined (Frison and Craig 2014:171).

Endscraper Handles

In historic times, the handle of composite scraping tools was most commonly documented as being made of antler; however, wooden and bone versions of this tool also have been observed ethnographically and appear to have been used prehistorically (Mason 1891; Metcalf 1970; Steinbring 1966; Wedel 1970:36, 41; Wood 2001:Figure 5). The typical L-shape of the handle used in many historic Great Plains cultures is found naturally in elk antlers making them ideal for this purpose. This type of scraper handle has been referred to as an adze shape (Metcalf 1970; Wedel 1970). Haft wear on many of the Paleoindian endscrapers suggest they were hafted, but the material and shape of the Paleoindian haft is unknown. There is limited evidence the L-shaped handle may have been in use as much as a thousand years ago in the Northern Plains; it appears this tool was either made of perishable materials or adopted later in the Southern Plains (Metcalf 1970; Schultz 1992:341; Wedel 1970:36-37).

Wedel (1970) documented another shape for such a tool found at Little River and Dismal River phases sites in the Central Plains; they date from ca. 1700. This tool also is made of antler, but it does not exhibit the distinctive L-shape. Instead they use the natural curve of the antler and hollow out an area at the end for the scraping portion of the tool. This interpretation of these artifacts as endscraper handles is supported by the one found in place with the chipped stone tool still in the slot (Wedel 1970:37). Wedel (1970:39) hypothesized that this composite tool was used by pushing away from the agent instead of pulling toward them as was common with the L-shaped handle.

Wooden Artifacts

In general, wooden tools are not preserved from Plains Paleoindian sites, but it is important to remember that Folsom people would have included perishable items in their toolkits, and archaeologists do not have the whole assemblage. Endscraper handles of wood have been documented in the Late Prehistoric period on the Plains (Metcalf 1970; Wedel 1970) and in the ethnographic record (Schultz 1992). Another wooden artifact type that has survived in some environments are wooden pegs. Pegs may have been used for a number of purposes, but the ethnohistoric text and image information suggests that many such pegs were used for staking out hides (Brink 2008).

Activity Areas and Spatial Analysis

Identification and Interpretation of Activity Areas

Archaeological material inherently contains spatial information (Andrews et al. 2008:467), and these data may be used to better understand the behavior of prehistoric peoples. Spatial analyses provide the means to identify and analyze patterning on various scales. Questions about the dispersal of artifacts both vertically and horizontally also can be addressed with spatial analytical methods. Intrasite spatial analysis considers the clustering of artifacts, features, or ecofacts within a site. It can assist researchers in the identification of features and activity areas at sites and illuminate the impacts of post-depositional site formation processes that have affected the distribution of artifacts. This project investigates locations that may be identified as used for hideworking at 14SN106 and 41WK21.

Binford (1983:147) defined activities as "an integrated set of tasks, generally performed in a temporal sequence and in an uninterrupted fashion." Like other models of prehistoric human behavior, archaeologically defined "activities" should be viewed as ideas generated from available data that require further evaluation (Ferring 1984:117). Activity areas are "places, facilities, or surfaces where technological, social, or ritual activities occur" (Binford 1983:148). Archaeologically speaking, activity areas can be identified by clustered groups of associated artifacts, ecofacts, and/or features in a specific context (Ferring 1984:117). Artifact clusters may be identified by observation during fieldwork and/or by subsequent analysis of artifacts and spatial data in the lab. Activity areas can be evidence of a single event by one individual or multiple activities conducted by an entire group (Binford 1983:148-149; Ferring 1984; Kent 1984:55). In some cases, when activity areas overlap one another or are the result of multiple occupations, their identification and analysis becomes more complicated (Ferring 1984).

Ethnographic, ethnohistorical, and ethnoarchaeological study; experimental archaeology; statistical spatial analysis; and comparisons with patterning at other sites have all been used to interpret activity areas at Paleoindian archaeological sites (for examples see Andrews 2010; Bamforth and Becker 2007; Deller and Ellis 1992; Hill et al. 2011; Ingbar and Larson 1996; Jodry 1999; Root 2000; Ruth 2013; Shott 1993; Surovell and Waguespack 2007; Wiederhold 2004; Zink 2007). Archaeologists interpret activity areas with a goal of understanding prehistoric site structure, to look for evidence of technological or social organization, observe how differences in mobility affect site organization, and whether there was any differentiation of space by age or gender (Keeler 2010:47-49; Hill et al. 2011). In the case of hideworking, several lines of evidence suggest women were the primary agents who processed hides (see above; Frink and Weedman 2005; Keeley 2010; Ruth 2013); an interpretation of archaeological data may support or refute this idea. Ethnoarchaeological research (Binford 1983; O'Connell 1979 as cited in Carr 1984:126) indicated intensive hideworking was completed outside and away from the main residential areas because of the space required.

Spatial Analysis and Hideworking Activity Areas at Paleoindian and Late Paleolithic Sites

North American Paleoindian and Late Paleolithic Paris Basin sites with spatial data on the location of endscrapers can provide a database of archaeological (source-side) data to assist in understanding endscraper activity areas. It is important to note, however, that not all endscrapers were likely used as hideworking tools, and they were not all discarded where they were used. An obvious example of this is endscrapers found in caches and burials (Ruth 2013:128-130). In addition to those discussed below, several other Paleoindian sites have been investigated for spatial analysis (Arnold 2007; Bamforth and Becker 2007; Deller and Ellis 1992; Hill et al. 2011; Larson et al. 2009; Shott 1993), but this section focuses on those that have specifically examined hideworking artifacts spatially within sites. Archaeologists have used a variety of spatial analysis methods to investigate patterning at Paleoindian sites. These include: density measurements, kernel density estimates (KDE), cluster analysis (e.g. k-means), nearest neighbor analysis), and local autocorrelation.

The Aubrey Site

A Clovis period site in Texas, the Aubrey site (41DN479) was the scene of extensive excavations in the late 1980s (Ferring 2001a). Interestingly, only 64 tools were recovered from the Aubrey site, including 41 from Area B and 16 from Area F, the two areas where spatial analysis was conducted (Ferring 2001a:Table 9.11). Tool types included bifaces and a Clovis point, end and side scrapers, utilized and modified flakes, radial and bend break tools, gravers, among others. The remainder of the approximately 9,800 chipped stone artifacts recovered from Areas B and F were debitage. Spatial analysis, specifically comparing those two areas of the site, indicated that, although the areas are spatially distinct, they may have been occupied at the same time (Ferring 2001a:238). Witt (2005) compared the spatial distribution of debitage, burned and unburned bone, biface thinning flakes and unifacial resharpening chips (UCRs or scraper retouch flakes) in Areas B and F. Bifacial and unifacial flakes were found in both areas, but there also were some distinct differences in the composition of the assemblages (Ferring 2001a; Witt

2005). Witt (2005) found that scraper retouch flakes were much more common in Area B, supported Ferring's (2001a) original conclusions that there were separate, but nearby, locations of bifacial maintenance, scraper resharpening, and bone processing in Area B. Area B yielded a "statistically supportable spatial separation of" biface thinning and scraper retouch flakes (Witt 2005:89). Indeed, Ferring (2001a:199) noted that the scraper retouch flakes in Area B were in an area where few, if any, other activities took place. If scraper retouch flakes were deposited in the location where endscrapers were used, that activity appears to have been separated from other camp activities.

The Bull Brook Site

At the Bull Brook site, excavators recovered artifacts from discrete areas with sterile areas between them so analysts did not have to define clusters at the site (Robinson and Ort 2013, Robinson et al. 2009). Bull Brook is a Gainey/Bull Brook phase site in Massachusetts. Spatial analysis included examining tool types in each activity area to determine any differences between them. The activity areas at Bull Brook are arranged in a rough rectangular shape. Looking at tool types in each area revealed the interior clusters were dominated by bifaces, drills, flakeshavers (small elongate unifacial tools), and channel flakes while those on the exterior were dominated by endscrapers, gravers, and wedges (Robinson and Ort 2013, Robinson et al. 2009). The idea that hideworking took place away from the main focus of a camp may be supported by the spatial patterning observed at Bull Brook. A pattern of specialized activities represented by artifact clusters with differing percentages of tool types, especially some clusters dominated by bifacial tools, also has been reported at Parkhill and Debert Paleoindian sites in Canada and the Whipple site in New Hampshire (Robinson and Ort 2013:117, Robinson et al. 2009:427).

The Stewart's Cattle Guard Site

Jodry (1999) examined the spatial distribution of endscrapers relative to other tools and identified a hideworking activity area at the late summer-early fall bison kill and processing site of Stewart's Cattle Guard site (5AL101) in Colorado. She observed there was a concentration of endscrapers and resharpening flakes, presumably unifacial, in the northern and central portions of the southwestern area of the site (k-means lithic cluster 1), away from the kill and initial butchering areas (Jodry 1999). Although endscrapers were recovered in each of the residential areas, none were recorded in the kill and initial butchering areas (Jodry 1999:Figures 74 and 83). K-means lithic cluster 1 is identified as being on the periphery of the camp (Jodry 1999:318); however, areas beyond it have not been excavated so its location relative to the site as a whole is difficult to evaluate. It is a logical assumption that hideworking would take place on the periphery, for as Jodry (1999:321) points out, hideworking takes up a significant amount of space and the process takes longer than a day to complete. Despite the space needed, fresh *Bison antiquus* hides would have been heavy and people may have chosen a location near the kill for convenience (Jodry 1999:321). Specifically, it appears that at least the initial stages of hide processing took place in this area, but Jodry (1999:320) suggests that fleshing, graining, and thinning of a hide may have taken place in a different location than tanning and softening. Fleshing may not leave an archaeological signature as, historically at least; it was commonly accomplished with a bone flesher that may not preserve (Ruth 2013:238). On the other hand, later stage hideworking "produces lower attrition (and resharpening) rates for tools" and may be less visible archaeologically (Jodry 1999:320).

The Lindenmeier Site

Lindenmeier (5LR13) is a large Folsom site in Colorado that was excavated in the 1930s (Wilmsen 1974; Wilmsen and Roberts 1978). Given the time in which it was excavated, the archaeologists recorded the spatial location of many artifacts in good detail with maps depicting the provenience of more than 5,500 artifacts. A recent study has digitized this data in a geographic information system (GIS) mapping program that allows for manipulation and analysis of the artifact patterns (Chambers 2015). Chambers (2015:89), explored hideworking artifacts at Lindenmeier and their relationship to projectile manufacture artifacts. For hideworking artifacts, he selected: bifaces, bone needles, endscrapers, grinding stones, hematite and ochre; artifacts in the projectile manufacture group included bifaces, channel flakes, all varieties of projectile points, and preforms (Chambers 2015:113). Using spatial auto- and cross-correlations between these artifact types, Chambers (2015) was able to identify artifact types that were statistically correlated with other artifact types. To summarize his results, *both* hideworking and projectile manufacturing co-occurred most commonly in Units G and H in Area II. This finding suggests that these activities were not spatially segregated at the Lindenmeier site (Chambers 2015:138).

Although Sellet (2013:392-394) did not focus on hideworking tools, he also examined spatial patterns at Lindenmeier. He compared where artifacts related to point manufacture (channel flakes and preforms) and finished projectile points were found in two site areas. He observed that the points were discarded in a more dispersed pattern across the area while channel flakes and preforms were more concentrated. Based on these results, he concluded non-functioning weapons were not discarded at the same time new ones were manufactured to replace them. Also, Folsom points were finished (fluted) in groups, not one at a time to replace the discarded items. Sellet (2013) indicated the dispersion of points may be the result of items being discarded a few at a time or the result of a palimpsest of occupations, while the concentrations could be the result of individuals re-using the same space or a group of people working together in one location.

The Rio Rancho Site

The Rio Rancho site is a Folsom locality in New Mexico. It was excavated in the 1960s (Dawson and Judge 1969; Judge 1973). Recently the spatial patterns at the site have been investigated by Ruth (2013). She used k-means cluster analysis, nearest neighbor statistics, and artifact density to explore the location of potential hideworking activity areas relative to other parts of the site.

At the Rio Rancho site, endscrapers were recovered from areas of dense artifact concentrations as well as in the site’s periphery where fewer artifacts were observed (Ruth 2013:340). In contrast, weapons debris is more concentrated in the dense artifact areas. In other words "endscrapers are spatially independent of weapons production" (Ruth 2013:299). She hypothesizes that this pattern may be the result of small and large scale hideworking. This is consistent with the results of my review of the ethnohistoric images where one or two hides are more likely to be worked near a habitation, but a larger number of hides are worked some distance from the habitation. This spatial pattern of endscraper deposition might also be explained as depicting where the artifacts were manufactured, used, and/or resharpened and discarded, i.e., the presence of endscrapers does not mean they were used there. For example, resharpening and replacing worn out scrapers in hafts may have been an activity that was completed near a hearth.

Another pattern Ruth (2013:300) commented on at the Rio Rancho site was the tendency for weapons artifacts tend to cluster in the south while endscrapers are more common in the north part of an area. She suggested this could be related to prevailing winds and identified a similar pattern in k-means lithic cluster 1 at the Cattle Guard site (Jodry 1999:297).

The Sandy Ridge Site

At the Sandy Ridge site in Ontario, Canada researchers have identified three Paleoindian (Gainey) activity areas and four Paleoindian hearth features; the artifact assemblage from the site is dominated by scrapers and scraper resharpening flakes (Jackson 1998). The majority of the 2,093 artifacts are scraper resharpening flakes, and 24 of 41 tools are endscrapers. Other tools from Sandy Ridge include bifacial wedges (*pièces esquillées*) and perforators, as well as unifacial side scrapers, gravers, modified flakes, and denticulates (Jackson 1998:36; 45-47). The function of this site appears to have been scraper rejuvenation, which occurred near hearths. Statistical analysis demonstrated the scrapers and scraper flakes were associated with one another while each of the three defined areas is independent (Jackson 1998:37). Based on the artifact distribution and assemblage, Jackson (1998:50) interprets the Sandy Ridge site as a "highly focused, short-term logistical camp."

The Verberie Site

Late Paleolithic hunters and gatherers had many things in common with Paleoindians in North America. In addition, archaeologists have spent a good deal of time precisely recording the location of artifacts from several of these sites making them a good place to examine spatial patterning.

The site of Verberie in France dates from the Magdalenian Upper Paleolithic period (ca. 11,000 ^{14}C yr. B.P). It has been carefully excavated for more than 25 seasons and a great deal of work has gone into understanding the spatial organization at the site. Audouze (2010) and Keeler (2010) reported on evidence of hideworking tools in Level II-1 at Verberie. The results indicate scrapers are present in the hearth periphery (1-3 m from them), in dumps, and away from other tools and hearths (Audouze 2010:162; Keeler 2010:112, 128). Audouze (2010:167) notes that every tool category was present throughout the domestic space associated with the hearths. Although all tools are found throughout this portion of the site, the researcher did note a concentration of hideworking tools (endscrapers and utilized blades) scattered northwest and "at some distance" from a hearth while weaponry retooling is concentrated southeast and nearer the same hearth (Audouze 2010:167).

Similarly to New World endscrapers, Old World scrapers appear to have been used primarily as hideworking tools (Carr 1985; Keeler 2010:93; Stapert 1989:27). At Verberie, use-wear analysis identified endscrapers that were used on either fresh or dry hides; however, there was no spatial difference in the distribution of the endscrapers based the material on which they were used (Audouze 2010:162; Symens 1986). Audouze (2010:171) hypothesized that women undertook hideworking tasks away from the hearth area, but returned with their tools to the hearth vicinity after the task was complete.

The Pincevent Site

Pincevent is a Magdalenian Upper Paleolithic site in France that has been extensively excavated and studied. This site contains a series of several occupations, and it is clear this location near the confluence of the Seine and Yonne rivers was an attractive campsite during the Magdalenian period. One of site areas is Habitation 1, which consists of a series of three hearths with associated artifacts and bones. Spatial analysis of this area has concentrated on the presence of structures; however, some researchers have included mention of endscrapers in this area (Carr

1985; Stapert 1989). Carr (1985:426-427) identified that scrapers were found in the same areas as micropiercers, and they both tend to occur away from the hearths. Stapert (1989) also identified a pattern of endscrapers distant from hearths at Habitation 1. He described a pattern wherein backed bladelets were found nearest the hearth, borers and burins were an intermediate distance from the hearth, and scrapers were farthest from the hearth. Only one hearth he examined at Pincevent (R143) did not fit this pattern. In general, scrapers were more than half a meter farther from the hearths than the backed bladelets (Stapert 1989:23). Assuming then that the scrapers were discarded where they were used in hideworking, Stapert (1989) suggests they are that distance from the hearth because hideworking takes up more space and has less need for fire than other activities. Stapert (1989:27) also identified this pattern in another area of Pincevent and at other Old World sites.

Simek (1984) conducted spatial analysis of another area of the Pincevent site, Section 36. By using k-means clustering and then grouping those clusters into zones and examining the composition of those zones, he concluded that the concentrations of artifacts near the hearths were not the result of specific tasks, but rather dumps of materials from clean-up of the hearth area (Simek 1984). It is important to consider that cleaning activities also may be represented in archaeological spatial data.

Critiques of the Archaeological Data

Inherent problems in archaeology include the impact site formation processes have had on the data. Some of these studies note and describe these potential impacts, but others do not address it in the course of their study. Site formation processes must be considered in analyses of spatial organization because many post-depositional impacts move cultural deposits either vertically or horizontally. Another consideration of the relevance of these archaeological data to this study is that they are not in the same settings as 14SN106 and 41WK21, the environment affects the need for hides, the species hunted, and ways of preparing hides.

Another common issue with using comparative archaeological data involves the methods the researchers have used. Certainly there are many ways of conducting spatial analysis and some of them may lead to the same result through different paths, but unless the data collected is provide and comparable, it is difficult to compare the outcomes of analyses.

Summary

Analogy is an integral part of most archaeological interpretations. The history of thought regarding ethnographic analogy in archaeology began with an equation of ethnographically observed cultures with archaeological complexes. This formal type of analogy created a reaction against the use of analogy in archaeology; however, ethnographic data is so informative about the varieties of human lifeways it was soon taken up again. Throughout the twentieth century, critiques leveled against the use of ethnographic analogy were addressed by attempting to improve how it was used in archaeology. In the past few decades, use of ethnographic analogy has included recognition that analogy can generate ideas and hypotheses about the past, but it must then be evaluated against the archaeological data rather than simply applied to archaeological complexes as explanation.

There are many sources that briefly describe the process of hideworking among various Plains Indian groups who hunted bison. These documents date from the mid nineteenth century through the mid twentieth century and were authored by people in a range of occupations. Taken together they tell a story of women hideworkers who completed a series of tasks to create rawhide and tanned skins for more than 50 uses. The steps of this process include hide acquisition, fleshing, scraping/thinning, tanning, and softening. The ethnohistorical data indicate a fairly uniform process that used similar tools to process bison hides throughout the Plains.

In addition to written sources, artists and photographers documented this process. More than 70 images of every aspect of hideworking were consulted for this study. Again, a remarkable uniformity in the basic actions and tools was observed. For example, use of a composite scraping tool employed while standing on a hide and bent at the waist appears in several cultures of the Plains. Women, not men, are associated with this processing of hides, but men may be involved in their decoration. The examination of images as well as text-based data allows one to explore additional aspects of the activity that were not recorded at the time. For example, multiple images show hides staked or being worked in front of or left of the door when facing the tipi, which is to the right when looking out of the structure. This aspect of the activity is not discussed in any ethnographic or historical sources.

A review of cross-cultural studies indicates people of both sexes participate in hideworking; however, women do more hideworking when groups are more reliant on hunting and fishing and in cooler climates (Ruth 2013). Archaeological evidence of hideworking has been observed by both examining the artifacts that are associated with hideworking and spatial analysis. Hideworking artifacts include fleshers, scrapers, endscraper handles or hafts, gravers, utilized knife flake tool, other knives, and hide-processing stones and bones. Several of these categories can be made of more than one material. Spatial analysis reveals that many archaeological sites have identified hideworking activity areas away from other activities, but this may not always be the case as endscrapers are found throughout several of the sites evaluated.

It is important to understand the relevance of an analogy of Plains hideworking for prehistoric Plains complexes. This, along with source-based critiques and subject-based evaluation are important for a comparative approach to creating an analogic model (Stahl 1993). Despite obvious differences, many of which are related to the coming of Europeans and Euro-Americans, the historic cultures can still provide useful hypotheses for prehistoric processing of bison hides. This data should not, however, be accepted without evaluation of any source and subject-side biases and deficiencies, which area addressed above.

Specifically, an evaluation of the source-side data revealed information about the type of tools that may be used in the hideworking process, the tasks required to complete the task, who was participating in the activity, where hideworking took place, and the position of the person completing the task. Similarly, subject-side data informed us about hideworking artifact types that are found in association, offered ideas about lithic and spatial analyses that would elucidate patterns in the archaeological data, and provided hypotheses about where Paleoindian hideworking took place. These findings are not the end of this research, but rather they provide the framework to create a comparative analogy used to examine site assemblages from 14SN106 and 41WK21. It is my intention that the archaeological data be used to modify or support aspects of the analogical framework.

Chapter 3. A Model for Paleoindian Hideworking Activity Areas

The source-side and subject-side data presented in Chapter 2 was reviewed with a goal of developing a comparative analogy that could be used to evaluate 14SN106 and 41WK21 for hideworking activity areas and assist in the interpretation of such activity areas. Given the proper application, written and visual data of historic and modern hideworking, as well as comparative archaeological data, can benefit our interpretations of the past. An understanding of the tools and space required for bison hideworking, the location of that activity relative to others, and information about associated activities, can all give researchers fodder for hypotheses about ancient hideworking practices. Note that this discussion is focused on the evidence available for ethnographic bison hideworking and Late Pleistocene and Early Holocene archaeological sites, since this appears to be the fauna worked at 14SN106 and 41WK21. Other hideworking examples may be relevant and a couple are mentioned, but the scope of this study precluded an exhaustive study of other prehistoric and ethnographic hideworking.

Hideworking Artifact Assemblages

Several types of tools are used in the process of working hide (Table 3.1). Together they form an expected hideworking artifact assemblage. Endscrapers are an important component of this assemblage. They are steeply retouched tools that are usually unifacial and exhibit a planoconvex cross section; they are typically made from flake blanks where the bit is at the distal end of the flake (Morrow 1997:71; Odell 1996:384). Experiments have demonstrated endscrapers require resharpening to remain useable. The flakes generated from resharpening may indicate where hideworking occurred. Because endscrapers need resharpening several times in the course of working a hide, it is likely that resharpening occurred near where the tool was used, and many scraper retouch flakes may have been deposited near where scraper use and resharpening took place. Other flake tools, including gravers and knives have been identified in association with scrapers at some sites. Some of these tools are expected to be more visible archaeologically. For example, endscraper hafts and fleshers are generally curated artifacts and do not have the same attrition as endscrapers. In addition, some artifacts, especially those made of wood and bone, are more susceptible to disintegration and are unlikely in Paleoindian assemblages.

Table 3.1. An expected hideworking artifact assemblage.

Tool	Material	Use	Source-side / subject-side data	Selected References
Abraders (hide-processing stones)	Ground stone, bone	Graining	Both	Adams 1988, 2002, 2014; Dubreuil and Grosman 2009; Grinnell 1972; Hoebel 1988; Wissler 1910
Composite scraper: endscraper	Chipped stone, metal	Graining and thinning	Both	Denig 1930; Ewers 1945; Hans 1907; Hayden 1979, 1986; Hiller 1948; Kavanagh 2008; Keeley 1980; Loebel 2013a, 2013b; Lowie 1983; Mason 1891; Metcalf 1970; Seeman et al. 2013; Wallace and Hoebel 1986; Wedel 1970; Weltfish 1965; Wilmsen 1970; Wood 2001
Composite scraper: haft	Bone (antler), wood			
Flesher	Bone, wood	Clean the hide	Both	Battey 1876; Dorsey 1884; Frison and Craig 2014; Hilger 1951; Hofman 1975; Matwychuck 1980; Moore 1999; Steinbring 1966; Wedel 1936; Wissler 1910
Gravers	Chipped stone (may have been replaced by metal tools)	Preparing for staking/racking	Subject-side data	Andrews 2010; Daniele 2003; Ellis 2007; Ellis et al. 1991; Maika 2012; Robinson and Ort 2013

Continued on next page.

Table 3.1. An expected hideworking artifact assemblage (continued).

Tool	Material	Use	Source-side / subject-side data	Selected References
Knives (bifaces/flake knives)	Chipped stone, metal	Skinning, dividing the hide, preparing for staking/racking	Both	Audouze 2010; Boldurian 1990; Chambers 2015; DeMallie 2001:6; Ewers 1945:10; Kroeber 1902:26
Red and Yellow Ochre	Stone	Preservative, colorant	Source-side data, suggestions in subject-side data	Dubreuil and Grosman 2009; Hill et al. 2011; Rifkin 2011
Scraper retouch flakes	Chipped stone	Byproduct of endscraper use	Subject-side data	Frison 1968; Jackson 1998; Jelinek 1966; Shafer 1970; Witt 2005; Witthoft 1952
Stakes	Wood, bone, stone	Stretch and keep hide in place	Source-side data	Binford 1983; Dodge 1877:357; Dorsey 1884:310; Ewers 1945; Kavanagh 2008; Moore 1999; Nye 1962; Wissler 1910
Rack(s)	Wood	Stretch and keep hide in place	Source-side data	Boller 1868:301-302; Hans 1907:159; Mandelbaum 1940; Schultz 1962:32; Weitzner 1979

Where did Hideworking Take Place?

To work on a large hide, like bison, a certain amount of space is required. If the activity is completed in an area separated from other tasks this area may be expected to yield primarily hideworking artifacts as is seen at Culloden Acres and Sandy Ridge archaeological sites. A single task use area may also lead to a low artifact density relative to other areas. This pattern seems to be more likely when there are multiple hides to be worked at once, and the period of occupation is relatively short. A short occupation means other activities are not likely to occur in the same space. The ethnographic data indicate that working many hides at once usually takes place some distance from residences; whereas, when only one or two hides are to be worked the activity is more likely to be undertaken near residences. This is an ethnographic pattern that Ruth (2013) noted as well.

If bison are being processed, the activity area will be large enough for a stretched complete bison hide. In either case, working a hide depends on the size of the piece. Modern bison (*Bison bison*) hides are approximately 3 x 3 m, and due to trimming and shrinkage, tanned museum specimens of about 2 x 2 m have been observed (Klek 2008). Wiederhold (2004:73) used two bison hides in his processing experiments; one was from a two-year old bull and the other from a cow. After trimming them to fit in racks, they still measured 1.8 x 2 m and 2 x 2.2 m respectively. Split finished tanned hides for sale average 2 m long and 0.7 m wide. As *Bison antiquus* was about 1.5 times the size of modern bison large bull hide could have been up to 4.5 x 4.5 m. **A**dditionally, in the images I observed, there was room to move around the hide as one worked by kneeling beside it. Therefore, although hideworking and habitations were found in association, there will likely be some space between the activity areas and both will be of considerable size.

One of the topics specifically addressed in this research was what the ethnographic record tells us about where hideworking took place during historic times. A better understanding of spatial relationships was provided by the inclusion of images in the source-side data. As presented in the discussion above, in 44 of the 53 images where a structure was observed the hideworking was observed near the structure. In another eight images the hideworking was taking place an intermediate distance from a structure; only one was identified as being far from the visible structures.

Although the types of structures in these images ranged from wooden houses to earthlodges to tents, the overwhelming majority of the structures were tipis. Hideworking was observed taking place behind these lodges, directly in front of them, to the right of the door, and in a couple of cases on all sides of the tipi. In only one case, Catlin's painting of a Crow tipi, does the hide appear to be staked to the left of the door. This pattern of hideworking near structures is one that can be explored archaeologically. As observed in the images, hideworking also takes up a considerable area. Generally no other activities were identified in the immediate vicinity of the hide processing. Both of these observations also can be evaluated by looking at the archaeological record.

Based on these observations, I suggest small-scale hideworking took place near habitations (structures) or hearths (domestic space) in an area large enough for a staked hide and worker. In addition, processing of many hides likely took place away from habitations and hearths in large open areas. Hideworking activity areas may be identified by the presence of tools and debris as well as where they are located in a site (Ruth 2013; this study). By examining and evaluating archaeological (subject-side) data, this hypothesis may be disproved or supported.

This hypothesis could be tested using any archaeological site; however, when evaluating it using Paleoindian archaeological data, it is important to include evidence of hearths as possible habitations because there is often limited archaeological evidence of Paleoindian residences. Hearths appear to have served as the center of domestic space for Paleoindian peoples, and most structures may have been temporary or have left limited archaeological evidence.

Archaeological data that would support the proposed hypothesis includes the identification of a hide processing location near a habitation at a site; or, if a hide processing area is identified, the archaeologist might examine the area for evidence of a habitation. In the analysis of images completed for this paper, a pattern of hideworking south of the door of likely east facing habitations was identified. This pattern should be further examined through historical, ethnographic, and archaeological data. If the pattern identified in the images is found in additional sources or the archaeological record, it would support an interpretation of gender associated areas extending outside the lodge. Depending on the number of hides, hideworking activity areas may be either spatially distinct from other activity areas or in the vicinity of other domestic activity areas

Associated Activities

"[I]t is impossible to separate completely the hide working process from that of butchering" (Frison and Bradley 1980:127). Hideworking was not accomplished in a vacuum. Prior to hideworking, tools had to be made, and an animal must be killed. Hideworking can be viewed as one among a group of activities associated with animal processing. Other activities in this processing system include butchering and skinning, crushing bones for marrow extraction, and jerky preparation (Bodu 1996:69; Jodry 1999; Scheiber 2005:65).

Artifacts that may be associated with butchering and skinning bison include knives; however, these tools may pierce the hide during skinning. Other tools, including fist-sized cobbles, also may have been used to pound a hide from the carcass (Bement 1999:79).

During butchering the meat to be used will be cut from the carcass and set aside. Additional meat may be used in the production of jerky or pemmican, ways of preserving the meat. Tools used in this process include knives such as specialized "jerky knives," which may have been ultrathins in Folsom times (Jodry 1999). These have been hypothesized to have been used as jerky knives used in cutting strips of meat for drying. Plains hideworking images shows 16 (approximately 25 percent) also have meat nearby drying on racks, so this does appear to be an activity that occurred near hideworking.

Another activity associated with animal processing is bone grease production (Scheiber 2005:65). Evidence of this activity may include broken bones and the stones used to break them. Although this falls into the animal processing category, it may have been undertaken away from hideworking due to sharp broken bones that could pierce a hide.

Other Considerations

Other considerations that can affect how hideworking is done include the season and access to a residential camp. Historic accounts on the Plains describe large fall and spring hunts with only a few animals taken the rest of the year. Therefore, one group may have different patterning depending on the time of year and size of the hunt. Paleoindians may not, however, exhibit multiple types of hideworking patterns at a single site because they were highly mobile.

As a result of this mobility, they also may have had access to a residential camp near bison kills. Indeed, several Paleoindian archaeological sites have identified camp areas in the vicinity of kills. In historic cases where a kill occurred away from the camp, portions of the processing sometimes took place at or near the kill. Only select cuts and perhaps hides were transported to the camp.

There are advantages to taking animals at different times of the year depending on the resource(s) needed. Unfortunately, unless preservation of bison bone is good and bison are found in association with a hideworking area, it is difficult to determine during what season a Paleoindian site is occupied.

Summary

Using a comparative approach to the application of ethnographic analogy to archaeological data requires knowledge of the source-side (ethnographic) data about the topic (Stahl 1993). Knowledge of source-side data allows the researcher to develop an analogically derived hypothesis about the kind of variability one might observe in the archaeological record. For example, I hypothesized that evidence of small-scale hideworking occurred near hearths and residential areas while large-scale hideworking may be found at a distance from those areas.

The forgoing hypothesis assumes that certain archaeological signatures, such as the remains of tools used to perform an activity, indicate the location of activity. Based on other ethnoarchaeological and archaeological data we know that this is, in some cases, true. In other situations, items are known to have been collected and dumped in a location that is not where they were used. One way to evaluate the latter possibility among the sites included in the archaeological (subject-side) data is to take the location of scraper retouch flakes in to account. Scraper retouch flakes are small and are therefore more likely to have entered the archaeological record where they were created. Using this line of evidence, in conjunction with larger chipped stone tools such as scrapers, ground stone graining tools, or bone tools such as fleshers, the identification of hide processing areas will be easier.

Refitting is another way to understand where on a site artifacts were used and if they were removed from those locations. Understanding this could be achieved by refitting scraper retouch flakes to the tools from which they were removed (Frison 2013:93) or refitting scraper fragments (Amick and Rose 1990). Finally, in cases of exceptional preservation, an archaeologist may find evidence of a hide staked in this location (e.g. Brink 2008).

Thus far I have emphasized the type of evidence that would support the association of small scale hideworking and habitation/hearth activity areas. However, some archaeological evidence would suggest there is no spatial association between these activity areas. For example, if a hearth was identified, but no hide processing tools were present in the vicinity one might question if these activities are always associated. After analyzing the 14SN106 and 41WK21 assemblages, a reevaluation of both the source-side and subject-side data to refine the comparative analogical model will assist archaeologists in forming interpretive conclusions about hideworking on the Plains during prehistoric times (Stahl 1993).

This study uses data from Paleoindian archaeological sites 14SN106 and 41WK21 to identify lithic and spatial patterns presumably associated with hideworking and consider similarities and differences to this analogy. After which, the analogy will be evaluated and refined. As a result of this archaeological tacking between source-side and subject-side data, a comparative model of analogy for hideworking on the Great Plains can be developed.

The identification of hideworking activity areas may seem like a topic of narrow interest; however, an understanding of this activity can help to enlighten researchers on several topics including how particular tools were used, the organization of space, intra- and inter-site comparisons, and women in prehistory.

Chapter 4. Field and Laboratory Methods

This study approaches the identification and understanding of Early Paleoindian hideworking activity areas at 14SN106 and 41WK21 through lithic and spatial analyses. Through lithic analysis archaeologists can interpret how the chipped stone artifacts at these sites made, used, and discarded. Combined with data about the artifacts, spatial analysis assists our interpretation of the type and location of activities conducted at a site. Before considering these methods, it is necessary to review how the data for this study were collected and processed. This chapter describes field methods, artifact and data management, lithic analysis, and spatial analysis at sites 14SN106 and 41WK21.

Field Methods

Field investigations at these two sites can serve to help us understand how data generated from varying field methods can be used to examine prehistoric activities at those sites. Site 14SN106 has been excavated by professional archaeologists, field school students, and supervised avocational volunteers since 2004. At 41WK21 one avocational archaeologist has collected nearly all of the data through systematic surface survey over the past 35 years. Because the field methods at these sites are quite different, they are discussed separately.

14SN106

Excavation at 14SN106 began in 2004, shortly after the site was identified; however, only one unit was excavated that year. Since 2004, seven field seasons have been undertaken at the site (2005-2008, 2010, 2011, and 2015). This dissertation is focused on the results of the Main Block excavation; however, excavations in the Mammoth Area, the Bison Area (Area C), and Area D also have been conducted. In 2011, no units were excavated in the Main Block, but each of the other years at least one 1 x 1 m unit was excavated there (Figure 4.1).

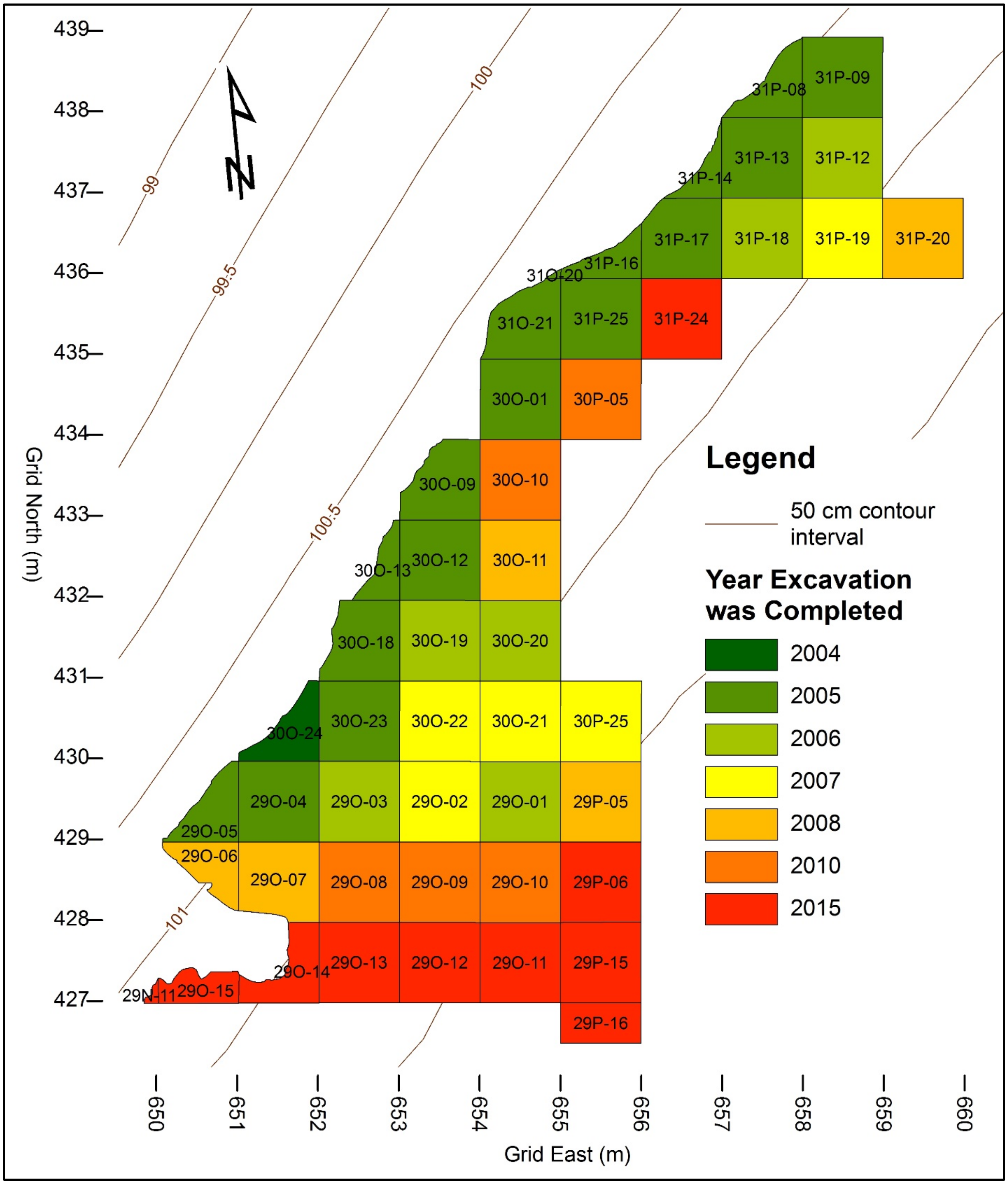

Figure 4.1. The Main Block at 14SN106 depicting the Block-Unit designations and year excavation was completed. Note that units excavated in 2015 are not included in the analysis.

As this study is focused on the Main Block, methods for that area are described here. Site 14SN106 was recorded when an endscraper was found eroded out of the cutbank, and the Main Block excavation began in the cutbank adjacent to where that tool was found. From there, excavation continued to the north along the edge of the cutbank and east into the terrace. Although 10 whole or partial units were excavated in 2015, the analysis of that data has not been completed and is not included in this study. Thirty-nine whole or partial 1 x 1 m units were excavated through the cultural deposits in the Main Block during the 2004-2008 and 2010 field seasons.

In 2003, prior to excavation at 14SN106, archaeologists working at 14SN105, a site approximately 0.8 km (0.5 mi) north of 14SN106, created a grid in which the first datum installed was located at N1000 E1000. This grid was extended to 14SN106 (and 14SN101) in 2004 linking all three sites in a single grid system. This grid is still in use at the Kanorado Locality; only slight variations have occurred between years. In 2005, Sokkia Set 6F and Topcon GTS-226 total stations were used to map items at the site; from 2006-2010 the Topcon GTS-226 total station was employed. Total station shots from the Set 6F machine in 2005 were not correct on the northing. Those readings were corrected by subtracting 0.041 m prior to their use in the analysis for this study. After the error with the Set 6F was discovered, the Topcon was used the rest of the season.

A Tripod Data Systems (TDS) Recon Pocket PC data collector was used to record the spatial data at 14SN106. Several datums have been installed at 14SN106; these points have been used as both the control point and backsight points (Table 4.1; Figure 4.2). Crew members checked the backsight when the total station was first set up for the day and after extended breaks. A ≤ 5 mm error tolerance in all three directions was maintained. Hence, total station data from 14SN106 is within a 1 cm tolerance. Except in rare instances, the total station was used to map and install grid corners, maintain vertical control during excavation, record major stratigraphic contacts, and map in surface and excavated artifacts and certain rocks in units. In addition, topographic shots were taken to provide contour interval data for the site. As with backsighting, error tolerances of ≤ 5 mm were employed during grid installation and for vertical control. Compared to most archaeological sites, the artifact density at 14SN106 is low. As a result, all artifacts, regardless of their size, were piece-plotted if they were found in situ. In addition, bone larger than 1 cm and selected rocks were mapped and collected. Piece-plotted items also were plotted on standardized forms. Piece-plotted artifacts were assigned specimen numbers and bagged separately with all provenience information included on the bag.

Excavators used elevation information from the total station to determine depths for each level excavated. Level elevations were recorded as depths relative to the datum. The first Kanorado datum at 14SN105 (N1000 E1000) was arbitrarily assigned the elevation (Z) of 100.000. All elevations in the Main Block are relative to that point, which is 3,850 ft (1,173 m) above mean sea level. In general, the top and bottom of the Kanorado paleosol were recorded in most units. Therefore, we are able to plot the artifact locations relative to the buried soil.

In preparation for excavating the Kanorado paleosol in the Main Block of 14SN106, most of the overburden was removed via heavy machinery and with shovels. Excavation was begun approximately 10-20 cm above the Kanorado paleosol by shovel skimming in a natural stratigraphic level. Once archaeologists reached the buried soil, excavation proceeded with trowels in 5 cm arbitrary levels. Excavation was halted when a unit was excavated entirely through the Kanorado paleosol, which coincides with the artifact bearing levels.

Table 4.1. Datum IDs and locations for 14SN106.

Datum ID	Grid Coordinates		
	Northing	Easting	Elevation (Z)
8	418.224	647.92	102.379
9	373.248	592.378	100.868
10	487.815	662.326	99.721
06-01	487.046	655.896	99.948
06-02	415.678	647.426	102.373
06-06	428.073	606.183	100.501
06-03 /07-03	441.912	616.623	100.377/ 100.367

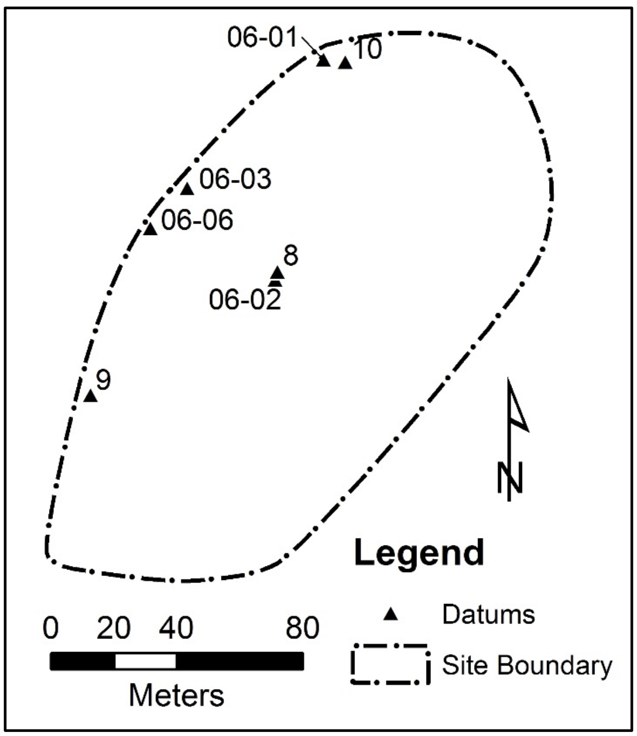

Figure 4.2. The location of concrete and rebar datums at 14SN106 relative to the site boundary. The datums were used as total station control points to set up the grid and record the location of artifacts.

Units were set up as 1 x 1 m in size; however, in reality, many of the units were not complete because they were situated on the edge of a cutbank where erosion had removed portions of the unit (Figure 4.3). On maps in this document the greatest excavated extent of units on the cutbank is portrayed. This was usually at the base of the excavation. Despite the actual amount of soil excavated, units are referred to by the designation assigned to the 1 x 1 m unit. In addition to numeric north and east coordinates that refer to a unit's southwest corner based on its location in the arbitrary grid system, each unit was assigned an alpha-numeric designation in a unit-block scheme. In this organization each 1 x 1 m unit is assigned a designation such as 29P-10. This system allows for ease of cataloging as a specimen number can be added to the end of the block-unit code to create a catalog number that encodes provenience (ex. 29P-10-10). Specimen numbers at 14SN106 were assigned to screen samples as well as any mapped items.

Figure 4.3. View of a unit in the northern portion of the Main Block at 14SN106 in 2006. This unit has partially eroded away, a situation typical of units along the edge of the cutbank in this area.

In 2004, matrix excavated from 14SN106 was 1/4 inch dry screened. A 1/8 inch dry screen method was used in 2005. Since 2006, the matrix from above the buried soil has been 1/8 inch dry screened while sediment from the Kanorado paleosol was waterscreened through 1/4 and 1/16 inch sieves. By unit and level, all material retained in the screen was collected and bagged as 1/4 or 1/16 inch waterscreen samples. Only modern vegetation was discarded in the field; all other materials were retained. Most of the waterscreen samples included significant amounts of natural, coarse sand and gravel. The presence of this material meant that the samples required laborious sorting to determine if any artifacts were present. This process is discussed in the laboratory methods section below.

At 14SN106, field methods included recording open and filled animal burrows (krotovina) of all sizes as well as documenting the gravels and sands found in the buried soil along with the cultural materials. When identifiable, krotovina fill was screened separately from the matrix that did not have an obvious disturbance. Artifacts from krotovina were assigned a specimen number that indicates they were recovered from a disturbed area. At the base of each level, krotovina and other observed disturbances (such as open rodent burrow) were mapped and described on field paperwork. Data about krotovina and burrows was gathered to facilitate an evaluation of the site's formation processes. As site formation processes can impact spatial distributions, consideration of these processes is especially important before undertaking spatial analysis.

Digital photographs, maps, and standard field forms were used to document the Main Block excavation at 14SN106. In 2006, the 14SN106 datums and areas were recorded with a handheld Trimble GeoXT global positioning system (GPS) unit of sub-meter accuracy (Table 4.1). This data was used to assist in georeferencing the total station data.

41WK21

Since his discovery of 41WK21 in 1981, Rose has made more than 413 visits to the site (Personal communication, email, July 20, 2015). His collection includes more than 21,000 artifacts from the site (Rose 2011b:4). Rose collected nearly all of these artifacts from intensive survey of the deflated surface of blowouts. Blowouts are areas of a dune field that have become devegetated and strong winds have eroded the loose dune sand away. Rose assigned each of the blowouts that yielded artifacts a numeric "area" designation (Figure 4.4). In this study, these areas are referred to as "Blowout Areas" to differentiate them from activity areas and artifact clusters identified in the 41WK21 data. Only very limited subsurface testing has been undertaken at 41WK21; Dr. Jack Hofman conducted test excavations in 1994 and Dr. David Meltzer and Dr. Vance Holliday have taken soil samples at the site.

Figure 4.4. Richard Rose overlooking Blowout Area 2 at 41WK21 in March 2010.

Rose recorded the year collected and blowout area where he recovered the debitage. He recorded more detailed location information for tools, channel flakes, and selected other artifact types. Beginning in June 1985, Rose (Personal communication, email, May 16, 2015) installed datums to use in mapping these artifacts. Rose estimated the location from these newly installed datums for artifacts he had collected between 1981 and 1985. As the site is in an active dune field, some datums were covered with sand over the years. When a datum was no longer usable, Rose installed additional datums to continue his process of mapping these artifacts in the new blowouts that developed. A total of 17 datums were used to map artifacts at the site (Figure 4.5). As a result of Rose's careful measuring in the field and recording information in field notebooks, there is good horizontal spatial control for the mapped items from 41WK21.

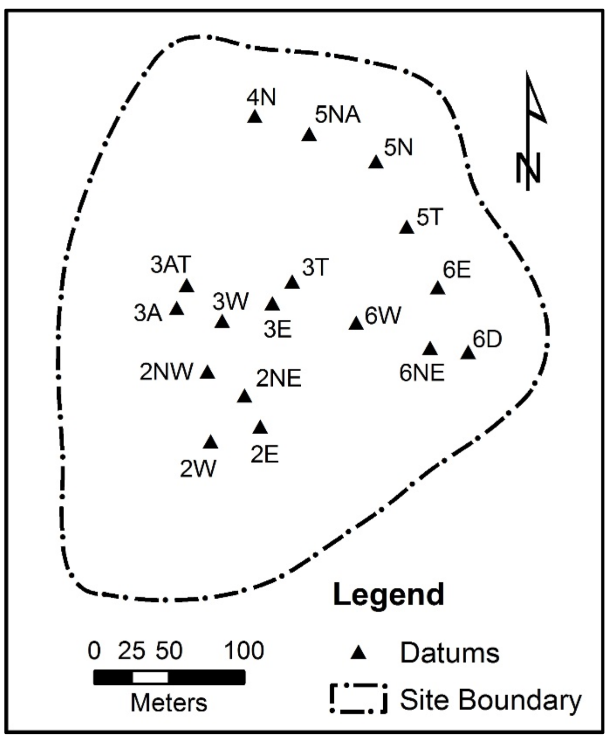

Figure 4.5. Datums Rose used to record the location of artifacts and features prior to gaining access to a GPS.

Between 1985 and June 2006, Rose mapped items by measuring the direction and distance from a datum to an artifact. His process consisted of standing at the datum nearest the artifact and utilizing a Silva Safari compass to determine the bearing to the nearest degree. His compass was not declinated in the field. Next, Rose used a tape measure to determine the distance from the datum to the artifact in feet. Since June 2006, Rose has used a wide area augmentation system (WAAS) enabled Magellan eXplorist 100 GPS to plot artifact locations (Rose 2011b; Richard Rose Shifting Sand field notes, 1981-2014). This model of GPS has an accuracy of <3 m with WAAS enabled (Magellan 2004:68). A total of 911 piece-plotted artifacts have been mapped and collected from the site since 1981. Based on the distribution of artifacts he has collected, Rose (Personal communication, email, November 23, 2015) is correct in thinking the majority of the area within the site boundary, as I have defined it, has been exposed in blowouts during the last 35 years. There are, however, gaps between some of the blowout areas that have not yet been exposed (Richard Rose, personal communication, email, November 23, 2015). For example, limited areas between blowout areas 2 and 7; between 3/3A, 5, and 6; as well as between 4 and 5 have not yet blown out and been exposed for collecting (Figure 4.6).

Laboratory Methods

The remainder of this chapter outlines the procedures used to inventory and analyze data gathered from investigations at 14SN106 and 41WK21. The analytical techniques were selected specifically to provide data needed to address this project's research questions. The 14SN106 collection is housed at the Archaeological Research Center (ARC) at the University of Kansas, Lawrence. The 41WK21 collection is currently curated by Rose in Midland, Texas.

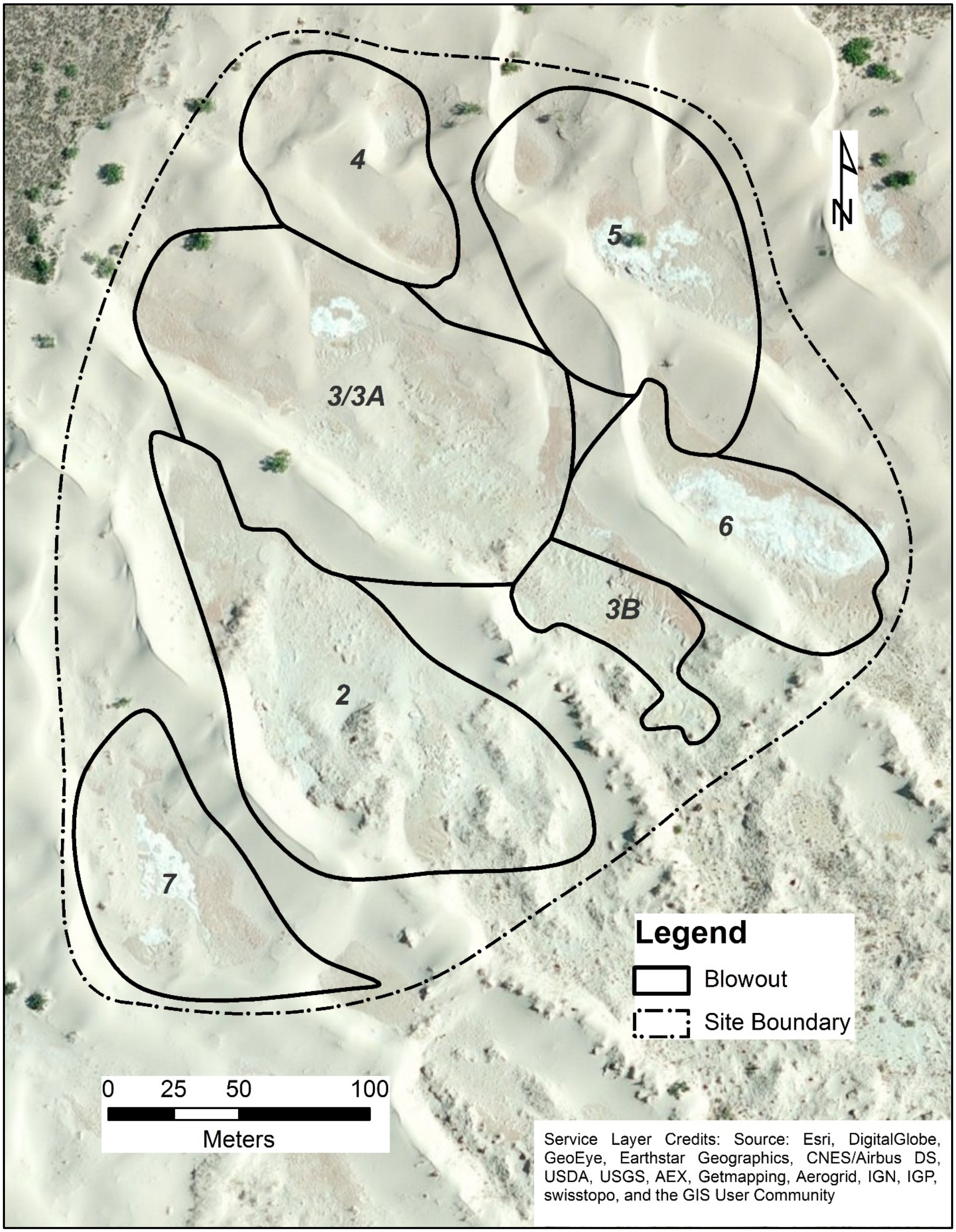

Figure 4.6. The areas defined by using Rose's notes, piece-plotted artifacts, datum locations, and the shapefile of blowouts mapped using a sub-meter GPS in April 2010 overlain on a ca. 2010 aerial image.

14SN106

At the conclusion of each field season, artifacts from 14SN106 were returned to the ARC for processing, cataloging, and analysis. When dry, waterscreen samples were bagged and brought to the laboratory for sorting.

Screen Samples

Sediments that make up the Kanorado paleosol at 14SN106 include a significant amount of material that was larger than 1/16 in. and was therefore retained after waterscreening. This material required hand sorting to extract any cultural materials. Approximately 40 boxes of waterscreen samples were sorted for this study and thanks are due to the numerous people who helped with this extremely tedious process over the years. Sorting of the waterscreened material separated chipped stone, bone, enamel, fire-cracked rock (FCR), snails, and any other items from naturally introduced sands and fine gravel. Analysts recorded on standardized forms all materials that were removed from the matrix as well as the weight of the gravels that were discarded. After this first sort I examined the items that had been pulled by analysts more closely. Commonly, analysts had pulled out small carbonate concretions that looked like bone; those were discarded. Although some rodent bones were retained, in other cases they were noted on forms, but unfortunately not kept. All waterscreen samples from the Main Block at 14SN106 were sorted for use in this study. Although time consuming, this process was necessary because small artifacts found in these samples can materially inform our understanding of the cultural deposits. Indeed, 93.5 percent (n = 1,047) of the chipped stone artifacts from 14SN106 were recovered from the screen samples.

Cataloging

The block-unit and specimen numbers assigned to piece-plotted artifacts in the field are used to designate artifacts from 14SN106 in this study. These numbers are generated when, for example, an artifact comes from unit N429 E652, which has a block-unit designation of 20O-3. Each artifact or waterscreen sample from that unit is then assigned a sequential specimen number. Artifacts that were recovered from the waterscreen samples were assigned catalog numbers consisting of block-unit, specimen number followed by another sequential number to identify them individually. Using this formula, provenience information about the unit and level of each artifact is embedded in the artifact designation. Catalog numbers are assigned to each artifact in accordance with the curation standards at the ARC.

41WK21

The chipped stone artifact assemblage from 41WK21 has been labeled and Rose has made it available for archaeologists to study. Rose assigned each piece-plotted artifact a number beginning with the blowout area from which it was recovered followed by a sequential number (ex. 612, the 12th artifact from Blowout Area 6). Note, in this study there are 11 artifacts for which the first number of the artifact and the blowout area do not match. These were assigned new blowout area numbers when mapping determined they should be assigned to a different area.

Using Rose's field notes and data forms completed for individual artifacts, I created a database which includes both provenience and attribute data for mapped items from 41WK21. Provenience data was entered as it was in Rose's notes and modified for use in the GIS later. Artifact descriptions were initially added to the database directly from the field notes, which were assumed to be correct. Subsequently, I used previously completed analysis forms and data collected during our 2015 trip confirm artifact descriptions. Finally, I standardized many of the types.

Lithic Analysis

Most recovered Early Paleoindian artifacts are chipped stone. Analysis of these artifacts in this study focuses on typological, technological, and macroscopic material sourcing analyses. Chipped stone artifacts expected at hideworking activity areas include scrapers and scraper retouch flakes, utilized flake knives, knives, and ultrathin bifaces.

Rose's 41WK21 artifact data included providence, material, tool type, and material. In some cases portion, thermal alteration, and cortex also are recorded. For this study, the previous work provides enough data about most artifact types. Only endscraper tools and a sample of the debitage were examined further.

In contrast, no chipped stone analysis had been undertaken on the artifacts from 14SN106. Attribute data including tool or debitage type, reduction trajectory, lithic material type (LMT), thermal alteration (TA), and presence of cortex were collected for all chipped stone artifacts. Because many of the artifacts from this site were very small, each item was examined under a LW Scientific stereo microscope with 10x and 20x magnification.

Chipped stone scrapers are steeply retouched tools that are usually unifacial and exhibit a planoconvex cross section; they are typically made from flake blanks (Morrow 1997:71; Odell 1996:384). On endscrapers, the "striking platform…generally forms the proximal, or 'butt' end of the tool and the distal end…generally forms the distal 'bit' or working end" (Morrow 1997:71). Evidence that these tools were hafted is often present at the proximal end of the tool. For this study, individual attributes of each endscraper from the sites were documented; these are described below.

Many endscrapers recovered from Early Paleoindian sites exhibit spurs, or projections, at one or both of the lateral margins where they meet the bit (Morrow 1997:71). Spurs are suggested to have been used for a variety of purposes including tattooing, piercing, ripping, and engraving (Weedman 2002:731). Alternatively, Weedman's (2002:731) ethnographic study suggested that spurs were unintentional side effects of scraper resharpening due to the "inexperience and/or waning strength of the hideworker." Shott (1995:59-60) also suggested spurs were the unintentional result of use and resharpening. To test these hypotheses, Eren et al. (2013) examined more than 1,000 Clovis tools and tool fragments for the presence of spurs (isolated projections) and compared those data with tool mass. Their premise is if Weedman's hypothesis was correct, spurs should increase as tools were further reduced and broken. Their data demonstrated the frequency of spurs did not increase as tool reduction proceeded or as tool breakage increased (Eren et al. 2013). Eren et al. (2013) interpreted their results to mean that sometimes spurs were created unintentionally while in other instances they were intentionally created through retouch. Indeed, some Folsom endscrapers exhibit ventral retouch that intentionally created spurs (Jack Hofman, personal communication, November 24, 2014). No matter how they were created, microwear indicates at least some of endscraper spurs were utilized (Wiederhold 2004). Some writers have suggested spurs on endscrapers may be a Paleoindian diagnostic (Kornfeld et al. 2010:52-53; Rogers 1986), but spurs are not present on all Paleoindian scrapers and are occasionally found on scrapers that date from other periods (Kornfeld et al. 2010:52-53; Morris and Blakeslee 1987; Weedman 2002).

Attribute data from endscrapers recovered from both 41WK21 and 14SN106 were analyzed for this project. The presence or absence of patina, thermal alteration, and cortex were recorded along with portion and number of spurs. Basic metric data including maximum length, width, and thickness and weight in grams also was tabulated. Finally, notes about the tools, which generally included flake blank type, information about ventral flaking, and other interesting aspects, were recorded (Appendices B and C).

Bifaces, utilized flake knives, and other knives may be associated with butchering and hideworking activities. A knife edge may be used for many things including cutting meat, tendons, and hides. These items were identified by type and provenience at 41WK21, but no in depth attribute analysis was undertaken. In the 14SN106 assemblage these items were submitted to the same analysis as the endscrapers. Similarly, projectile points, preforms, and other tools were identified by type, but additional analyses were not conducted.

Folsom ultrathin bifaces may be found in hideworking activity areas. It is hypothesized these tools were used for butchering, an activity that often takes place near hideworking. Ultrathin bifaces are thin with ovate to bipointed outlines (Jodry 1998; Root et al. 1999:151). They exhibit flat to biconcave cross sections and are commonly 1-2 mm thinner in their center than along the cutting edges. At their thinnest point, ultrathins average 3.2-4.8 mm and have width to thickness ratios ranging from 10:1 to 20:1 with an average ratio of 15:1 (Root et al. 1999:151; William et al. 1997). The cutting edge of an ultrathin biface often exceeds 100 mm in length (Jodry 1999:206). A study of ultrathin manufacturing revealed that they have a reduction trajectory that is distinct from fluted point manufacture (Root et al. 1999; William et al. 1997); however, in some cases they may have been recycled into unfluted (William et al. 1997) or fluted projectile points (Surovell et al. 2003). Finished ultrathin bifaces initially have pressure flaked working edges between 30 and 50 degrees (Root et al. 1999:164; Root et al. 2000:254). Ultrathin bifaces were often unifacially retouched to resharpen the tool edge (Jodry 1998; Root et al. 1999).

Nine ultrathin biface tools have been recovered from 41WK21; eight of these are mapped. Measurements on these complete and partial artifacts have been published (Rose 2011b:Table 9). This research examines where these tools were found at the site and if they are found in association with hideworking activity area(s). If they are associated, data from 41WK21 may support Jodry's (1998) hypothesis that they were used as fillet knives. No ultrathins have been recovered from 14SN106.

Debitage is the material that is removed and left behind while flintknapping or resharpening chipped stone tools. Understanding the reduction trajectory that created the debitage is important for creating a picture of the activities at a site.

The typological category of scraper retouch flakes includes all artifacts that are identifiable as having been removed from steeply beveled chipped stone tools and includes both late-stage production flakes and resharpening flakes meant to rejuvenate a working edge (Shott 1995:64). Scraper retouch flakes, despite their name, may originate from non-scraper artifacts; however, this is the exception. In general, scraper retouch flakes can be distinguished from unifacial knife retouch by their plunging terminations. Unifacial knife retouch flakes have been described from the Cooper Site assemblage (Brosowkse and Bement 1997). Scraper resharpening flakes may be removed from either end or side scrapers. Frison (1968:151) suggests that side and endscraper retouch flakes are similar, but endscraper retouch flakes are smaller.

Basic attribute data including lithic material, thermal alteration, and scraper retouch flake type were collected for scraper retouch flakes analyzed for this study. The following typology for scraper retouch flakes is used: Type 1 is a flake that was removed from the dorsal side of a scraper; it corresponds to Shafer's (1970) Retouch Method B. This scraper retouch flake exhibits small, flat, lenticular to circular platforms (Frison 1968:150; Shott 1995:64). The platform angle is commonly “at nearly a right angle to the adjacent portion of the back of the flake, which is the dulled edge of the tool” (Frison 1968:150). Type 1 flakes have prominent bulbs of percussion (Shott 1995:64). Because this type of retouch flake traverses the bit of the scraper and terminates on the dorsal side, they usually exhibit a pronounced curvature near the distal end of the artifact (Shott 1995:64).

A second kind of scraper retouch flake (Type 2), Shafer’s (1970) Retouch Method C, is created by using the working edge of the tool as the platform and removing the flake from the ventral side of a scraper. This type of flake also has been called a ventral scraper resharpening flake (Jackson 1998). The platforms of this type of flake are multifaceted because they include a portion of the worked edge. When this kind of resharpening occurs, the debitage created is usually oval, exhibit prominent bulbs of percussion, and often have hinge terminations (Frison 1968:150; Shafer 1970:484). Scraper retouch flake Type 3 was identified by Shafer (1970) as Retouch Method A. In this case, burin-like rejuvenating flakes remove a dulled working edge from the scraper along the longitudinal, oblique, or transverse axis. This type of rejuvenation was noted in the Lindenmeier assemblage (Wilmsen and Roberts 1978:98).

Both the 14SN106 and 41WK21 artifact assemblages include hundreds of these flakes. But, because of the different recovery methods this aspect of the assemblages is not directly comparable. Newcomer and Karlin (1987:35) have emphasized the difficulty of determining if scraper retouch flakes are from manufacturing or resharpening; however, given the limited evidence of manufacturing at 14SN106, it was predicted that most, if not all, of the scraper retouch flakes were generated from resharpening events. Any evidence that supports or refutes this was recorded during the analysis.

Basic categories of unifacial retouch, bifacial retouch, indeterminate retouch with platform, and no platform were used to quickly sort debitage from 41WK21 and get an idea of the amount of scraper use in each blowout area.

At 14SN106, particular interest was given to scraper retouch flakes, but debitage also included angular debris, bifacial retouch flakes, biface reduction flakes, core reduction flakes, bipolar reduction flakes, blade reduction flakes, a channel flake, and flakes of indeterminate reduction type. Some flakes of indeterminate reduction type were identified as retouch flakes, but further analysis did not conform the type of retouch.

Lithic Materials

The 41WK21 assemblage consists almost entirely of Edwards chert (Figure 4.7). Edwards chert is found in the Edwards Formation of central Texas (Banks 1990; Hofman et al. 1991). Other materials represented in that assemblage from closer lithic material sources include Notrees chert, quartzite, and white chalcedony (Rose 2011b:302). Rose included the lithic material of the artifacts in his catalog; the assignments for the endscrapers were confirmed during additional analysis, the rest were transferred from the catalog.

During analysis lithic material type (LMT) was identified for all of the 14SN106 chipped stone artifacts. Because many of the cultural materials are so small in size, there was some difficulty in identifying the LMT for some items; however, several of the materials from the Great Plains are distinctive enough to identify even on small specimens. Hartville Uplift chert makes up approximately half of the 14SN106 assemblage; other lithic materials include Alibates agatized dolomite/Day Creek chert, Smoky Hill silicified chalk, Fossilized wood, Edwards chert, quartzite, White River Group Silicates, Moss Agate, Tecovas chert, and unidentified cherts and chalcedonies (Figure 4.7). Descriptions and source locations of these materials may be found in

Bailey (2000); Banks (1990), Gade (2013); Hoard et al. (1993); Hofman et al. (1991); Holen (2001:89-94); Jodry (1999:Table 46); Kraft (2008); Miller (2010); Reher (1991); Stein (2005); Wyckoff (2005). At 14SN106 only Hartville Uplift chert and Alibates/Day Creek compose more than ten percent of the total assemblage.

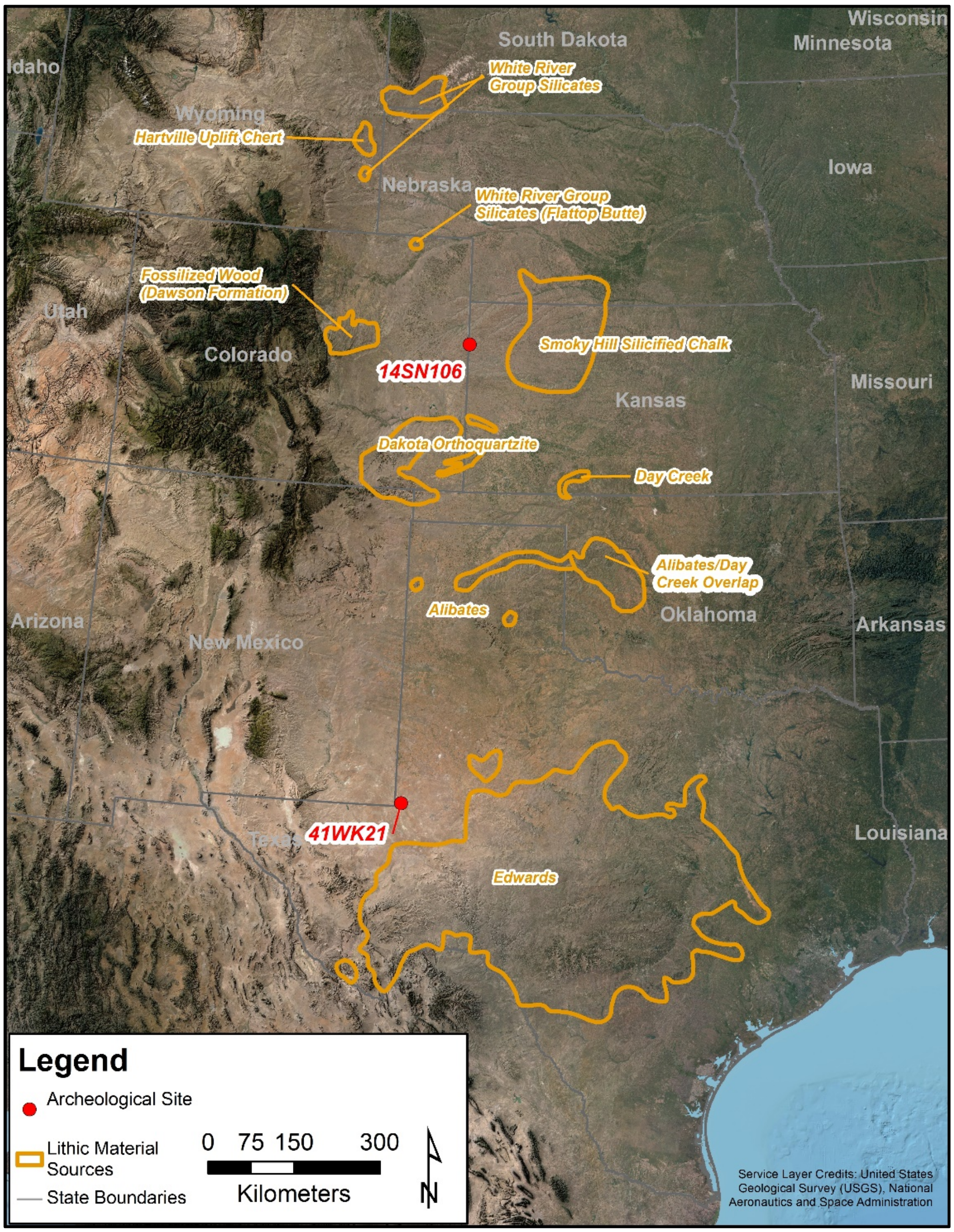

Figure 4.7. Overview map depicting 14SN106 and 41WK21 relative to the sources of lithic materials found at the sites (adapted from McLean 2005).

Thermal Alteration

Thermal alteration may be from cycles of freeze and thaw or heat. Freeze-thaw breakage occurs when freezing water inside pores or natural fractures in the stone expands. Chipped stone is sometimes heat treated to improve knappability, but also may be unintentionally burned during surface fires. Alterations caused by heat include blackening, crenated fractures, crazing, potlids, and reddening (Purdy 1975). In addition to the type of thermal alteration noted, this project recorded the location of the evidence on the artifacts from 14SN106 and endscrapers from 41WK21.

Spatial Data

Data Management

In the field, crews mapped in surface points to use in topographic mapping, grid points, and mapped artifacts. Each season, at the conclusion of fieldwork, 14SN106 spatial data was downloaded from the data collector and imported into Excel. These data were imported into ESRI's ArcGIS 10.2.2 (ArcGIS), a geographic information system (GIS) and georeferenced. After upgrades, some of the analyses for this study were conducted using ArcGIS 10.3 and 10.4.

In my database of mapped artifacts from 41WK21, artifacts mapped using a compass and tape were recorded by distance (in ft) and direction (in un-declinated degrees) relative to a datum. GPS coordinates were entered as recorded in the field in degrees and decimal minutes. Calculations to use this data in ArcGIS included converting feet to meters, declinating degrees, converting decimal minutes to decimal degrees, and plotting the resulting direction and distance measurements in ArcGIS.

As the datums were used to generate the direction – distance data for piece plotting most of the artifacts, their locations needed to be mapped prior to digitizing artifact locations. Using a combination of GPS, transit readings, and direction-distance measurements between datums, I was able to determine the location of all 17 datums fairly precisely (Figure 4.5). For 11 of the datums GPS data was utilized, the other seven were mapped using the GPS measurements and other data. It is important to note, however, that there may be some small discrepancies between the mapped and actual location of these datums.

Declination of Rose's degree readings from the field was completed using the U.S. Historic Magnetic Declination Estimated Values provided by the National Centers for Environmental Information (NCEI) at the National Oceanic and Atmospheric Administration (NCEI 2015). This program can derive the declination for any location in the United States. Since 1985, this program has used the International Geomagnetic Reference Field (IGRF) spherical harmonic model to derive historic declinations. As Rose installed his first datum and starting measuring locations in the field in that year, this is the model I used. All artifacts collected before 1985 (1981-1985) were mapped in at their approximate locations in 1985 after the installation of the first datums. The IGRF is a mathematical description of the Earth's magnetic field. Historic declinations provided by the NCEI are displayed to the nearest minute but may not be that accurate (NCEI 2015). Between 1985 and 2006 the declination at 41WK21 ranged from 9.45 to 7.92 degrees east. To calculate the declinated degrees, the number for declination was used to edit the degree reading Rose calculated in the field.

To plot artifacts that were recorded by degree and feet I used the Direction-Distance tool in the ArcGIS Editor Toolbar tool palette. This tool allows you to create a temporary bearing line and a distance circle from a known point (in this case a datum location). Using the intersection of the line and circle, ArcGIS can create a point at a new location a specific direction and distance from the original point.

Maps for this study utilize data from pacing and measuring, a transit, a total station, and GPS mapping methods; UTMs were recorded in Zone 14N, NAD 1983 coordinate system. Partial excavation units at 14SN106 are depicted using the maximum size, usually at the base of the excavation.

Spatial Analysis

Archaeologists have utilized several techniques to understand intrasite spatial patterning. Perhaps the most common method employed is to display and visually evaluate the distribution of artifact frequencies and artifacts type frequencies across a site area. This investigation does this as well as employing statistical analysis to identify clusters and inform our understanding of site structure at 14SN106 and 41WK21. The content of each area also was compared with other areas both at these sites and with patterns published for other sites.

The first step in the statistical analysis of spatial data is to test for spatial autocorrelation. Spatial autocorrelation shows if the data is uniform, randomly distributed, or clustered. For polygons, one can test for clustering using the Spatial Autocorrelation (Global Moran's I) tool available in the Spatial Statistics extension in ArcGIS. Positive spatial autocorrelation exists if nearby values are more like each other than like more distant values. If neighboring values are unlike each other, this pattern reflects negative spatial autocorrelation. Random patterns of values exhibit no spatial autocorrelation. The Global Moran's I spatial autocorrelation report for the Main Block at 14SN106 indicates positive spatial autocorrelation which means the data are clustered (Global Moran's I = 0.525559, z-score = 4.521691, p-value <0.0001).

Average nearest neighbor analysis was used to determine if the point data for mapped artifacts from 41WK21 are clustered or dispersed. The results of the average nearest neighbor analysis indicate the data are significantly clustered (Nearest Neighbor Ratio = 0.572750, z-score = -24.670177, p-value <0.0001).

For this study, I investigated spatial patterning at these sites using kernel density estimates (KDE), TwoStep Cluster Analysis, and Cluster and Outlier Analysis. For 41WK21, TwoStep Cluster Analysis was undertaken in SPSS; the results of the TwoStep Cluster Analysis were then imported into ArcGIS for display purposes. ESRI's proprietary Cluster and Outlier Analysis: Anselin Local Moran's I tool available in the Spatial Statistics extension for ArcGIS, examines local autocorrelation and was employed for the 14SN106 assemblage. Local spatial autocorrelation methods permit the use of materials recovered during the systematic screening of excavated sediments and indicate clusters.

Kernel density estimations allow us to visualize univariate or bivariate data as a smoothed histogram. In ArcGIS, the kernel density function calculates density values based on the counts of bivariate points within a user-defined search radius. The ArcGIS output consists of a raster that connects equal density values and is read the same way as a topographic map (Hill et al. 2011:760-761).

Kernel density estimation creates contouring based on specified percentages of the most densely clustered points. This means KDEs do not impose structure on the data (Baxter et al. 1997:353). The contouring process allows the "real structure of clusters" to emerge, an improvement over some other types of cluster analysis (Keeler 2007:8, 2010). Although useful as a visualization technique, the significance of patterning observed in kernel density maps requires external statistical validation (Hill et al. 2011:760-761). KDE maps are used in this study to examine the distribution of artifacts at 14SN106 and 41WK21.

TwoStep analysis is a clustering method available in SPSS 11.5 and later. In the first step the program examines each record to decide if it should be clustered with the previously formed clusters or start a new cluster based on distance criterion. This creates a cluster feature tree with many sub-clusters. In the second step the program groups these sub-clusters into the desired number of clusters (SPSS 2001). One advantage of the TwoStep Cluster Analysis is that the program includes an auto-cluster procedure that automatically determines the appropriate number of clusters. Alternatively, the analyst may specify the number of clusters. TwoStep Cluster Analysis can handle both continuous and categorical variables (SPSS 2001) and is recommended for large sets of data (Norušis 2011). Finally, another advantage over the commonly employed k-means cluster analysis method is the ability within TwoStep to identify clusters of varying shapes.

Local autocorrelation methods that permit the incorporation of both artifacts recovered by piece-plotting and screen recovery was used to validate the KDE results for the 14SN106 data. A minimum of 30 units are required to apply local methods (ESRI 2013). ESRI's proprietary Cluster and Outlier Analysis: Anselin Local Moran's I tool available in the Spatial Statistics extension for ArcGIS 10.2. ArcGIS 10.2's Cluster and Outlier Analysis tool uses mathematical formulas to calculate Local Moran's I index values, Z scores, and p-values (ESRI 2013). ArcGIS computes Z scores and then derives p-values as a numerical approximation of the area under the curve for a known distribution; furthermore, ArcGIS assumes a standard normal distribution (ESRI 2013).

The ArcGIS Cluster and Outlier Analysis tool identifies clusters of features with values similar in magnitude as well as identifying spatial outliers. This is accomplished by calculating a Local Moran's I value, a Z score, and a p-value. Cluster types are identified based on the statistical significance of the Moran's I values as interpreted in the context of the Z scores and p-values. A positive Moran's I value and a high positive Z score indicate the neighboring features have similar values. A high-high cluster has a statistically significant (0.05 level) cluster of high values; a low-low cluster has a statistically significant (0.05 level) cluster of low values. A negative I value and a low negative Z score indicate a statistically significant (0.05 level) spatial outlier, either an outlier with high values surrounded by low values (high-low outlier) or low values surrounded by high values (low-high outlier)

Finally, intercluster distance (ICD) is employed to investigate the size and distance between clusters at 41WK21 relative to other Folsom sites in the region (Andrews et al. 2008). There is not enough data for this to be accomplished at 14SN106. ICD is used to measure the distance between spatially discrete artifact concentrations (Andrews et al. 2008:468). It is defined as the straight line distance from the center of a cluster to the center of the nearest cluster (Andrews et al. 2008:468, Figure 2).

Site Formation Processes

Introduction

Site formation processes are "[t]he factors that create the historic and archaeological records" (Schiffer 1987:7). These factors include both the depositional environment and post-depositional disturbances. As Schiffer (1987) acknowledged, both natural and anthropogenic forces may be site formation processes. Formation processes affect the artifacts and spatial integrity of sites from the time they are deposited until they are removed; however, formation processes impact cultural materials in different ways depending on the site's age, geomorphic setting, sediments and soils, climate, type, and the complexity of occupation (Goldberg and Macphail 2008). Common site formation processes include sedimentation (alluvial, colluvial, and eolian), soil formation (pedogenesis), pedoturbation (including bioturbation, cryoturbation, and argilliturbation), anthropogenic deposition, and anthropogenic modification (Goldberg and Macphail 2008). Because these processes can modify cultural materials and their spatial patterning, examining their impact is a necessary first step to understanding the human behavior that deposited the cultural materials.

This study considers site formation processes, including both the depositional environment and the type and extent of disturbance, with reference to 14SN106 and 41WK21. This section provides the background about the processes that impacted these sites. First, research on natural site formation processes that impacted these sites is summarized, after which the anthropogenic site formation factors are considered. Sites 14SN106 and 41WK21 both include Folsom-aged cultural materials that were buried, impacted by natural and cultural factors, exposed, and partially excavated or collected.

Site formation processes, or factors that create the archaeological record (Schiffer 1987), may be defined to include the human activity that created the site (Stein 2001). However, only those factors that impacted the site after deposition are considered in this section. Knowledge of the potential site formation processes at a site gives researchers their best chance to understand the original patterns of artifacts and the human behavior that created the site. Because understanding the behavior of prehistoric people is a primary goal of archaeological research, the study of site formation processes is important.

Researchers use a variety of methods to understand the presence, variety, and impact of formation processes on cultural materials. Specifically, they gather and examine documentary information, undertake fieldwork and observation, and use laboratory techniques and experimentation to better understand site formation processes. Documentary information may include satellite and aerial photography as well as maps. These sources are helpful in determining information about the site's geomorphic setting and soils, which in turn can inform researchers about the potential types of site formation processes that may be represented.

During fieldwork, observing and documenting the location and position of artifacts and any observable disturbance is another method of gathering information. Evidence of disturbance must be precisely recorded in the field so the information can be used during analysis of the site. Disturbances that are not observable in the field may require laboratory techniques to understand. Pertinent laboratory techniques include grain size analysis, soil micromorphology, scanning electron microscopy (SEM), X-ray analysis, 3-D scanning, and dating (Goldberg and Macphail 2008; Grosman et al. 2011; Leigh 2001). Several of these technologies can both identify disturbance and corroborate field observations of depositional and post-depositional processes (Goldberg and Macphail 2008). In addition, when there are no visible signs of disturbance, refitted artifacts and/or bone also can help researchers identify types of disturbance that have taken place at a site (Hofman 1981; Villa 1982:287). However, refitting evidence must be used with caution, as the presence of refitted or conjoinable items does not mean disturbance has not occurred (Schick 1987:102). Because of this, refitting evidence is best used in combination with other methods to assist in understanding disturbances.

Despite field and laboratory work, questions, especially ones related to quantifying the severity of an impact upon archaeological items, often remain. These are the questions researchers hope to answer through experimentation. Experiments that are set up in a controlled environment, or in a natural environment with some controls, provide researchers with an independent view of the results of both natural and anthropogenic site formation processes (e.g. Buenger 2003; Lopinot and Ray 2007). In experiments archaeologists can control the artifacts' size and placement prior to observing processes of sedimentation and disturbance. Hence the observed changes are quantifiable.

Natural Formation Processes

Natural site formation factors include "any and all events and processes of the natural environment that impinge upon artifacts and archaeological deposits" (Schiffer 1987:7). These effects include sedimentation (deposition), post-depositional processes (pedoturbation), and erosional processes that exhume cultural deposits (Goldberg and Macphail 2008:2013; Hole 1961; Rapp and Hill 2006:98-102; Wood and Johnson 1978:317). Although there are other formation processes (Hole 1961; Wood and Johnson 1978), this section focuses on those most commonly identified at archaeological sites in the Great Plains and evaluates their presence and potential impact at sites 14SN106 and 41WK21.

Some sites remain exposed on the surface for a lengthy period before they are buried, others are buried quickly or never buried, and still others are repeatedly buried and exposed. Like impacts after burial, a variety of anthropogenic and natural processes are at work on cultural materials deposited on the surface. Surface artifacts are susceptible to movement caused by water, wind, and animal trampling. Large herbivores have roamed the Great Plains in large numbers in the past. In modern times ranchers have limited cattle's roaming, perhaps creating a greater impact to sites in their pastures. Trampling experiments have demonstrated that animals can bury, kick, and generally disrupt surface sites (Eren et al. 2010; Lopinot and Ray 2007). In addition, experimental and historic research has documented that large animals can create and modify items in such a way that they appear to be intentionally modified artifacts (Knudson 1979; Lopinot and Ray 2007). Because this type of disturbance is not limited to non-human animals, this topic is revisited below under anthropogenic processes.

Burial can be the most significant formation process at a site if its impacts are substantial. Cultural deposits are almost always buried through natural sediment deposition (sedimentation). Sediment may be deposited through wind, water, gravity, or biogenic processes. Biogenic burial occurs through the formation of a biomantle. A biomantle is the upper part of a soil produced largely through bioturbation (Johnson 1990:85; Johnson et al. 2005:19). In a biomantle, the soil has been reorganized by flora and fauna (Van Nest 2002). All soil organisms contribute to the formation of biomantles, but various soil organisms bioturbate differently thereby contributing different soil mixing processes (Johnson et al. 2005:16). Johnson et al. (2005) separate soil organisms into three categories: conveyor belters (e.g., earthworms, ants, and termites), mixmasters (e.g., ground squirrels, prairie dogs, moles), and cratermakers (e.g., badgers, tree falls, humans). Conveyor belters and mixmasters are the primary bioturbators in most soils. Conveyor belt animals transfer significant amounts of soil to the surface through casts and mounds (Balek 2002; Darwin 1896; Johnson et al. 2005; Stein 1983). In addition to moving soil to the surface, worms contribute to the formation of biomantles by burrowing, taking stones and seeds underground, building cairns, producing calcium carbonate nodules (granules), and homogenizing soils (Canti 2003). Biomantle formation eventually results in the gradual burial and "downward gravitational displacement" of materials originally on the surface (Balek 2002:43). Other results of pedoturbation include size sorting of larger clasts and cultural materials and the development of stone zones (Van Nest 2002). Several researchers have described the role that biomantle formation plays in the burial of upland sites (e.g. Balek 2002; Johnson 2002; Johnson et al. 2005; Leigh 2001; Peacock and Fant 2002; Van Nest 2002).

Often sediment is deposited on cultural material (and throughout the landscape) by water, wind, and/or gravity. Indeed, these processes play a number of roles in site formation processes.

They may disturb surface sites, limit disturbance by burying artifacts, and erode sediment and artifacts again causing disturbance. One way sedimentation helps to preserve the integrity of archaeological sites is by separating components. When sedimentation occurs between occupations archaeologists can more easily identify and interpret multicomponent sites. Deposition associated with a stream is called alluviation. Fluvial deposits more specifically refer to alluvium transported and deposited in a stream (Rapp and Hill 2006). Sediment transported by the wind is referred to as eolian (aeolian). Colluvium is poorly sorted, unconsolidated sediment deposited at the base of slopes. This sediment is moved downslope as the result of water and/or gravity acting on material upslope. Most New World hunter-gatherer sites, including 14SN106 and 41WK21, were buried as a result of natural sedimentation; 14SN106 was covered with alluvial sediment and 41WK21 with eolian deposits.

It can be difficult to determine if biomantle formation (pedoturbation) or other processes of sedimentation buried cultural materials (Darwin 1896; Leigh 2001; Van Nest 2002). Indeed, often both of these processes operate at the same time. Leigh (2001) presents several methods for differentiating these burial processes. His proposed techniques include: examining the geomorphic setting, sedimentary structures, stratigraphy, and pedology of the matrix, grain-size analysis, evaluating the distribution and integrity of cultural materials, micromorphology, and luminescence dating techniques. Although Leigh (2001) discusses these techniques in the context of sandy soils, they also can help us determine the process of burial of sites in other types of soil.

Water is essential to humans and animals, and alluvial settings can preserve cultural deposits. Therefore, it is not surprising that cultural deposits are commonly found near water sources (Rapp and Hill 2006:68; however see Mandel 2006b). Water deposits sediment on floodplains, terraces, alluvial fans, and deltas. Of particular interest here is stream deposition on floodplains, as this is how 14SN106 was buried. Upstream erosion, the carrying capacity of the stream, and the topographic location of the site all affect the amount of sediment deposited at a site (Rapp and Hill 2006:249). The type matrix that buries cultural materials can inform researchers whether the materials were located in a low or high energy setting when they were buried. The amount of stream energy has implications for the amount of disturbance the water may have caused to the cultural materials during burial as well as the rate at which the materials are buried.

Silts, clays, and fine sands are deposited in relatively low energy settings and can bury sites with little to no disturbance (Isaac 1967; Schick 1987). The "(a) superpositioning of artifacts associated with serial occupations, (b) differential preservation of organic materials, and, (c) differential physical disturbance of original associations among artifacts and features" (Ferring 1992:17) can all be impacted by a high energy stream. In addition, artifacts found in high-energy fluvial settings may be abraded or broken as a result of being rolled in the water (Ferring 2001b:95; Rapp and Hill 2006; Schick 1987), and realignment due to high-energy water flow also has been used to explain the orientation of bones and stone tools at some sites (Frison and Todd 1986; Isaac 1967).

In *Natural Formation Process and the Archaeological Record,* Schick (1987) and Petraglia and Nash (1987), both reported on experiments designed to identify how fluvial processes impacted bone and stone artifacts. Their experiments and conclusions are similar. Both groups of researchers experimentally tested movement and burial of lithic artifacts using test plots in a variety of settings. In their experiments, smaller items were more likely to be transported by water while larger or heavier items (>15 g in one experiment, cores in the other) tended to stay in situ despite strong fluvial events (Petraglia and Nash 1987; Schick 1987).

However, they concluded “the integrity of sites located in fluvial contexts is related to the tempo, magnitude and duration of hydrological events” (Petraglia and Nash 1987:126). By studying the new “sites” created by redeposited materials, analysts determined artifacts may be redeposited in multiple locations, they may be size sorted, and lighter items may travel farther downstream. When researchers compared the original site area and the area of artifact redeposition, they discovered the latter was elongated in the direction of the water flow (Schick 1987). One experiment also recorded the number of artifacts that were buried as the result of alluvial action. Once buried, artifacts were more likely to remain in situ because the sediments protected the artifacts from water transportation. Buried artifacts may be impacted by other post-depositional processes, but they are not moved during runoff unless incision occurs (Petraglia and Nash 1987:126-127).

Cultural deposits in alluvium often occur in soils. The cultural materials in the Main Block at 14SN106 are in a buried soil called the Kanorado paleosol (Cordova et al. 2011; Mandel 2008). Soils are the result of the interaction of physical, chemical, and biological processes acting on rock or sediment over time (Holliday 1992:102). They form on the earth’s surface as layers of weathered, unconsolidated material containing organic matter (Holliday 1992:102; McGeary and Plummer 1994). As soil forming (pedogenic) processes occur, distinct horizonation and structure develop. The presence of a soil indicates a period of slower sedimentation or even stability (no sedimentation). Therefore, cultural deposits in soils were generally not significantly disturbed by horizontal movements during burial.

The type of soil, timing of its development relative to the artifacts’ deposition, texture of the parent material, length of development, and burial history control the types of post-depositional processes at work on cultural deposits in soils (Ferring 1992). For example, cumulic floodplain soils, because they are products of slow and continuous sedimentation both before and after a site is created, generally protect artifacts from many common post-depositional pedogenic processes including "erosional disturbance, carnivore gnawing of bone, and active near-surface bioturbation" (Ferring 1992:18). In contrast, soils that form on stable floodplain surfaces are subject to these pedogenic processes for a longer period (Ferring 1992:18). Cultural deposits at 14SN106 are contained within a cumulic alluvial soil.

Unlike 14SN106, which was buried by alluvium, 41WK21is located in a sand dune field and was buried and exposed through eolian processes. Dunes are most common in arid and semi-arid environments were eolian sedimentation is a dominant process. They consist of "mounds of loose sand grains heaped up by the wind" (McGeary and Plummer 1994:444). Depressions in the middle of dune fields that are caused by a disruption in local stabilizing plant growth and wind erosion are called blowouts (McGeary and Plummer 1994:445). Blowouts form "as sand is scoured away from the disrupted area" (Machenberg 1984:16). Forces that disrupt flora on dunes creating blowouts include fires, overgrazing, livestock trampling, ground-water withdrawal, and man-made constructions such as roads (Machenberg 1984:24, 28).

As with water, wind can both cover and preserve cultural deposits or create disturbances and uncover the deposits. Deflation, the removal of sediment through eolian processes, is common in dune settings. As sediment is removed by wind, artifacts and other larger items are left behind as residual material and eventually lowered (telescoped) to a usually lower elevation creating a lag deposit. The formation of a lag deposit drastically affects the vertical distribution of artifacts, but it may or may not have significantly altered their horizontal distribution. At multicomponent sites where the multiple occupations were originally separated by sedimentation, a lag deposit often makes it difficult to differentiate the components (Rapp and

Hill 2006). Wood and Johnson (1978:359) describe deflation as when "nature had done the excavating and, unfortunately, had left a two-dimensional chronologically blurred site context for archaeologists."

To understand how wind action affects the distribution of artifacts, Wandsnider (1988), conducted a series of experiments. She found wind can move small artifacts directly, or transport items indirectly by "forming small obstruction dunes behind the artifact, which then 'plow' the artifacts along" the wind may also "excavate small pits behind and under larger artifacts into which these may roll" (Wandsnider 1988:20). Her experiment lasted three seasons and involved placing chipped stone artifacts on dunes and observing how they moved. Based on Wandsnider's (1988) preliminary observations, several of the artifacts were repeatedly buried and uncovered and they moved a maximum of 6.5 cm. She argued, therefore, that it is unlikely this disturbance would affect the artifact distribution to an extent that the spatial integrity of the behavior that created it is compromised (Wandsnider 1988). On the other hand, she acknowledged a number of other factors may influence artifacts movement in this setting and that artifacts may be exposed for longer periods than in her study.

Factors that influence the distance an artifact travels due to wind are its size, weight, and shape. In one study, small artifacts were transported, but larger items (>8 mm) moved minimally (Cameron et al. 1990). Based on her experiment, Wandsnider (1988:20-21) agreed size affects the distance artifacts may be transported by wind. It should be noted that several authors also observed artifacts "settling in" to sediments during the first few months after deposition. After this settling in period, the objects were partially buried and were less likely to be moved by wind and/or water (Petraglia and Nash 1987; Schick 1987; Wandsnider 1988).

Post-burial natural site formation processes include bioturbation, cryoturbation, argilliturbation, and mass wasting (Hole 1961; Wood and Johnson 1978). The first three of these processes are aspects of pedogenesis and pedoturbation (soil mixing). Bioturbation is the reworking of sediments and soils by plants (floralturbation) and animals (faunalturbation). Cycles of freeze/thaw create mixing called cryoturbation, and the shrink/swell of clays is argilliturbation. Mass wasting (sheet erosion) and slumping include several processes all instigated by gravity. Since all of these processes cause sediment mixing, artifacts in those sediments also are potentially being mixed. Most archaeological sites, including 14SN106 and 41WK21, have experienced many pedogenic processes.

Bioturbation is one of the most common and well known processes of pedoturbation. Surficial evidence of faunalturbation includes holes surrounded by mounds (also called hills or chimneys) of sediment that animals have brought to the surface. Archaeologists commonly examine the mounds for artifacts that animals have brought up along with the sediment. The presence of artifacts indicates the presence of an archaeological site. However, observation of artifacts associated with these animal disturbances does not tell us if the artifacts were in a buried or surficial context prior to disturbance. Burger et al. (2008:222-223) demonstrated that harvester ants gather construction material for their mounds from the surface as well as underground. Over time the obvious surficial evidence of bioturbation may be obliterated. Hence, a concentration of artifacts on the surface, even when there is no visible evidence of bioturbation, may be the result of animal collection.

Subsurface indicators of animal disturbance include open and filled burrows, casts, and linear concentrations of rocks or artifacts. Over time, animal burrows in one soil horizon are often filled with sediment from another horizon due to rain, gravity, and trampling. These filled burrows are called krotovinas and are often observed during archaeological excavations (Bocek 1986; Wood and Johnson 1978). Not all krotovinas look the same; their size, shape, and density vary depending on the burrowing patterns and size of the animals that created them.

Thoms (2007:81) points out that the identification of many krotovina indicates significant bioturbation, while "the near absence of these manifestations would be consistent with flood-scouring and rapid re-deposition. Of course, a paucity of root casts and krotovina should also characterize rapid deposition sufficient to bury an occupation surface beyond the reach of roots and rodents." Certainly, some rodent burrows have collapsed or were filled with sediment from the horizon where they were excavated. These disturbances are not easy to identify and quantify, but when rodent remains are found unassociated with visible krotovina, an indistinguishable former burrow is one explanation. Recent rodent burrows also are encountered at archaeological sites.

Faunalturbation can be caused by a number of burrowing mammals, earthworms, ants, termites and other burrowing arthropods. Burrowing mammals include smaller rodents such as mice, prairie dogs, ground squirrels, gophers as well as larger animals like beavers, badgers, rabbits, opossums, and armadillos (Wood and Johnson 1978). Several studies have shown that burrowing mammals turn over a large quantity of sediment annually (Bocek 1986; Ohel 1987; Wood and Johnson 1978). During burrow construction and maintenance, burrowing animals commonly move smaller artifacts up while burrowing under larger objects. Eventually the larger objects collapse into the burrow, moving them down in the profile (Bocek 1986:591). This process may produce cultural horizons that have no vertical integrity (Bocek 1986:601). One way to identify significant amounts of this type of faunalturbation is by size-grading artifacts. If all sizes of artifacts occur in the same levels the cultural deposits were not significantly affected by size-sorting burrowing animals (Bocek 1986). In some cases, one type of animal disturbance can attract another burrowing animal. For example, krotovina and decaying roots often have lower bulk density than the surrounding sediments. Consequently, worms and rodents make use of these areas and move organic material from the edge of the disturbance into the surrounding sediment (Pietsch 2013).

For some time, geologists thought bioturbation was uncommon or nonexistent in eolian sediments. This has been disproved; hundreds of species of burrowing arthropods and larger burrowing mammals have been documented in dune settings (Ahlbrandt et al. 1978). In their study of 12 dune fields, Ahlbrandt et al. (1978) found evidence of the burrowing arthropods, but noted that the larger vertebrate burrows were not preserved in the older dune sediments. There are two explanations for this: either the burrows were never present or they have been obliterated over time.

As mentioned above, graphically displaying artifacts by size grade or count can visually help identify disturbance (Brantingham et al. 2007; Bueno et al. 2013; Hofman 1986; Van Nest 2002) or provide evidence of a lag deposit (Hewitt and Allen 2010). Bueno et al. (2013) used size grading combined with radiocarbon and luminescence dating to interpret a site in a dune setting as having two distinct occupations with some upward movement of small (<2 cm) artifacts. They hypothesized that this movement was the result of eolian processes, bioturbation, or both. A follow-up article by Araujo (2013) supported the idea that bioturbation caused this movement, but noted that wind action did not move small artifacts upward in the profile. According to Araujo (2013), ant and termite bioturbation explains the movement of small artifacts upward. Although no evidence of bioturbation was observed during excavation, it is a plausible explanation for artifact movement at the site (Bueno et al. 2013:201).

Refitting, which involves putting pieces of artifacts that were originally joined back together, allows researchers to study the extent of artifact dispersion. This type of analysis has been used for bone, chipped stone, FCR, and pottery; and it is a direct way to examine the probable amount of post-depositional vertical movement of artifacts. The results of refitting at several sites indicates that around 40-50 cm of vertical dispersion is common (e.g., Bruner 2009; Hofman 1986; Van Noten et al. 1980; Villa 1982), and at Gombe Point in Central Africa the dispersion was greater than one meter (Cahen and Moeyersons 1977:813). Although faunalturbation usually transports small artifacts upward, Hewitt and Allen (2010:13) suggested that when the sediments have been turbated by small animals, such as ants and termites, small artifacts may move downward.

Animals can quickly move and/or bury artifacts; sometimes during this process the orientation and/or location of an artifact changes in a patterned way. This means a researcher may be able to determine whether faunalturbation took place. Since Darwin (1896) began observing the effect earthworms had on soil in 1837, earthworms (small soil fauna) have been documented to live in a variety of settings and turn over large quantities of sediment (Stein 1983; Van Nest 2002; Wood and Johnson 1978:325). "In fact, earthworms play a principal role in the development of A horizons of many if not most grassland and forest soils in the mid-latitudes" (Wood and Johnson 1978:327). Assisting in biomantle formation, worms move sediment within the earth and some also extrude sediment rich castings on the surface. As discussed above, worms can bury stones, seeds, and cultural materials on an otherwise stable upland surface. Worms also produce calcium carbonate nodules and homogenize soils (Canti 2003). Although it is usually viewed as a destructive process, when worms bury artifacts their horizontal integrity is potentially preserved (Van Nest 2002).

Disturbance by plants is called floralturbation, and there are two main types: root casts and tree throws. Root casts are created when vegetation dies and the roots decompose, leaving voids in the sediment that are then filled, similar to krotovina. In arid environments root casts may be extensive. For example, shin oak roots from a single plant can extend more than 5 m deep (Haukos 2011:108) and grow over 20 m through dune sand to access water (Machenberg 1984:20). Although they are generally small and taper along their length, root molds and casts are indicators of sediment disruption and artifact movement (Ahlbrandt et al. 1978:846).

Tree throws, disturbances caused by falling tees, are generally more disruptive to sediments than root casts. Trees may fall over naturally after they die or during storms. When a tree falls, sediment, rocks, and artifacts caught in the tree's roots are redistributed. A single tree throw can invert and mix a large volume of soil, and over time the entire surface may be affected by this disturbance (Mandel and Bettis 2001:186; Wood and Johnson 1978:329). As the sediment in a tree throw erodes, the only evidence of the location of the disturbance may be a slight depression and mound (cradle and knoll topography) and/or a veneer of stones or artifacts (Wood and Johnson 1978:332-333). Although sites 14SN106 and 41WK21 are both in areas largely devoid of trees today, recognition of the remains of tree falls could indicate the area had trees in the past.

Cryoturbation is the "[d]isturbance of sediments, soils, and artifact-distribution patterns caused by cycles of freezing and thawing" (Rapp and Hill 2006:99). For cryoturbation to occur, sediment must have sufficient water for ice to form, and it must periodically freeze and thaw. Except in areas of permafrost, the ground freezes from the surface downward. As a result, more deeply buried sites are less likely to have been impacted by cryoturbation. Generally, cryoturbation impacts sediments and artifacts by distorting strata and moving larger objects to the surface or laterally. This distortion occurs because the "soil begins expanding in the direction of least resistance – upward" (Wood and Johnson 1978:337). More specifically, this process may be identified by a variety of soil characteristics including "sand wedges, soil deformation, stone polygons and/or stripes, solifluction lobes, and by diagnostic micromorphological features" (Mandel and Bettis 2001:187). In addition to moving artifacts, cryoturbation can reorient the long axis of artifacts vertically (Rapp and Hill 2006:100). Frost-heaved rocks that are pushed to the surface often appear in patterns such as stripes, circles, or polygons (patterned ground) that can be misinterpreted as archaeological features (Rapp and Hill 2006:100; Wood and Johnson 1978:344).

Several experiments have been conducted to determine what factors affect the vertical distance an artifact moves due to cryoturbation (Johnson and Hansen 1974; Johnson et al. 1977; O'Brien 2006). The results of these experiments were variable. Additional research is needed to understand the amount of upheaval freeze/thaw cycles create and the factors (such as the mass, thickness, or effective height of artifacts) that influence this movement. How much artifacts are moved due to cryoturbation also is impacted by the type of sediment in which they are situated. Generally, items in silty sediments are more significantly affected, but cryoturbation can occur in any sediment (Johnson and Hansen 1974:95). Experiments have demonstrated that cryoturbation is a slow process requiring many freeze/thaw cycles to significantly move deeply buried artifacts upward (O'Brien 2006). Deeply buried artifacts tend to have more overburden pressure, which slows the rate of frost heave. Conversely, because they experience more freeze-thaw cycles and have less overburden pressure, cryoturbated objects that are shallowly buried tend to move upward faster (Johnson and Hansen 1974:91).

Argilliturbation is a mixing process that occurs in soils that are rich in expandable clays (usually Vertisols). Expanding 2:1 lattice clays, like montmorillonite and other smectites, can absorb large amounts of water and have both high plasticity and high shrinkage rates (Rapp and Hill 2006:212). When soils rich in these clays are subjected to cycles of wetting and drying, the sediment expands and contracts, respectively. It is important to keep in mind that a significant amount of expandable clay and wet and dry cycles are prerequisites for argilliturbation to take place. Hence, in some environments argilliturbation is not a factor; it does not appear to have had a significant impact at 14SN106 or 41WK21.

Argilliturbation creates cracks in the ground surface and mixes sediments and inclusions below the surface. The surface cracks allow sediment, stones, and artifacts from the surface to fall into cracks thereby moving them down the profile (Morris et al. 1994; Wood and Johnson 1978:356). The swelling of clay-rich sediment also can cause lateral and upward movement of cultural materials. This process is similar to cryoturbation; and, over time, argilliturbation can move artifacts and rocks all the way up to the surface (Wood and Johnson 1978:356). One of the indicators that a site has been disturbed by argilliturbation is artifacts resting at vertical and near vertical angles. However, these angles also may occur when artifacts are disturbed by flowing water (Thoms 2007:80). If cultural materials from the same period are found at several depths, argilliturbation may be the cause of this disturbance (e.g. Morris et al. 1994).

Many archaeological sites are located on slopes and several processes of mass wasting (also called mass movement or graviturbation) act on these sites. Mass wasting is "the mixing and movement of soil and rock debris downslope, including subsidence, principally under the influence of gravity, without the aid of the flowing medium of transport such as air, water, or glacier ice" (Wood and Johnson 1978:346). Mass wasting includes falling, sliding, flowing, creeping, and subsidence (Rapp and Hill 2006:249). Heavier and denser items are transported greater distances downslope than lighter and smaller artifacts because lighter artifacts will come to rest on a steeper slope while heavier objects will continue to move to a gentler slope (Rick 1976). This is unlike some other post-depositional processes (such as fluvial action) where smaller objects are more readily moved (Rick 1976). In sum, mass wasting is a colluvial process that both transports artifacts downslope and buries items at the base of the slope. This process is unlikely to have impacted the study sites.

Anthropogenic Formation Processes

Anthropogenic formation processes are "the processes of human behavior that affect or transform artifacts after their initial period of use in a given area" (Schiffer 1987:7). Like natural formation processes, anthropogenic processes affect artifacts from before burial to after exposure. Some human impacts on sites include reuse of site area or artifacts, burial, trampling, plowing, digging/excavating, and collecting.

After initial deposition, humans may continue to occupy or reoccupy a site area prior to burial (if burial occurs at all). During occupation, human trampling may bury some artifacts while leaving others exposed and can mix artifacts from more than one occupation. Children may alter artifact distributions created by adults through play and imitation (Grimm 2000). Even a site that was abandoned for some time (from a few days or thousands of years) is susceptible to additional disturbance from reoccupation and/or collection. For example, throughout prehistory people have collected chipped stone from earlier sites for reuse and/or admiration, and diagnostic artifacts from earlier periods are sometimes found at later sites (e.g., Hesse 1995; Smith 2006). Some of these curated tools were even modified by the collectors, and their original form is unidentifiable today. The extent of this activity in prehistory is unknown. Anthropogenic deposition or burial is not common at hunter-gatherer sites, but has been documented at many sites where people built on top of old sites to create a new living space (Goldberg and Macphail 2008). Tells are one of the best examples of this for non-hunter-gatherer sites. They are large mounds that were formed over time as people rebuilt new structures on the location of old ones.

Trampling is a force that may affect artifacts from the time they are initially deposited. This factor may be initiated by humans, animals, or both. Studies that help us understand the effects of trampling on both the horizontal and vertical distribution of artifacts include those by Burger et al. (2008), Gifford-Gonzalez et al. (1985), Villa and Courtin (1983), and Wandsnider (1988). Prior to abandonment, humans likely contributed to the trampling effects at a site through normal use (Gifford-Gonzalez et al. 1985:804). This kind of trampling has been documented to move artifacts downward in a variety of substrates including sandy (Gifford-Gonzalez et al. 1985) and water-logged ones (Eren et al. 2010). Trampling also can affect shallowly buried cultural materials. Because of its depth of burial, it is unlikely 14SN106 was affected by trampling after burial. Although 41WK21 may have been re-exposed through time, it appears to have usually been buried under meters of dunes deposits and would have received little effects of trampling after it was initially buried. However, prior to burial, some trampling occurs at nearly every site. The effects of trampling are limited by quick and deep burial.

Soil disturbance to sites through human activity such as plowing, digging, and even excavation can be significant. Modern mechanical plowing can cause both horizontal and vertical displacement of artifacts as well as size sorting (Diez-Martin 2010; Dunnell and Simek 1995; Roper 1976; Steinberg 1996). Humans dig at sites for a variety of reasons including looting and earth moving related to development or water control. It is important to note that earth moving, even if it is only near a site, may lead to disturbance of the cultural materials. For example, Middle Beaver Creek, where 14SN106 is located, was channelized in the mid-1960s. Decades later the site was discovered due to erosion that had occurred on the cutbank of the channelized stream.

Although archaeologists attempt to carefully and systematically record the location of artifacts and sediments during excavation, it is still a destructive process. Once artifacts are recovered, a site has been completely disturbed, and those items cannot again be observed where they were in situ. This emphasizes both the need to preserve portions of sites for future study and the need to carefully document what and where artifacts and features are found. Without provenience data researchers would be at a loss to know how formation processes affect cultural materials.

Artifact collectors are members of the public who visit archaeological sites and remove items that interest them. Another important aspect of archaeology, context, is often ignored by collectors. For many collectors, the *item* retains prominence over the locational information or understanding of past behavior. Nearly all collectors selectively remove only the artifact types in which they are interested. For example, they may remove formal chipped stone tools from a surface lithic scatter but leave the flakes. Many buried sites are protected from this type of disturbance, but even some of those experience looting. It is essential to mention, however, that not all collectors have the same bias. Rose, a member of the public with an interest in archaeology, has systematically collected artifacts from 41WK21 for decades. His collection forms the basis for my research at the site. Rose has avoided two of the pitfalls of many collectors: he has recorded the context of artifacts and picked up every type of item he encountered. In this case, the collector has done the archaeologist a service, as professionals usually do not invest the time and effort he has to revisit one site over many years.

The study of site formation process is complex and each site has been impacted by multiple site formation processes. Site formation processes do not all disturb sites in the same way: "[c]ultural materials, then, may sink into the soil, may be concentrated into layers at depth, may be reoriented within the soil, may be thrust to the surface, or may be moved horizontally on a plan or downslope" (Wood and Johnson 1978:369). Table 4.2 provides a summary of site formation processes and their impact on artifacts.

To determine the likely scenario for how artifacts have moved after they were deposited, one must first understand the site's setting. Just because a site exhibits evidence of multiple post-depositional site formation processes, it does not mean the integrity has been compromised. Indeed, all sites are "disturbed" to some degree. This has led some authors, in their discussion of site formation processes, to reject the notion of a "primary" context for artifacts (see Schick 1987). Instead, the integrity of each site must be examined independently after site formation processes are identified (Hewitt and Allen 2010; Wood and Johnson 1978).

Table 4.2. Summary of the effects of site formation processes on how artifacts move. Note that these are generalities, not hard and fast rules. Also, most sites experience several of these processes.

Process		Source of Process	General Direction Artifacts Move	References
Alluvium		Natural	Downstream	Petraglia and Nash 1987; Schick 1987
Eolian		Natural	The direction of the wind	Cameron et al. 1990; Wandsnider 1988
Mass wasting		Natural	Downslope	Fanning and Holdway 2001; Rapp and Hill 2006; Rick 1976; Wood and Johnson 1978
Cryoturbation		Natural	Up and laterally in sediment	Rapp and Hill 2006
Argilliturbation		Natural	Both up and down in sediment	Rapp and Hill 2006; Thoms 2007; Wood and Johnson 1978
Bioturbation	Faunalturbation	Natural	Small artifacts move up in sediment	Bocek 1986; Van Nest 2002; Wood and Johnson 1978
		Natural	Larger artifacts move down in sediment	
		Natural	All artifacts can be buried in sediment - appear to move down	
	Floralturbation - Root casts	Natural	Down in sediment	
	Floralturbation - Tree falls	Natural	All directions, can cause inverted stratigraphy	
Trampling		Natural and Anthropogenic	Down into sediment	Burger et al. 2008; Eren et al. 2010; Gifford-Gonzalez 1985; Villa and Courtin 1983; Wandsnider 1988
Digging/Excavation		Anthropogenic	Selected artifacts removed, others redeposited randomly	--
Collection		Anthropogenic	Selected artifacts removed, others redeposited randomly	--

Chapter 5. Results from 14SN106

Introduction

Site 14SN106 is the location of Early Paleoindian cultural deposits discovered in the channelized cutbank of Middle Beaver Creek in Sherman County, Kansas (Figure 1.1). This area has been extensively investigated for archaeological sites. As of November 2015, a total of 67 sites were recorded in Sherman County, and 15 of those were in the immediate vicinity of 14SN106. Site 14SN106 is near two other Early Paleoindian sites with cultural deposits contained in alluvial fill beneath the T-1 terrace of Middle Beaver Creek: 14SN101 and 14SN105. Cultural materials from the three buried Paleoindian sites are attributable to the Paleoindian period and date between ca. 11,500 and 9,200 ^{14}C yr. B.P. years ago (Blackmar and Hofman 2006; Cordova et al. 2011:Table 6; Mandel et al. 2005). Together, sites 14SN101, 14SN105, and 14SN106 are known as the Kanorado Locality, named for the nearby town of Kanorado, Kansas. Thus far these sites have been identified as loci of hideworking and other domestic activities; only one potential kill site has been identified at Kanorado, Area C at 14SN106.

Excavations have been undertaken in four areas of 14SN106 (Figure 5.1). A site boundary drawn around these four areas encompasses 4.43 acres (17,915.7 m^2). Areas B and C have dated Paleoindian materials. Paleoindian artifacts from Area B, the Main Block, have been recovered from the Kanorado paleosol. Artifacts also have been recovered from similar contexts at both 14SN101 and 14SN105. The Main Block, which is the focus of this study, has seen the most extensive excavation and was interpreted as a hideworking activity area. Approximately 37.5 m^2 have been excavated in this area; the exact amount of sediment excavated is difficult to determine because several of the units were on the edge of the cutbank.

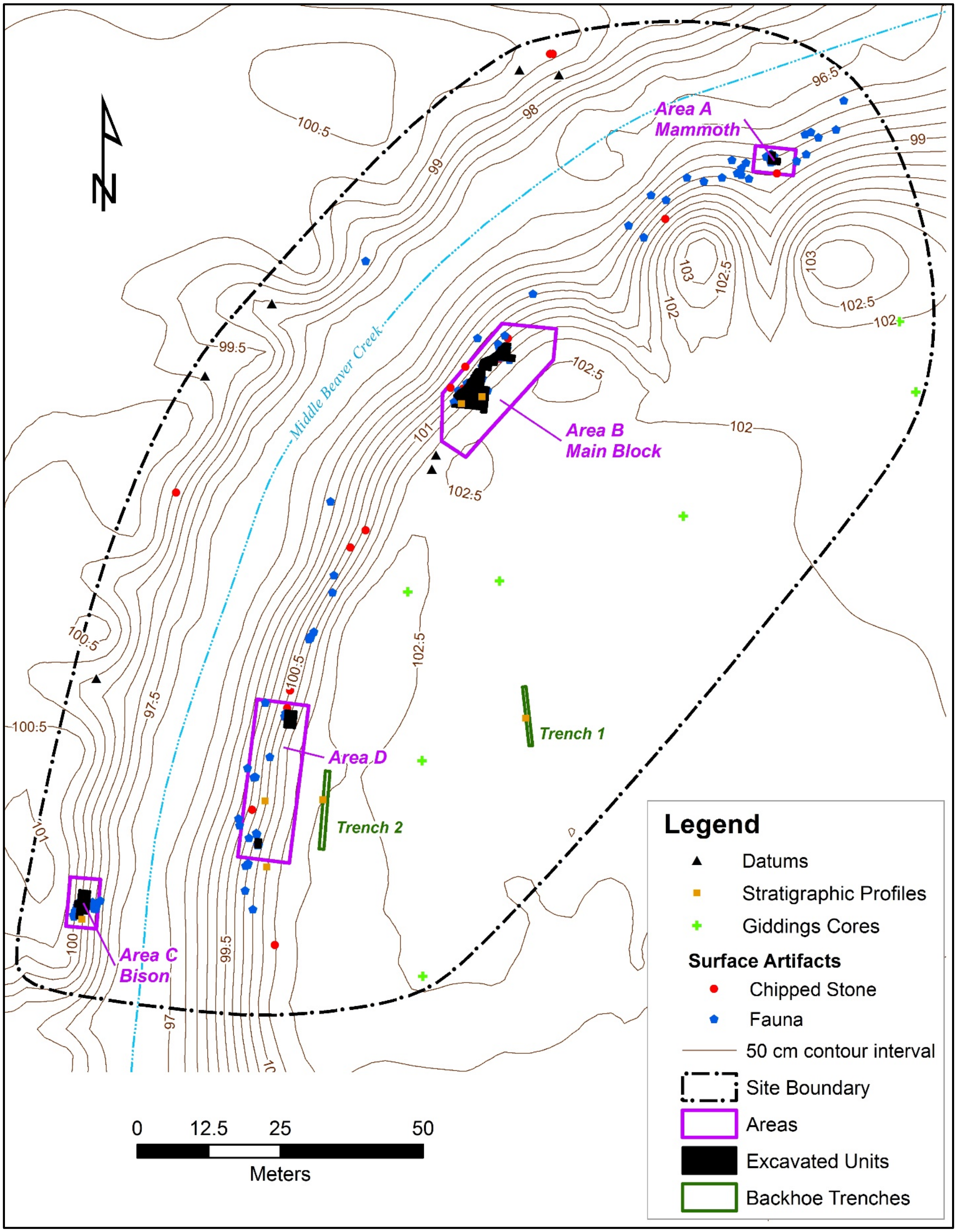

Figure 5.1. Site14SN106 plan map.

The Main Block can be examined as one area, by excavation unit, or divided along the N432 line to compare the north and south portions of the Main Block. Like the other sites at the Kanorado Locality, artifacts in the Main Block are sparse and consist primarily of chipped stone tools and very small flakes. Most tools at 14SN106 are endscrapers, and many of the small flakes are scraper retouch flakes.

History of Work at the Site

Test excavations began in 2004 with one partial unit excavated by Odyssey Archaeological Research Fund (Odyssey) crew members (Figure 4.1). In 2005, several volunteer members of the Kansas Anthropological Association participated in the excavations. The University of Kansas Field School students joined Odyssey crew to excavate at 14SN106 in 2006 and 2008 (Figure 5.2). Excavations in 2007, 2010, 2011 (Area A only), and 2015 were completed by Odyssey. As described in the method chapter, waterscreening was implemented at 14SN106 in 2006 and has been used since that time.

Site Setting

The Kanorado Locality sites are near the Kansas-Colorado border and along Middle Beaver Creek. This portion of the creek was channelized during the construction of Interstate 70 (I-70) and County Road 3 (CR3) in the late 1960s. In the mid twentieth century, prior to channelization, each of the Kanorado Locality sites was situated near Middle Beaver Creek (Figure 5.3). In 1968, construction had begun on I-70 but the creek was not yet channelized. By 1975, the construction of I-70 and CR3 and the channelization of the creek were complete (Figure 5.3).

Figure 5.2. Members of the University of Kansas' archaeological field school excavate and waterscreen at the Main Block of 14SN106 in the summer of 2006.

The channelization created a cutbank in the vicinity of 14SN105; and in 1976, the landowner and his son discovered mammoth bones eroding out of the bank at that location. Excavations in the 1970s and early 1980s yielded numerous bone samples from the site. As a result of Dr. Steven Holen's examination of these bones, archaeologists visited the site in 2002. When artifacts were observed east the original mammoth bone findspot, that locality was assigned archaeological site number 14SN101. Eventually artifacts were discovered at the original findspot and it was assigned the number 14SN105.

Figure 5.3. Kanorado Locality buried Paleoindian site boundaries depicted on georeferenced aerial imagery showing the channelization of Middle Beaver Creek in the late 1960s. Imagery dates from 1953, 1968, 1975, and 2014 (National Agriculture Imagery Program [NAIP] 2014; U.S. Army Map Service 1953; USGS 1968, 1975).

Dr. Rolfe Mandel subsequently identified another locality where artifacts were eroding from a cutbank. This site, 14SN106, is south and slightly upstream from the others. When Middle Beaver Creek was channelized, a large amount of sediment was removed from 14SN106. Although the removal of this sediment combined with erosion eventually allowed the site to be discovered, it appears to have had a significant impact potentially removing a substantial portion of the cultural deposits.

The Kanorado Locality is in the High Plains physiographic province of the Great Plains (Fenneman 1931). The High Plains is a relatively flat region created by alluviation from the Rocky Mountains. More specifically, the Kanorado Locality is in the Flat to Rolling Cropland of the Western High Plains ecoregion (Chapman et al. 2001). This area has a continental climate with hot summers and cold winters (Mandel 2006a:19). The semiarid climate of western Kansas means the area only receives an average about 16 inches of precipitation per year, and droughts are common (Mandel 2006a:18-19). Average monthly temperatures range from 79º F in July to 34º F in January (Mandel 2006a:20). In general, the Kanorado Locality has experienced a gradual shift from C_3 to C_4 plant dominance from Paleoindian times to today (Cordova et al. 2001:95). C_3 plants live in cool, moist areas. The vegetation at 14SN106 in the late Quaternary would have been open woodland. C_4 plants prefer warmer, drier locales such as the shortgrass prairie, which is the modern plant community of 14SN106. The shortgrass prairie is dominated by blue grama (*Bouteloua gracilis*) and buffalo grass (*Buchloe dactyloides*) (Küchler 1974; Mandel 2006a:20). Today the area around 14SN106 is used as cattle pasture, and the creek is intermittent; it holds water only after heavy rainfall events (Cordova et al. 2011:94).

The Holocene and late-Pleistocene alluvium in the Middle Beaver Creek valley is inset against the Ogallala Formation and is stored beneath a low, narrow floodplain (T-0) and a broad flat terrace (T-1) (Cordova et al. 2011:94). The three sites at the Kanorado Locality are all in the valley fill below the T-1 terrace. This type of setting is typical in low-order draws on the High Plains, and several Paleoindian sites have been identified in buried soils in similar T-1 fills (Mandel 2008:353).

The Tertiary-age Ogallala Formation is made up of coarse-grain sediments that were transported east from the Rocky Mountains during the Miocene and early Pliocene (Buchanan 1984; Frye and Leonard 1952; Ludvigson et al. 2009; Merriam 1963). In the late Quaternary it appears Middle Beaver Creek was a perennial stream. Two species of bivalves, *Lampsilis siliquoidea* and *Sphaerium simile*, that live in permanent-water habitats, have been identified at the Kanorado Locality in Late Pleistocene contexts (Warren and Holen 2007). The phytolith evidence from 14SN106 indicates there was a somewhat variable climate during the formation of the Kanorado paleosol; conditions changed from a more cool, wet environment to a more arid one and back to more moist (Cordova et al. 2011:96). In historic times, the Kanorado vicinity had more available water. Springs were present where the Ogallala Formation is exposed in the walls of stream valleys near the site. As the Ogallala aquifer has been tapped for irrigation, many of these springs, including those near the Kanorado Locality, have run dry (Mandel 2006a:17-18).

The T-1 terrace of Middle Beaver Creek contains two buried soils: the Beaver Creek and Kanorado paleosols. The artifacts at 14SN106 (as well as 14SN101 and 14SN105) occur in the more deeply buried Kanorado paleosol (Figure 5.4). Soils form when a landscape becomes relatively stable and parent materials, such as alluvium, experience diagenesis. When the landscape becomes unstable and alluviation occurs, soils can be buried. Buried soils that formed under environmental conditions that are different from modern conditions are referred to as paleosols. Since soils indicate a period of landscape stability, they are good places to find archaeological evidence.

Figure 5.4. South wall of the main excavation block at 14SN106 at the end of the 2010 field season. The dark, recently excavated horizon is the Kanorado paleosol, the Beaver Creek paleosol is visible above it. An open rodent burrow is visible at photo right and some disturbance is observable in the Kanorado paleosol.

The Beaver Creek paleosol is approximately 1.0-1.5 m below the T-1 surface at 14SN106 (Cordova et al. 2011:95). No artifacts have been recovered from this weakly expressed mid-Holocene aged soil (Cordova et al. 2011:95). On the other hand, an Early Paleoindian period archaeological component has been identified in the Kanorado paleosol. The Kanorado paleosol is about 1.7-3.1 m below the terrace surface and is much more strongly expressed than the Beaver Creek paleosol (Cordova et al. 2011).

The remains of a bison were excavated in the southern portion of the site slightly upstream from the main block excavation (Area C). This bison appears to have been trapped and killed in an arroyo. Today that arroyo is observable in the form of a paleochannel, a drainage that was incised but has been filled with sediments. Although only the one nearly complete Paleoindian age (10,854±40 ^{14}C yr. BP [NZA-27348]) bison skeleton has been excavated at 14SN106, it is likely that others were removed from the same area when the stream was channelized during the 1960s. This hypothesis is supported by two Clovis-age radiocarbon ages of 11,085±20 ^{14}C yr. BP (CURL-9009) and 11,005±50 (CAMS-112742) on a bison astragalus and a horse metapodial, respectively, from the site (Mandel et al. 2005; Cordova et al. 2011). In addition to these faunal remains, mammoth and camel bones have been recovered from 14SN106. The remains of these animals have all been recovered from below the Kanorado paleosol, and no artifacts are associated with them (Cordova et al. 2011:95). Two bison skulls from another part of the same paleochannel described above date from the Archaic (Middle Holocene) period. Several chipped stone artifacts found on the surface of the site likely date from later prehistory.

When people first occupied 14SN106 they were stopping near a creek. It is therefore not surprising that alluviation was the process that buried the cultural deposits. The artifacts were deposited on a former floodplain that experienced "gradual sedimentation accompanied by soil development" between ca. 11,000 and 9,200 ^{14}C yr. BP (Mandel 2008:354). This is the period when the cumulic Kanorado paleosol developed. Cumulic soils develop on quasi-stable landscapes where slow sedimentation is accomplished by pedogensis. At 14SN106, rapid alluviation began after 9,200 ^{14}C yr. BP and buried the Early Paleoindian cultural deposits deeply below the T-1 terrace (Mandel 2008:354).

Site Formation Processes and Implications

It is likely that several site formation processes have affected the sediments and artifacts at 14SN106. The most obvious of these processes, faunalturbation, digging, and erosion also are the most likely to have significantly disturbed the site. Others, such as sedimentation, cryoturbation, argilliturbation, floralturbation, and trampling probably had minimal impact on the site.

Cumulic soils form on floodplains far from the main water channel. In such a setting, cultural materials can be buried shortly after deposition but are not affected by the high energy of a fluvial channel or near-channel depositional environment. Because of this, Ferring (1992) described cumulic soils as advantageous for archaeological preservation. Site 14SN106 is in such a location, and a cumulic soil is present. Experiments that examined the position of artifacts redeposited by water indicate they often have a vertical or near vertical angle of repose, smaller artifacts may be further downstream than larger ones, and the site area may be spread out in the direction of the stream flow. Although our research at 14SN106 cannot address this third attribute, the artifacts mapped in situ were lying on a horizontal plane, and both large and small items were found in the same area. The evidence supports the interpretation that these artifacts were not transported by alluvium during burial.

Generally soil freezes from the surface downward, and the maximum depth of frost penetration at 14SN106 is 75-100 cm (see Wood and Johnson 1978:Figure 9.9). Early Paleoindian cultural materials at Site 14SN106 were shallowly buried shortly after they were deposited, but buried below the maximum depth of frost penetration only after 9,200 ^{14}C yr. BP. Hence, there was an approximately 2,000 year period when cryoturbation may have affected the cultural materials at 14SN106. Once the artifacts were deeply buried, cryoturbation would not have impacted the site. A second time when cryoturbation may have affected the site is in recent times. Soil can freeze horizontally in from the cutbanks. Since the 1960s there has been a cutbank adjacent to the cultural deposits at 14SN106. Because it has been a relatively short period, it is unlikely cryoturbation affected the deposits in recent times (see O'Brien 2006; Wood and Johnson 1978:337). Artifacts' angle of repose (not horizontal) and size sorting (larger artifacts higher in the profile) can indicate cryoturbation. As described above, most mapped artifacts at 14SN106 were lying on a horizontal plane and, based on the preliminary analysis, larger artifacts are not systematically higher than smaller ones. This suggests cryoturbation has not significantly affected the spatial distribution of artifacts at 14SN106.

For argilliturbation to take place, sediments must have a significant amount of expandable clay. As sediments with expandable clays gain and loose moisture they expand and contract, potentially creating disturbance to cultural materials. The Kanorado paleosol is a silt loam with a clay content that is less than 25 percent (Mandel et al. 2004). Therefore, conditions at 14SN106 are not conducive for argillitubation.

The cultural materials that make up 14SN106 were originally deposited on a floodplain. Eventually they were deeply buried beneath a terrace. During the late Quaternary, the region was open woodland and some tree falls may have occurred at the site. Today there are no trees at 14SN106. The Kanorado paleosol contains fine and very fine roots (Mandel et al. 2004); hence the size of the roots would have prevented them from significantly moving artifacts. Vegetation, including yucca plants with large roots, on the cutbank may have affected the cultural deposits along that edge, but that would have been a localized impact.

Research shows that trampled material sorts by size and small pieces move the most. The vertical distribution by size of the lithic artifacts in a pilot study shows small and large artifacts concentrated in the same levels (Ottaway and Ryan 2006). There also is a high percentage of flake completeness at 14SN106, which suggests little trampling has occurred.

Since the archaeological components at 14SN106 are in a cumulative soil, it is likely they were buried soon after they were deposited; however, they may have been exposed to many near-surface bioturbation factors even after burial. Since the creek was channelized in the 1960s, portions of the site have been on or near the surface of the cutbank; therefore, those portions of the site along the cutbank have been exposed to bioturbation in recent years. Also, faunalturbation is not limited to near surface disturbances and has been impacting the cultural materials since deposition.

During excavation, both open (modern) rodent burrows and older krotovinas were encountered (Figure 5.5). Additionally, smaller insect krotovinas were noted and larger chambers that may have been nesting, listening, or turnaround areas also were identified. A variety of species are likely responsible for the bioturbation at 14SN106. Although today there are no beaver in the area, the name of the creek suggests they were present in the past. Burrowing animals that were observed during our visit to the site include prairie dogs, burrowing owls, and mice (Figure 5.6). For several years, while excavations were being conducted at 14SN106, the surface of the T-1 in the vicinity of the site was the location of an occupied prairie dog village. Indeed, in 2007, we excavated a nest of young prairie dogs that were living in a unit adjacent to an excavated unit (Figure 5.6).

Figure 5.5. Excavation unit at nearby Site 14SN105 with both open rodent burrows and krotovinas.

Figure 5.6. Young prairie dogs (a, b) and a field mouse (c) encountered during excavations at 14SN106. Photos a and b show a prairie dog nesting chamber that had been dug into a unit being excavated in 2007.

Prairie dogs burrows usually have at least two entrances with distinctive shapes and height designed to create good ventilation throughout the burrow. The accumulation of sediment outside the entrance also allows for observation of the surroundings (Hoogland 1995). Burrows are usually 2 to 3 m deep, but some are as deep as 5 m (Hoogland 1995). Their length is usually about 5-10 m long; however, they may be as short as 4 m and as long as 33 m (Hoogland 1995; Sheets et al. 1971). Burrow entrances are typically 10 to 30 cm in diameter, but their passageways narrow underground (Hoogland 1995:26). The passageways are about 10-12.7 cm wide, but areas of branching can be up to twice as wide and chambers are larger. Nest chambers excavated by Sheets et al. (1971:452) were elliptical and about 38 cm wide and 25 cm high, with a dry grass mat covering the floor and extending up the sides of the chamber. Burrows with nest chambers are used for rearing unweaned juveniles and presumably for sleeping (Hoogland 1995). Burrows also have listening/turnaround chambers about one meter below the ground.

Prairie dog burrows are similar to several other rodent species' burrows. While some burrows are distinctive and can be assigned to a particular type of animal, many are similar and cannot be identified to species, and still others may be occupied by multiple species (Ahlbrandt et al. 1978; Sheets et al. 1971). This information provides a comparison for the krotovina and rodent burrows observed at 14SN106. In general, the size of burrows observed is similar to a prairie dog's burrow. As with other types of bioturbation, burrowing displaces artifacts and sediments and we would expect smaller artifacts to have been moved up and out of the burrow while larger ones may have been moved down. Additionally, artifacts may be moved laterally within a burrow (Bocek 1986; Wood and Johnson 1978). Finally, the fill that enters burrows to make them krotovina is displaced and artifacts, although they may come in with that fill, are out of context.

During excavations at 14SN106, the sediment from krotovinas was bagged and screened separately. This method of separately screening allows us to eliminate artifacts found in the displaced krotovina sediment from our study of the Paleoindian deposits. Very few artifacts have been recovered from krotovina-derived sediments. The majority of artifacts from the Main Block excavation at 14SN106 are very small (< 1 cm) chipped stone flakes. Their presence suggests that the sediments that appear to be intact may be relatively undisturbed. However, the number of artifacts at this site is low, and we cannot calculate how many flakes have been redeposited by burrowing animals.

In 2006, a pilot study examined the chipped stone recovered from five units at 14SN106 that were excavated completely through the buried soils. The results of that study showed large and small artifacts were concentrated in the same levels, and there was a slight bimodal distribution (Ottaway and Ryan 2006). The bimodal distribution of artifacts suggested there was minimal vertical displacement of chipped stone.

Although the krotovinas that were observed at 14SN106 can be accounted for using archaeological methods, there may be impacts of faunalturbation that were not obvious during excavation. If a krotovina is filled in with sediment of the same color and texture as the surrounding matrix, then it may be difficult or impossible to identify them. One other way former burrows may be identified is the presence of rodent bones. Rodents and other burrowing creatures often died and decayed in their burrow. This area of study has not yet been investigated at 14SN106.

In the mid 1960s, when Middle Beaver Creek was channelized, an unknown amount of sediment was removed from 14SN106. Although this sediment removal eventually allowed the site to be discovered, it had a significant, detrimental impact on the cultural deposits. It limits our interpretations of the site because we do not know what is missing. In addition, since the 1960s, the exposed cutbank has experienced slumping and erosion, which removes artifacts and soils that were part of the site.

The Artifact Assemblage at 14SN106

There were 1,120 chipped stone artifacts excavated from the units in the Main Block from 2004-2010. Four additional chipped stone artifacts were included in my analysis because they clearly came from the Kanorado paleosol of the Main Block despite not having been excavated from a unit (these items are: 106-05-118, 106-04-012, 106-05-113, and 106-05-119). With these Paleoindian artifacts included, there are a total of 1,124 chipped stone artifacts from the Main Block.

In addition to chipped stone, some 200 faunal pieces, several potential fire-cracked rocks, and a few smears of yellow ochre (limonite) also have been recorded in the Main Block at 14SN106. Although the faunal remains are considered here, the focus of this analysis is on the chipped stone.

Site 14SN106 has a relatively sparse distribution of chipped stone artifacts; however, even that can tell us much about the prehistoric occupants. Few artifacts at a site may indicate a single, short-term occupation. Few chipped stone artifacts can also be the result of a single activity conduced at a location and is influenced by the number of people there. An analysis of the chipped stone and its spatial properties can help us to understand why this site has a paucity of artifacts compared to other Paleoindian sites.

Thirty-four units have been excavated in the Main Block, but not all of them were complete 1 x 1 m squares (Figure 4.1). In fact, 13 of the units were incomplete due to erosion and the intrusion of the stratigraphic trench. In addition, some erosion occurred to units depicted on maps as compete because between excavation seasons, slump occurred; however, compared with the erosion along the edge of the cutbank, this erosion was minimal. In addition to more complete units, significantly more flakes were recovered from units excavated from 2006-2010 because a smaller screen was used to capture artifacts during that excavation. Fourteen of the units yielded fewer than 10 chipped stone artifacts. Two of these units (30O-10 and 30P-5) were screened with 1/16” hardware cloth while the other 12 were all excavated in 2004 and 2005, before those methods were used. Because many of the units excavated in 2004 and 2005 were along the edge of the cutbank, it is likely the low numbers of artifacts is magnified because they were not complete units.

In contrast to these units with so few artifacts, 29O-2 (N429E653), with 194 chipped stone items is the unit with the greatest number of artifacts. The average number of chipped stone items per unit was 32.94 overall, 21.33 among the 2004-2005 units, and 50.29 among the 2006-2010 units. The difference in screening methods made a significant difference in the number of chipped stone recovered because this site assemblage is dominated by small artifacts.

Of the 1,120 chipped stone artifacts, nearly 90 percent (n = 1,005) are less than 1 cm in maximum dimension. These items are divided roughly evenly between flakes that are <0.5 cm or from 0.5-1 cm. Given the size of the flakes, nearly one half of this assemblage would not have been collected if only a 0.25 in screen had been used during fieldwork. Artifacts greater than 1 cm were size-graded in 1 cm increments and none of those categories account for more than eight percent of the total (Table 5.1). Not surprisingly, the majority of the artifacts were collected in the 1/16” waterscreen sample, which was employed from 2006-2010. A total of 951 items came from that method of recovery while another 96 were found in the 1/8” dry screen (2004-

2005) or 1/4" waterscreen sample (2006-2010). Seventy-two chipped stone artifacts were mapped in situ with the total station (Table 5.2).

Table 5.1. Table showing the number of chipped stone artifacts from the 14SN106 Main Block by size grade.

Size Grade (cm)	Count	Percent
0.5	506	45.02%
1	499	44.40%
2	89	7.92%
3	18	1.60%
4	5	0.44%
5	5	0.44%
6	2	0.18%
Grand Total	***1124***	***100.00%***

Table 5.2. Site 14SN106 Main Block chipped stone by method of recovery.

Method of Recovery	Count	Percent
1/16" Screen	951	84.61%
1/4" Screen	44	3.91%
Mapped Item	72	6.41%
1/8" Screen	52	4.63%
Eroded out of place from Main Block	3	0.27%
Surface	2	0.18%
Grand Total	***1,124***	***100.00%***

Lithic Material Types

A variety of lithic material types are present in the 14SN106 Main Block assemblage. Although half of the artifacts are Hartville Uplift chert (Figure 4.7), at least 12 other materials also are represented in the assemblage (Table 5.3). All of the most common lithic material types were recovered from both the northern and southern areas of the Main Block (Figure 5.7).

Table 5.3. The frequency of each lithic material type represented in the Main Block.

Lithic Material	Count	Percent
Alibates/Day Creek	122	10.89%
Edwards chert	48	4.29%
Fossilized Wood	110	9.82%
Gray Quartzite	85	7.59%
Hartville Uplift chert	566	50.54%
Moss Agate	5	0.45%
Orange Quartzite	4	0.36%
Red Quartzite	8	0.71%
Smoky Hill silicified chalk	59	5.27%
Tecovas chert	1	0.09%
Unidentified chalcedony	16	1.43%
Unidentified chert	84	7.50%
White River Group Silicates	12	1.07%
Total	1,120	100.00%

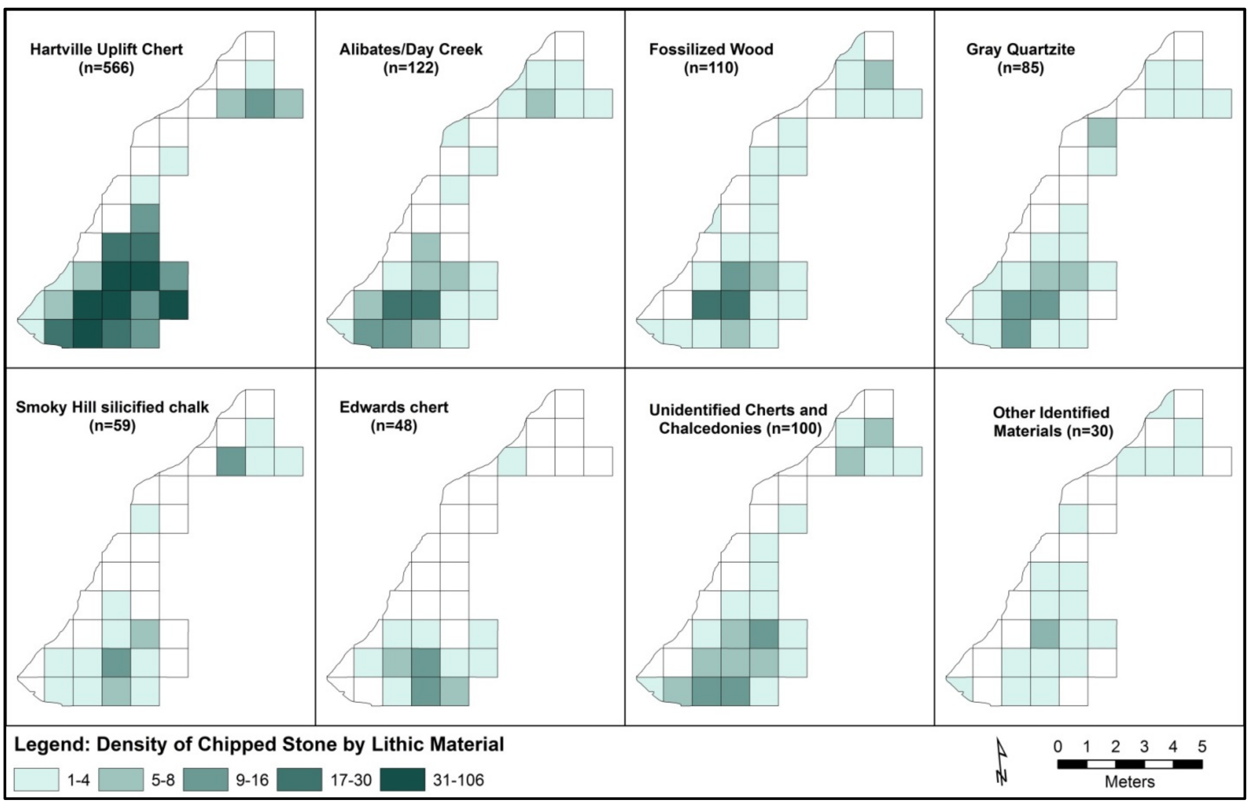

Figure 5.7. Maps depicting the density of different lithic materials in the Main Block. Nearly all of the material types are found, albeit in varying numbers, throughout the block. This suggests that this assemblage, despite the variety of lithic materials, is part of one component.

Hartville is from Wyoming, north of 14SN106. The second most common lithic material from the site, Alibates agatized dolomite or Day Creek chert, is from the south, the opposite direction of Hartville. Both of these materials came from significant distances: the source of Hartville is approximately 375 km (231 mi) northwest of the site, and Alibates/Day Creek is approximately 286 km (178 mi) at its closest and up to 370 km (230 mi) away. Edwards chert from central Texas is the source that is the greatest distance from 14SN106. The assemblage contains 48 pieces of Edwards that were identified macroscopically and using an ultraviolet light. Edwards chert sources are some 713 km (444 mi) distant from the site. The majority of the lithic materials at 14SN106 come from north and south of the site; however, the source of Smoky Hill silicified chalk (n = 59) is to the east, and Dawson Formation fossilized wood is to the west (Figure 4.7). Smoky Hill silicified chalk is the most local identified material, but even those items likely traveled about 71 km (44.4 mi) to the site. Undoubtedly, some of the unidentified materials from the excavations at 14SN106 are from the local Ogallala gravels, but the majority of the chipped stone appears to have been imported from a great distance.

Thermal Alteration

Nearly 90 percent of the 14SN106 Main Block assemblage did not exhibit any thermal alteration. For the approximately 11 percent (n = 125) that were thermally altered, the majority were reddened or reddened with potlids and crazing. Only seven items had only blackening or potlids with reddening as well. On the majority of the thermally altered artifacts the evidence was pervasive on the item (n = 75), but for some, the thermal alteration was localized (n = 40), or only on a platform (n = 9) or isolated projection (n = 1).

The distribution of thermally altered artifacts mirrored the overall distribution of chipped stone in the Main Block. Units N429E653 (29O-2) and N429E652 (29O-3) contained the greatest numbers of artifacts and the most thermally altered artifacts. Overall, about 14 percent of the artifacts per unit were thermally altered. There are no areas of the Main Block with significantly higher concentrations of thermally altered artifacts that might indicate the location of hearths.

Tools

The Main Block 14SN106 chipped stone assemblage includes 25 tools and tool fragments as well as 1,099 pieces of debitage. Figure 5.8 depicts the tools and debitage recovered from the screen by unit density and the piece-plotted items in their mapped locations.

Endscrapers

Twelve complete and fragmentary endscrapers have been recovered from the Main Block (Figure 5.9). As there have only been 23 tools and tool fragments recovered, endscrapers account for just over half of the tool assemblage. Eight of the endscrapers were mapped in situ, six in the south part of the Main Block and two in the north (Figure 5.10). Two of the endscrapers were found eroded out of place: one, Specimen 106-04-012, was the initial artifact find that led to recording the site, and the second, 106-05-113, was discovered on the talus slope west of the north 430 line. The final two endscrapers were recovered from the screen.

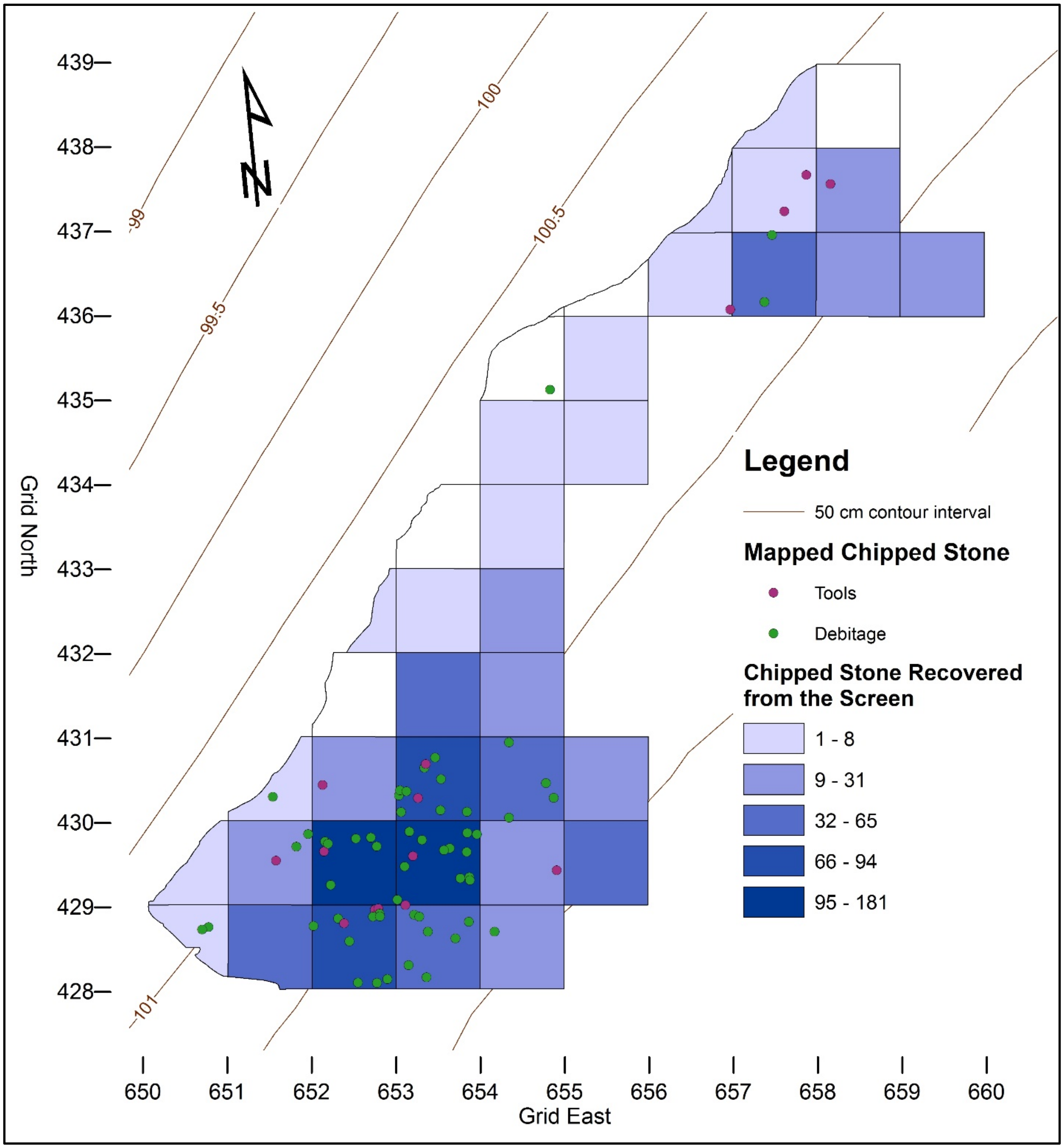

Figure 5.8. Map depicting all the chipped stone from the Main Block; mapped items are depicted where they were mapped with the total station and screen-recovered items are shown as a range of counts per unit.

Figure 5.9. Photograph of the complete endscrapers from the Main Block at 14SN106. Several different outline morphologies are visible in this image: triangular (letters A, E, H, and I), tapered (C, D, and F), convergent (G), and parallel-sided (B) scrapers.

Nine of the endscrapers (75 percent) were complete; the fragmentary examples include one distal fragment, one proximal fragment, and one radially broken medial fragment. Similarly to the chipped stone assemblage as a whole, half of the endscrapers (n = 6) are made on Hartville chert; the remaining endscrapers were made of Alibates (n = 2), Edwards (n = 2), and Fossilized wood (n = 2).

Maximum length, width, thickness, and weight were taken for the nine complete endscrapers and the statistics are presented in Table 5.4. Incomplete specimens were measured, but their measurements were not included in the statistical calculations. In general, these results indicate the endscrapers at 14SN106 are similar to those from the Rio Rancho and Cattle Guard

Folsom sites (Jodry 1999:Table 32; Ruth 2013:Table 9.8) as well as 41WK21; however, the low sample numbers at 14SN106 limit our interpretations of these data. In the 14SN106 assemblage, length is the attribute with the largest range and standard deviation; this is unsurprising as it is the attribute that changes the most during the life of the artifact. With each resharpening, the length of the item decreases, but the width and thickness vary less. Of the nine complete endscrapers from 14SN106; one third exhibited no spurs; one third had one spur; and the final third had two spurs. The percentage with spurs (60 percent) is slightly more than have been reported at other Early Paleoindian assemblages (29-53 percent) (Eren et al. 2013:Table 6; Sechrist and Ruth 1997:6); however, given the small sample size from 14SN106, this data cannot be interpreted as significant.

Thermal alteration was observed on three of the endscrapers: one had reddening only on the platform; one had localized reddening; and the third was burned and exhibited crenated fractures, reddening, and crazing across the specimen. Given the low incidence of burned endscrapers, it is likely the thermal alteration was incidental, perhaps a result of endscrapers located near hearths during their life cycle or burned in a natural fire after discard. None of the endscrapers exhibited any cortex.

Outline morphology was recorded for the 10 of the endscrapers using categories in Morrow (1997:Figure 2). Despite the small sample size, a variety of outlines were represented including triangular (n = 5), tapered (n = 3), parallel-sided (n = 1), and convergent (n = 1) (Figure 5.9). Flake blank type was identifiable for seven of the 12 endscrapers. Six of those were made on core reduction flakes while the seventh was a blade blank. The flake blank type could not be determined for the remaining five endscrapers.

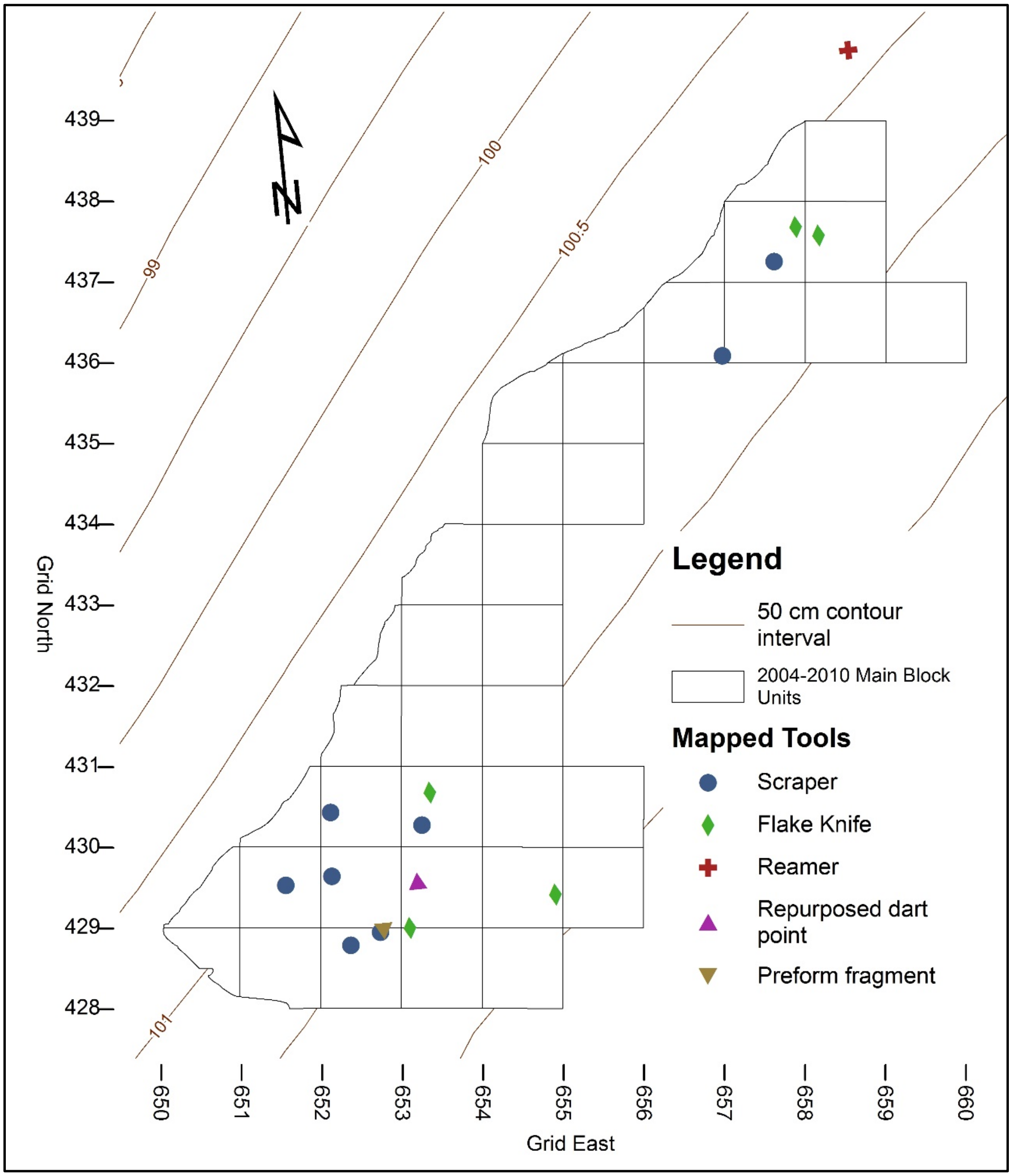

Figure 5.10. Location of the mapped tools from the Main Block excavation at 14SN106.

Table 5.4. Measurements of complete endscrapers from 14SN106.

Variable	Count	Range	Mean	Standard Deviation
Length (mm)	9	25.1-58.2	35.58	12.37
Width (mm)	9	21.4-36.5	26.43	4.96
Thickness (mm)	9	4.9-11.9	7.98	2.33
Weight (g)	9	2.4-16.3	8.62	4.7

Other Tools

Evidence for projectile point manufacture, use, and discard in the 14SN106 assemblage is limited to one channel flake fragment, two preform fragments, and the fragment of a repurposed projectile point. The channel flake fragment is discussed in the debitage section below. Two pieces of a reamer, three unimarginal scrapers, a unimarginal knife, and four utilized flake knives comprise the flake tool assemblage.

Debitage

The 1,099 debitage were analyzed for information about their reduction trajectories in an effort to understand the activity that created them. More than half of the debitage were identified as scraper retouch flakes (n = 526); however, several other categories of debitage also were represented including indeterminate retouch flakes (n = 414), bifacial retouch flakes including a single channel flake example (n = 55), amorphous core reduction flakes (n = 51), indeterminate debitage sub-type (n = 37), bifacial reduction flakes (n = 8), angular blocky debris (n = 7), and a single bipolar reduction flake. Indeterminate retouch flakes are small retouch flakes that could not positively be identified as either scraper or bifacial reduction. Many of these unidentifiable retouch flakes are most likely scraper retouch, but did not exhibit all of the classic features of these flakes.

Scraper Retouch Flakes

There are 526 (47.86 percent) scraper retouch flakes in the debitage assemblage. In contrast, there were only 55 bifacial retouch flakes, a ratio of 9.5:1. The vast majority of the scraper retouch flakes were Type 1, where the ventral edge of the scraper is the platform and the flake curves up and over the bit end of a scraper. This type accounted for 515 (97.91 percent) of the artifacts, while Type 2 had seven examples and Type 3 only one example. The scraper retouch flake type was indeterminate for three scraper retouch flakes from 14SN106. The majority (n = 333, 63.31 percent) of the scraper retouch flakes exhibited plain, intact platforms as would be expected on Type 1 flakes; however, the platform was crushed on 128 (24.33 percent) and 15 (2.85 percent) had faceted or multifaceted platforms. The remaining scraper retouch flakes had broken, missing, or indeterminate platforms.

In the completeness category, this group is again dominated by one type. More than 90 percent (n = 483) of the scraper retouch flakes are complete. The other 43 flakes are incomplete; the bias towards complete flakes may be explained in a couple of ways. First, scraper retouch flakes are easier to identify when complete. Several of the incomplete retouch flakes were classified simply as unidentified retouch because not enough of the flake remained to classify. Secondly, the completeness of scraper retouch flakes is unsurprising because they are small. These small flakes are unlikely to be broken as a result of some site formation processes that may break larger pieces.

Nearly every lithic material type identified at 14SN106 is present in the scraper retouch category. Like the overall assemblage, Hartville and Alibates are the two most common materials in the scraper retouch flake sub-assemblage (Table 5.5; Figure 5.11). To produce scraper retouch flakes, an endscraper (or similar tool) must have been resharpened at the site. Recovered endscrapers are all made on Hartville Uplift chert, Alibates/Day Creek, Edwards chert, and fossilized wood. The presence of scraper retouch flakes of moss agate, Smoky Hill silicified chalk, White River Group Silicates, gray and orange quartzite, and other unidentified materials indicates the people of 14SN106 removed scrapers of these materials or they are yet to be uncovered at the site.

Table 5.5. Lithic material types represented in the scraper retouch flake sub-assemblage.

Material	Count	Percent
Alibates/Day Creek	56	10.65%
Edwards chert	15	2.85%
Fossilized Wood	50	9.51%
Gray Quartzite	4	0.76%
Hartville Uplift chert	345	65.59%
Moss Agate	1	0.19%
Orange Quartzite	1	0.19%
Smoky Hill silicified chalk	16	3.04%
Unidentified chalcedony	3	0.57%
Unidentified chert	29	5.51%
White River Group Silicates	6	1.14%
Total	***526***	***100.00%***

Figure 5.11. From left to right, columns of Edwards, Hartville, Alibates, and Smoky Hill silicified chalk, scraper retouch flakes from 14SN106.

At 14SN106, only five scraper retouch flakes exhibited cortex. This is expected since retouch flakes are a late stage reduction or maintenance flake type, and the recovered tools lacked cortex; however, several endscrapers and scraper retouch flakes with cortex were observed in the 41WK21 collection. These items are almost completely missing from 14SN106.

Newcomer and Karlin (1987:35) have emphasized the difficulty of determining if scraper retouch flakes are from manufacturing or resharpening; however, given the limited evidence of manufacturing at the site, I hypothesized most, if not all, of the scraper retouch flakes at 14SN106 were generated from resharpening events. In my examination of the assemblage I identified 17 scraper retouch flakes that did not appear to have been utilized prior to removal. These may be the result of final manufacturing of a scraper or an instance where resharpening resulted in the removal of more than one flake from the same area of the tool edge. Either way, the vast majority of scraper retouch flakes from 14SN106 exhibited features such as step fractures, polish, and rounding that appear to be indicative of use.

Amorphous Core Reduction

Only 51 amorphous core reduction flakes have been identified at 14SN106. This debitage category is dominated by Gray Quartzite items (n = 41) (Table 5.6). It appears someone may have collected the gray quartzite nodule from nearby, perhaps from the Ogallala cobbles at the site and reduced the nodule while there. All of the other lithic materials in the amorphous core flake category are represented by three or fewer items.

Just over 40 percent of the core reduction flakes are complete (n = 22). The largest flakes from the site belong to this category including one with a maximum length of more than six centimeters. Smaller size grades are represented as well; however, no flakes under 0.5 cm were included in this group. Although some of the largest artifacts from the site are core flakes, only four of these items retained any cortex. Thermal alteration of only four specimens was observed, because so few were thermally altered, it is assumed the burning was incidental.

Bifacial Reduction and Bifacial Retouch

Sixty-three bifacial reduction and retouch flakes were identified in the Main Block. Of those, 55 were bifacial retouch flakes; seven were categorized as biface reduction or thinning flakes; and one was an incomplete channel flake. Like the scraper retouch flakes and the assemblage as a whole, several lithic material types are represented (Table 5.7). Bifacial debitage of each of these materials suggests bifacial tools of each of these materials were present at 14SN106. However, it is important to note that some endscrapers, including one at this site are bifacially worked, therefore, bifacial debitage and scrapers are not mutually exclusive. None of the bifacial reduction and retouch debitage had any cortex and only eight (12.7 percent) were thermally altered.

Table 5.6. Lithic materials represented in the amorphous core flake sub-assemblage.

Material	Count	Percent
Fossilized Wood	2	3.92%
Gray Quartzite	41	80.39%
Hartville Uplift chert	3	5.88%
Moss Agate	1	1.96%
Red Quartzite	1	1.96%
Smoky Hill silicified chalk	1	1.96%
Unidentified chert	2	3.92%
Total	***51***	***100.00%***

Table 5.7. Lithic materials represented in the bifacial reduction and bifacial retouch flake sub-assemblage.

Material	Count	Percent
Alibates/Day Creek	11	17.46%
Edwards chert	10	15.87%
Fossilized Wood	8	12.70%
Gray Quartzite	1	1.59%
Hartville Uplift chert	21	33.33%
Smoky Hill silicified chalk	6	9.52%
Unidentified chalcedony	1	1.59%
Unidentified chert	5	7.94%
Total	***63***	***100.00%***

Spatial Analysis

Number of Components

Before examining the artefactual materials and their vertical distribution, it is useful to consider their context, the Kanorado paleosol. In general, the Kanorado paleosol is about 50 cm thick and in the vicinity of the Main Block at 14SN106 it is gently dipping to the north (Figure 5.12). Throughout the course of the excavation, several elevation reading were made on the top (fairly consistently) and bottom (less consistently) of the buried soil in the units. The general trend is that the paleosol was about 5 cm deeper in the northern portion of the Main Block (Figure 5.13). This trend also was observed during excavation. The dip is most clear when one examines the trend line for the top of the buried soil. The dip is not well represented in the total station measurements of the bottom of the buried soil for at least two reasons: the measurements were not consistently taken and the bottom of the buried soil is a more gradual transition and therefore more difficult to pinpoint.

Figure 5.12. A 2008 photograph of the east cutbank at 14SN106. The Main Block excavation is near the center of the photo and the Kanorado paleosol (darker layer) is visible in the cutbank.

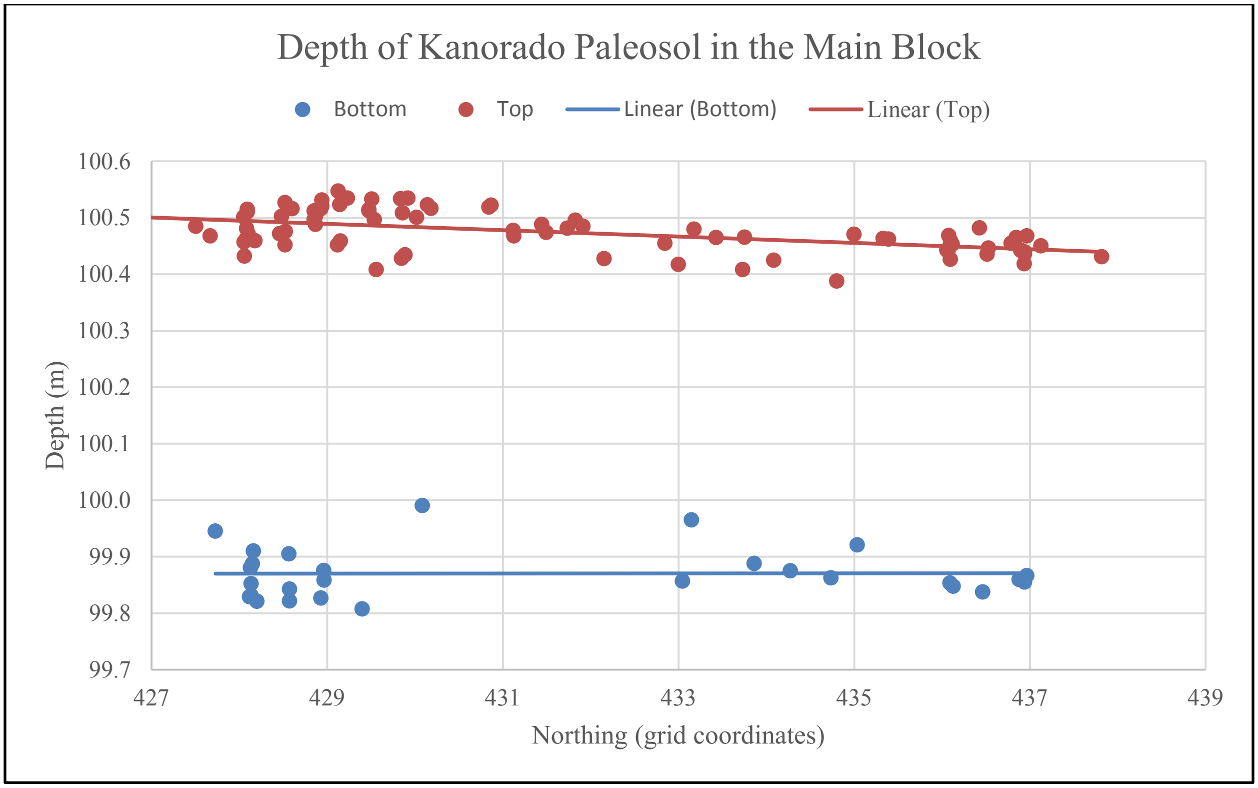

Figure 5.13. Graphic representation of the depth of the Kanorado paleosol in the Main Block at 14SN106. Red points indicate total station readings for the top of the soil while blue ones are total station readings for the bottom of the soil.

Chipped stone artifacts were recovered throughout the Kanorado paleosol in the Main Block excavation, but they appeared to be concentrated in two levels, which led to the supposition that two components were represented in this area. To investigate this hypothesis, I examined the distribution of artifacts vertically and horizontally.

The vertical distribution of chipped stone artifacts was examined by looking at the frequency of items in the north and south portions of the Main Block (using the N432 line as a divider) by 5 cm level (Figure 5.14). The most obvious spike in artifacts is in the southern part of the Main Block in Level 100.100-100.050. A second, much smaller hump in the southern data occurs at 100.250-100.200. This slight increase may be a second component; however, additional data would be needed to support that interpretation. In the northern portion of the Main Block there were many fewer artifacts overall, but both of these high points can be seen in the data approximately one level, or 5 cm below the peaks in the Main Block South data. This difference is consistent with the 5 cm dip observed in the Kanorado paleosol itself.

To shed more light on the number of components at 14SN106, I have created two maps, showing the horizontal distribution of artifacts in the 100.25-100.15 levels and the 100.15-99.95 levels (Figures 5.15 and 5.16). There are significantly more artifacts from 100.15-99.95 and they are more concentrated; however, most of the artifacts are found in the same areas of the Main Block no matter the vertical distribution. This suggests the chipped stone assemblage from the Main Block all make up one component that has been distributed vertically, but has retained horizontal integrity. If the Main Block contains multiple components, the assemblage is at least dominated by one occupation that created this concentration (cf. Sellet 2013:393).

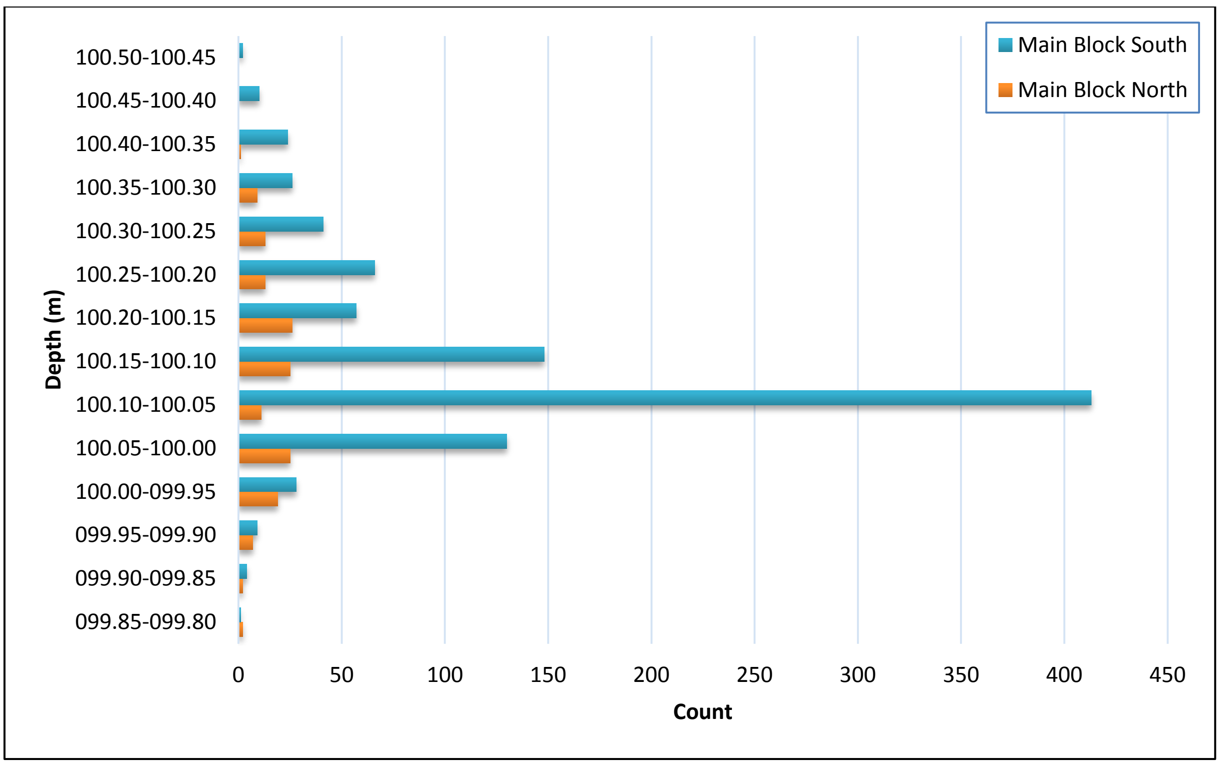

Figure 5.14. Bar graph showing the number of artifacts by depth and area.

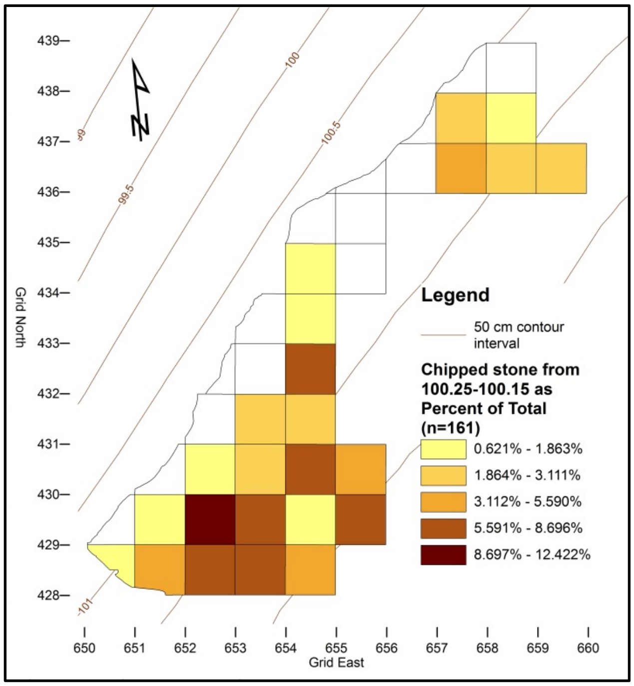

Figure 5.15. Density of chipped stone from 100.25-100.15 levels in the Main Block. Artifacts are concentrated at the south end of the block with a much lighter distribution at the north end. Note the majority of the 2004-2005 units did not identify any artifacts in these levels because a different screening method was employed.

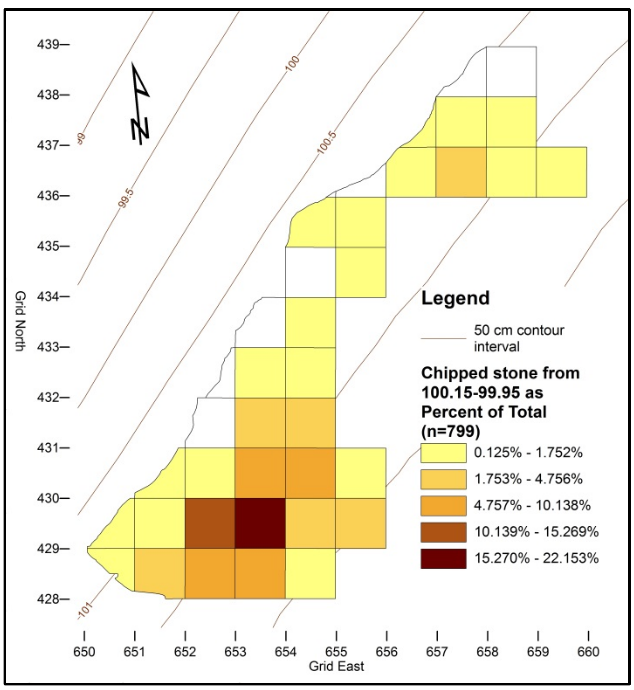

Figure 5.16. Density of chipped stone from 100.15-99.95 levels in the Main Block. These levels yielded significantly more artifacts. Like the higher levels, artifacts are concentrated at the south end of the block with a much lighter distribution in the north. Note several of the 2004-2005 units did not identify any artifacts in these levels because a different screening method was employed.

Although the chipped stone evidence suggests one Folsom/Midland component is present at the Main Block of 14SN106, the site area was likely visited more than once. The presence of a Clovis-age bison bone at the base of the buried soil in the Main Block, as well as evidence from nearby sites 14SN101 and 14SN105, indicate people visited this locality multiple times during the Paleoindian period.

Site Structure

Because of the number of endscrapers and scraper retouch flakes recovered from the Main Block, it is hypothesized that area was used for hideworking activities. Is there spatial information that can support or negate that interpretation? To address this question I began by simply considering the density of chipped stone artifacts across the excavated area. Immediately it is clear that the artifacts were clustered in the southern part of the block (Figure 5.17). With the tools removed, the debitage distribution also depicts this concentration. That map also highlights the possibility that our excavations have caught the edge of a second concentration in the northern portion of the site. This northern concentration is observed in other maps of the artifacts in the Main Block as well. It appears the distribution in Figure 5.17 is overwhelmed by the large numbers of artifacts in the south end and the less dense north end concentration is not observed.

To compare the distribution of endscrapers and scraper retouch flakes with biface artifacts, I have plotted the distributions of both screen and mapped items for each (Figures 5.18 and 5.19). Although there are many fewer biface items, the distributions are fairly similar. The southern concentration is the strongest on both maps while the northern concentration is present, albeit in smaller numbers.

For comparison with the chipped stone, I have plotted all of the faunal materials from the site; however, several of these materials are rodent bones, which contribute to our understanding of site formation processes, but not occupation. As a result, all rodent bones are excluded, and a distribution map of the screen sample bone and mapped bone identified as medium mammal and large mammal, including bison, has been created. This map depicts a slightly different distribution than the chipped stone one (Figure 5.20). The fauna map shows a concentration in the south, but east-northeast of the densest chipped stone concentration. It also indicates a concentration in the northern portion of the block, similar to the chipped stone. The differences in these distributions are especially visible in the KDE (1 m radius) (Figures 5.21 and 5.22).

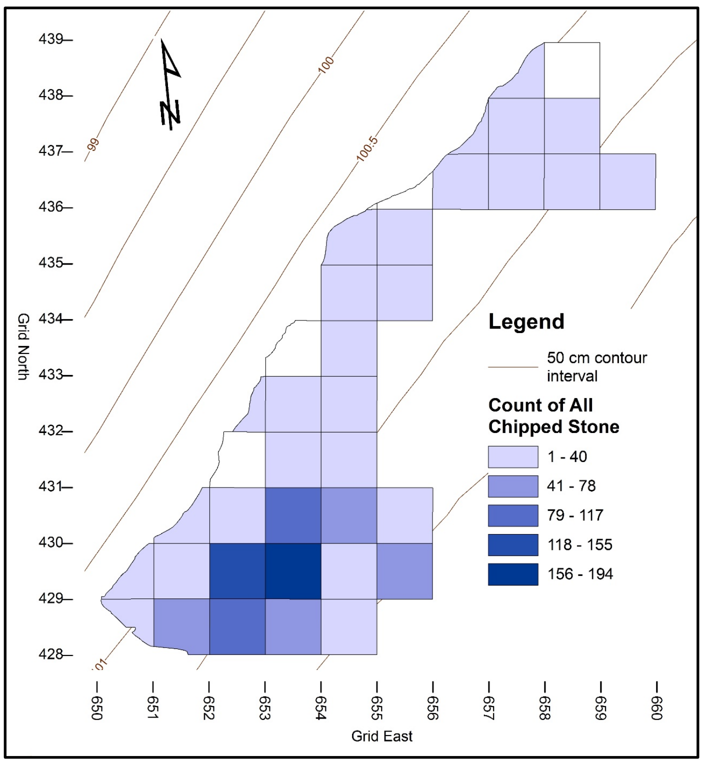

Figure 5.17. Density of chipped stone artifacts recovered from the Main Block excavations at 14SN106. Units 29O-2 (N429E652) (n = 153) and 29O-3 (N429E653) (n = 194) yielded the most artifacts. Note that four of the units, all excavated in 2004-2005, did not yield any chipped stone. This is a reminder that only 1/8" screening was employed during those years. As a result, units excavated in those years have significantly fewer artifacts.

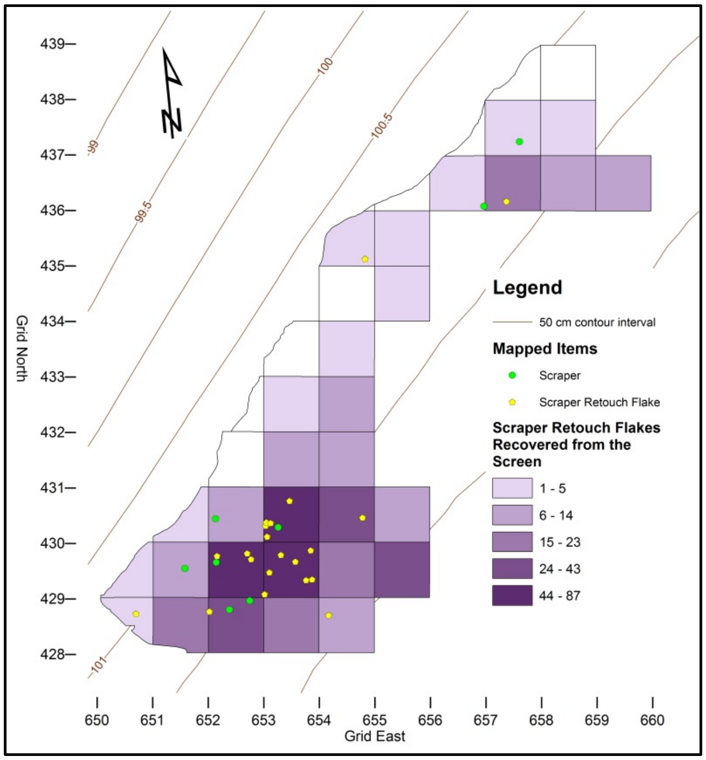

Figure 5.18. Mapped and screen recovered scraper retouch flakes and scraper tools.

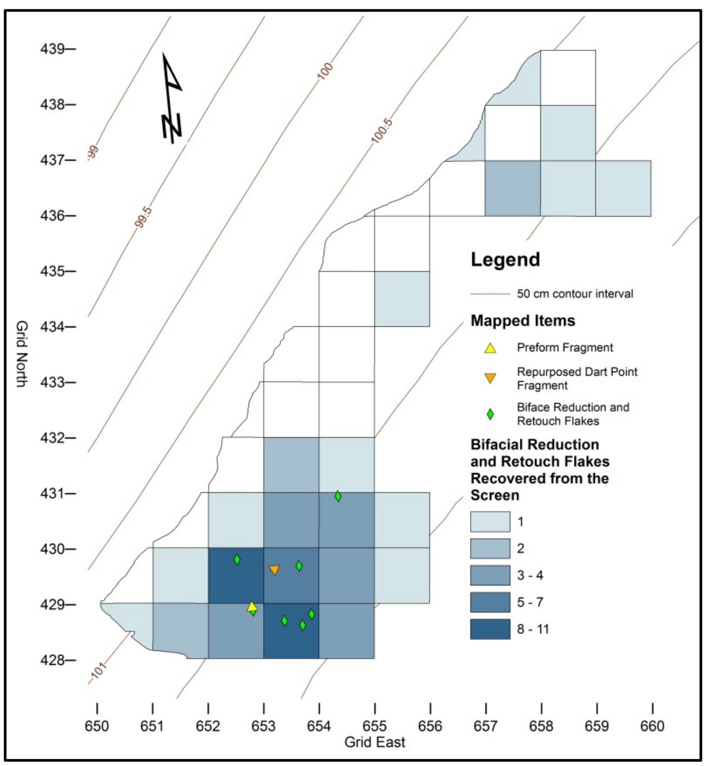

Figure 5.19. Mapped and screen recovered bifacial tools and debitage.

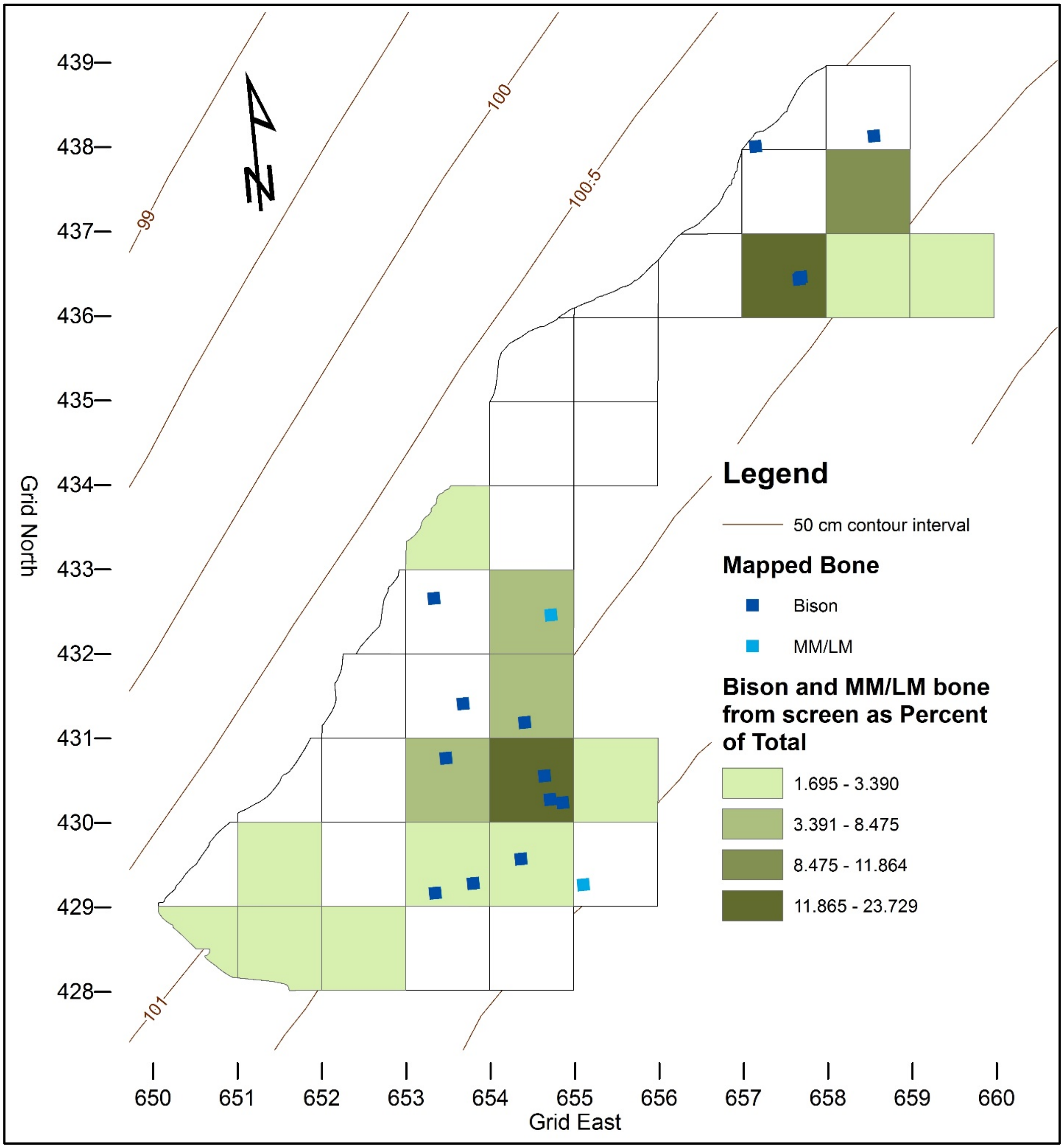

Figure 5.20. Bison and medium/large mammal bone from the Main Block screen sample and mapped items.

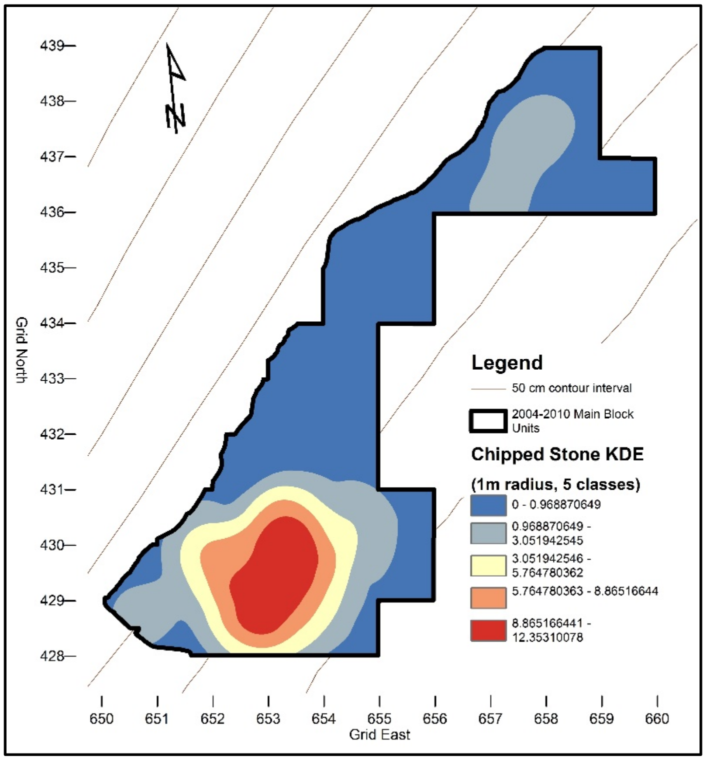

Figure 5.21. Kernel density estimates (1 m) for mapped chipped stone in the Main Block.

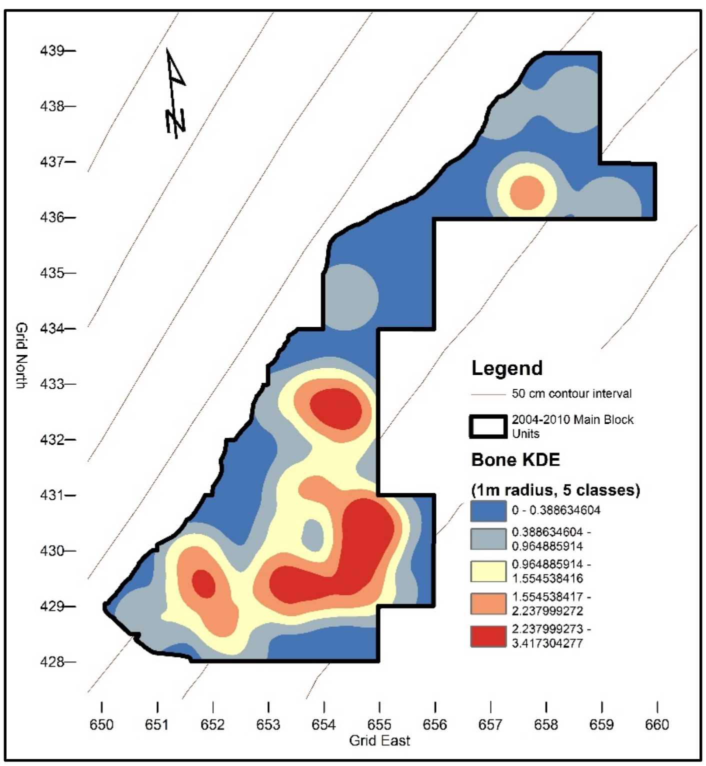

Figure 5.22. Kernel density estimates (1 m) for mapped medium mammal/large mammal and unidentified bone in the Main Block.

Discussion

The composition and clustering of the artifacts recovered from the Main Block at 14SN106, support the hypothesis this was primarily a hideworking activity area. Endscrapers and flake knives dominate the tool assemblage, and scraper retouch flakes are the most common type of debitage. Moreover, there are few artifacts from the excavations that may be interpreted as the result of other activities. A few core and biface reduction flakes were knapped, and it appears one gray quartzite core was worked while people occupied the area; however, these activities appear to be incidental.

Although there may have been reoccupation of this location, the horizontal distribution of artifacts suggests the site consists of one component that has been vertically disturbed as the result of post-depositional site formation processes. Despite this, the horizontal impacts of the disturbance appear to have been minor.

The number of artifacts from 14SN106 is relatively small: a few tools, a few pieces of debitage, and small retouch flakes make up the entire chipped stone assemblage. This assemblage indicates Paleoindian peoples were not manufacturing tools in this area. Instead, they arrived at the Main Block with their tools ready to use. While at the site they utilized endscrapers until they were dulled and resharpened them near where they were being used leaving behind debitage. As they worked in the area, people also discarded and/or lost tools. The concentration of artifacts in the southern portion of the excavation block may be the remains of an in situ resharpening location or a dump of items from the vicinity that were collected and discarded there. Given the small size of much of the debitage, if artifacts were dumped in this location they were likely knapped onto a surface; many of the small flakes would not have been recovered from the ground surface.

The small amount of large and medium mammal bone recovered from this block exhibit a pattern somewhat different from the chipped stone. In the bone KDE the densest area is east of the densest chipped stone concentration. Although this is an interesting pattern, the number of bone items is so small, it is hardly significant. Additional excavation in the vicinity of the northern bone concentration may help elucidate the distribution of bone in this area.

This Main Block area appears to have been used for a short period of time for the purpose of hideworking. Because we have not identified a hearth or evidence for any structure in this area, it is not possible to explore this relationship of the hideworking to other activity areas except to note that this area appear to have been set aside for that task. Additional exploration of the Paleoindian component of 14SN106 should expand the Main Block.

Chapter 6. Results from 41WK21

Site 41WK21, the Shifting Sands site, was discovered in June 1981 when Mr. Richard Rose observed Paleoindian-age artifacts in a series of 5-8 m deep blowouts in the Andrews Dunes extension of the Monahans Dunes system (Holliday 1997:133) (Figure 6.1). Rose has recovered more than 20,000 artifacts in a site area of 22.82 acres (92,335.36 square meters). As a result of Rose's careful artifact collection, there is an impressive amount of horizontal spatial data from the site. In addition, Rose has continued with this project for more than 30 years and has visited the site numerous times each year. As a result, his sample of artifacts is large and covers all of the area that has been exposed in blowouts since 1981 (Rose 2011b). To identify hideworking activity areas I have used a combination of lithic and spatial analysis, the results of this study are presented in this chapter; however, first an understanding of site formation processes is necessary. Site formation processes can impact the spatial patterns at sites leaving archaeologists with patterns that did not result from human action.

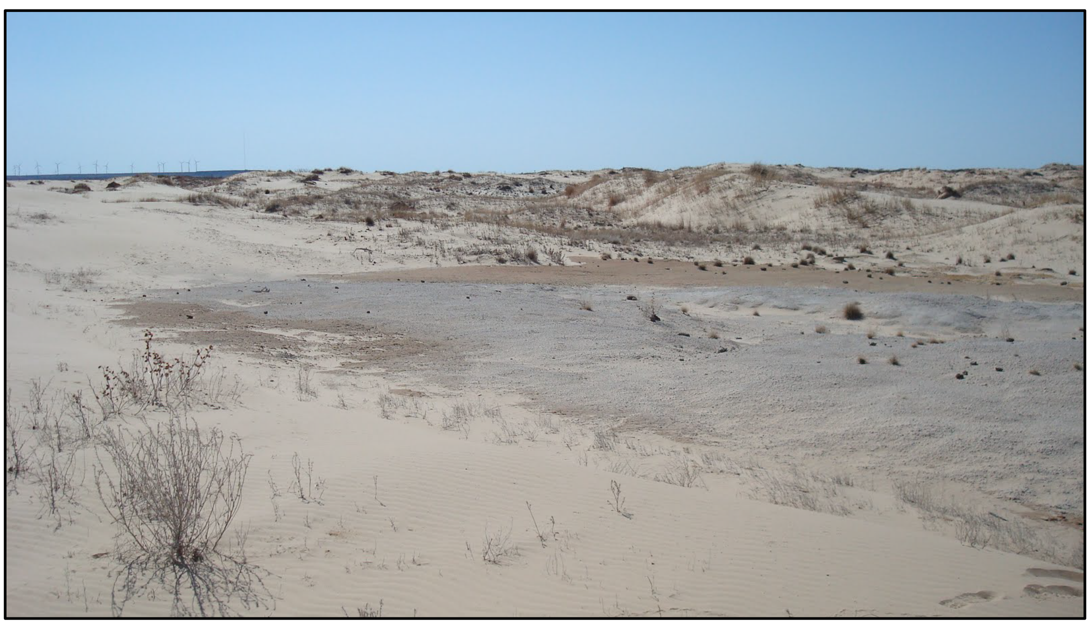

Figure 6.1. Overview of Area 6 at 41WK21. The lighter colored sediment at the base of the blowout in the middle of the image is the marl.

This setting is significantly different from the alluvial setting where 14SN106 was identified. Instead of fluvial processes, 41WK21 was buried and uncovered by eolian, or windblown, sediments. As with 14SN106, the site's formation processes must be considered in order to evaluate spatial patterning.

Site Setting

The Monahans Dunes field, where 41WK21 is located, is in western Texas (Figure 1.1). Fenneman (1931) included this area in the Pecos Section, but it is near the intersection of the Pecos Section and the Southern High Plains. Here the High Plains region extends to the edge of the Llano Estacado and the Pecos Section and encompasses the eroded areas around the Pecos River to the west (Fenneman 1931:47). More specifically, 41WK21 is in the Shinnery Sands ecoregion of the High Plains on the southern margin of the Llano Estacado (Griffith et al. 2007). This area also is known as the Pecos Plain, named for the Pecos River to the west (Rose 2011b). There are four primary dune fields on the west and southwest margins of the Llano Estacado: the Muleshoe Dunes in the north, the centrally located Lea-Yoakum and Mescalero Dunes, and the Monahans Dunes in the south (Figure 6.2).

The Monahans Dune field extends about 110 km from the southeast to the northwest and is approximately 32 km wide (Machenberg 1984:3). Many of the dunes in the Southern High Plains are stabilized; however, active dunes are found in several areas of the Monahans, including at 41WK21 (Machenberg 1984:2; Muhs and Holliday 2001:78). In 1984, approximately 300 km^2 of the Monahans Dune field was active. Significantly more of the dune field was apparently active in the nineteenth century (Muhs and Holliday 1995:203). The Andrews Dunes are a northeastern extension of the Monahans Dunes located in the Winkler Valley, a reentrant valley on the western escarpment of the Llano Estacado. Site 41WK21 is located near the center of the Andrews Dune field (Holliday 1997:129, 131; Muhs and Holliday 2001:Figure 5).

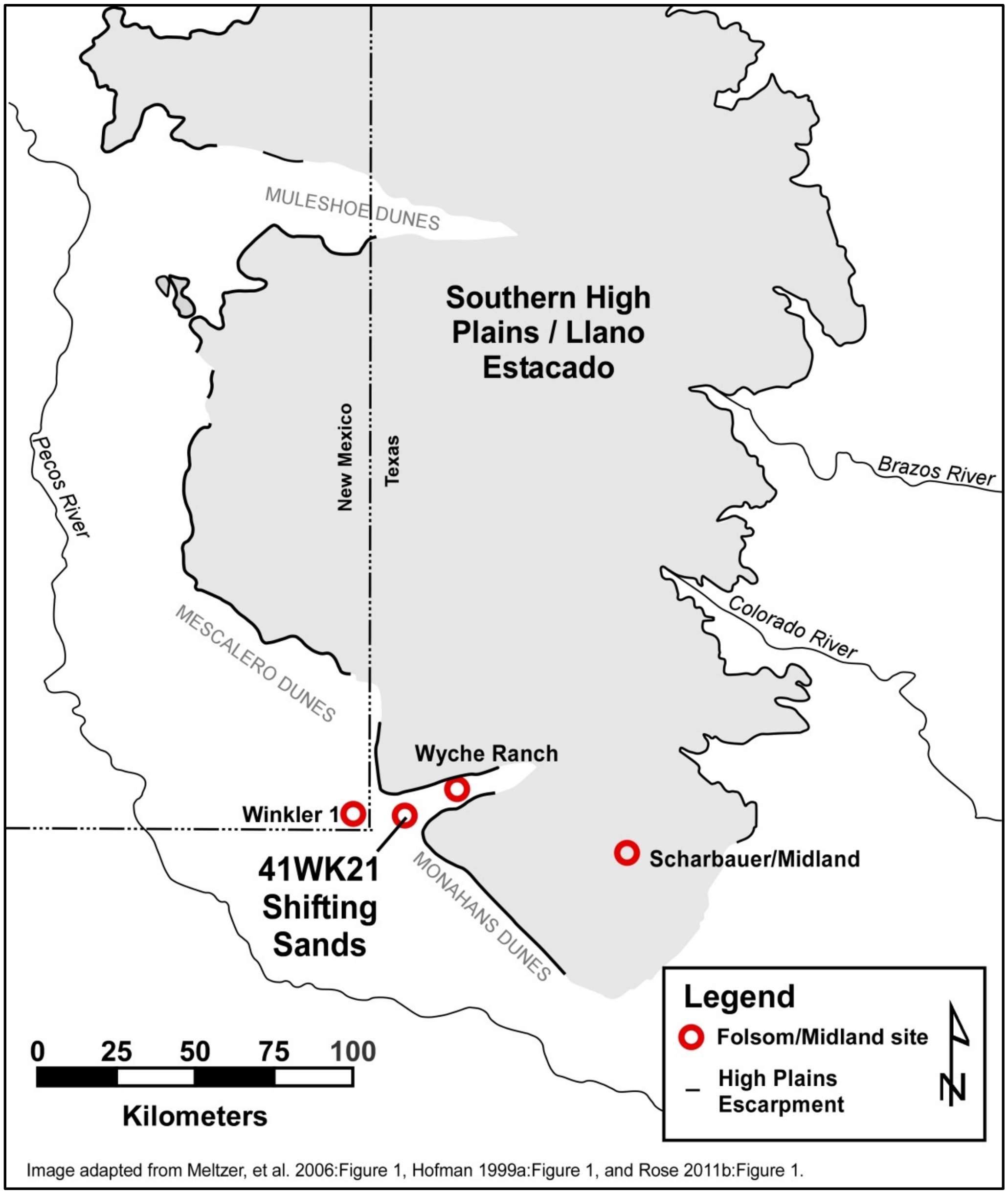

Figure 6.2. The Southern High Plains region depicting the location of 41WK21 and nearby Folsom-aged sites in dune settings.

Site 41WK21 is not the only Paleoindian site to have been recorded in a dune field. Indeed, dunes are known to contain many sites from the late Quaternary and have been considered good settings to find sites (Mayer 2002:1199; Wandsnider 1988:18; Wendorf and Hester 1962). Sites Winkler-1, Bedford Ranch, and Wyche Ranch, are all near 41WK21 in the Andrews Dune field (Holliday 1997:131-136) (Figure 6.2). Another well-known Paleoindian site, the Midland (or Scharbauer) site (41MD1) is located approximately 80 km east of 41WK21 (Hofman et al. 1990). The Midland site, which is the type site for the Midland projectile point, was identified eroding from several adjacent blowouts from a small dune field that is encroaching on Monahans Draw (Holliday and Meltzer 1996). The stratigraphy there "indicates two phases of dune construction in the Holocene, similar to the record from the Monahans-Andrews system" (Holliday 1995:303).

The Southern High Plains climate is semiarid, with low humidity, and a mean annual precipitation between 12-18 inches. The mean monthly temperature in January is 43º F and 82º F in August (Griffith et al. 2007:24; Machenberg 1984:3). Muhs and Holliday (1995) argued that the Monahans Dunes are climatically part of the Chihuahuan Desert. The prevailing wind direction of an area significantly controls the direction dunes drift. In the Monahans Dunes, wind direction is variable throughout the year. In the summer (May to October) the prevailing winds are from the southeast to the north-northwest; however, during the rest of the year, winds generally come from the southwest, west, or northwest (Machenberg 1984:15; Muhs and Holliday 2001:77). This variation in dominant wind direction means an overall reduced net drift potential. The drift potential of the Monahans Dunes is to the northeast, but it is less pronounced than in other portions of the Southern High Plains dunes (Machenberg 1984:15; Muhs and Holliday 2001:77). However, Holliday (2001:101), suggests that at 41WK21 in the Andrews Dunes, the Winkler Valley "funnels the westerly winds and produces a dominant orientation in the dunes" generally more to the east.

Although the dune field where 41WK21 is located has a small net drift potential, the activation of the dunes at the site during the past 60 years has been significant. Historic aerial images from 1954, 1970, and 1996 depict the activation of the dune field as it moves primarily in a northerly direction (Figure 6.3). In 1954, only approximately 30 percent of the site was part of the active dune field; however, by 1996, 99 percent was active dune field. Since the activation of the dunes at 41WK21, blowout areas have continued to change. We can visualize the changing size and shape of blowout areas by mapping the artifact distribution as they were uncovered (Figure 6.4). Figure 6.4 depicts the location of artifacts recovered by decade and provides a view of the blowout areas and dunes dominant movement, which is to the northeast. For example, orange and red dots, representing the years 2000-2009 and 2010-April 2015 respectively, can be seen northeast of artifacts recorded earlier in Blowout Area 2.

Vegetation on the dunes consists of shrubs, including honey mesquite (*Prosopis glandulosa*), shin oak (*Quercus havardii*), desert willow (*Chilopsis linearis*), and fourwing saltbush (*Atriplex canescens*). Mesquite belongs to the legume family and has edible seeds that grow in pods and thorns up to 5 cm (2 in) long. In deep sandy soils mesquite can grow as a decumbent or running bush, but it also grows more upright with multiple stems to heights of 3-4.6 m (10-15 ft) and can reach heights of 12 m (40 ft) with a single strong stem (Steinberg 2001). The taproots of honey mesquite trees commonly reach 12 m (40 ft) but can be much longer. In addition, they have lateral roots that can extend up to 18 m (60 ft) from the plant base (Steinberg 2001). The number of mesquite trees has increased since the introduction of livestock to Texas. Mesquite plants are present at 41WK21 today.

Shin oaks are indigenous, anchoring plants in the dune fields of the Southern High Plains. They only grow to about 1-1.2 m (3-4 ft) and produce edible acorns (Griffith et al. 2007:22;

Machenberg 1984:20). Despite their short height, shin oaks have extensive root systems (sometimes more than 20 m in length) to reach water (Machenberg 1984:20).

Grasses, yucca, cacti, and wildflowers also are present in the Shinnery Sands region (Griffith et al. 2007:23; Machenberg 1984:20-21). Varieties of grasses in the dune fields include plains lovegrass (*Eragrostis intermedia*), sand bluestem (*Andropogon* sp.), big sandreed (*Calamovilfa gigantean*), sand sagebrush (*Artemisia filifolia*), sand dropseed (*Sporobolus cryptandrus*), and panic grass (*Panicum harvardii*).

The dunes in the vicinity of 41WK21 were stabilized primarily by vegetation, which limits the sediment availability and reduces wind velocity impacts (Machenberg 1984:21; Muhs and Holliday 2001). The roots of vegetation also keep older, stabilized dunes from eroding (Machenberg 1984:21). Therefore, when vegetation is removed or diminished in this region, more sediment becomes available and the dunes become active. Blowouts occur as a result of decreased vegetation. Vegetation that stabilizes dunes is fragile and vulnerable to overgrazing, the amount of available water, and other disturbances (Griffith et al. 2007:23; Muhs and Holliday 2001).

Several types of animals make their home in the dune fields. The shin oak and mesquite offer shaded nesting locations and provides a food source for the lessor prairie chicken (*Tympanuchus pallidicinctus*). Other wildlife in the region include mule deer (*Odocoileus hemionus*), bobcat (*Lynx rufus*), coyote (*Canis latrans*), and peccary (*Pecari tajacu*) (Griffith et al. 2007:23). Insects and burrowing animals also are common. Beetles, scorpions, ants, and burrowing owls have all been documented in the Monahans Sandhills State Park near 41WK21 (Machenberg 1984). Ahlbrandt et al. (1978:Table 1) found abundant digger wasps and camel crickets and common wolf spiders in the Monahans Dunes.

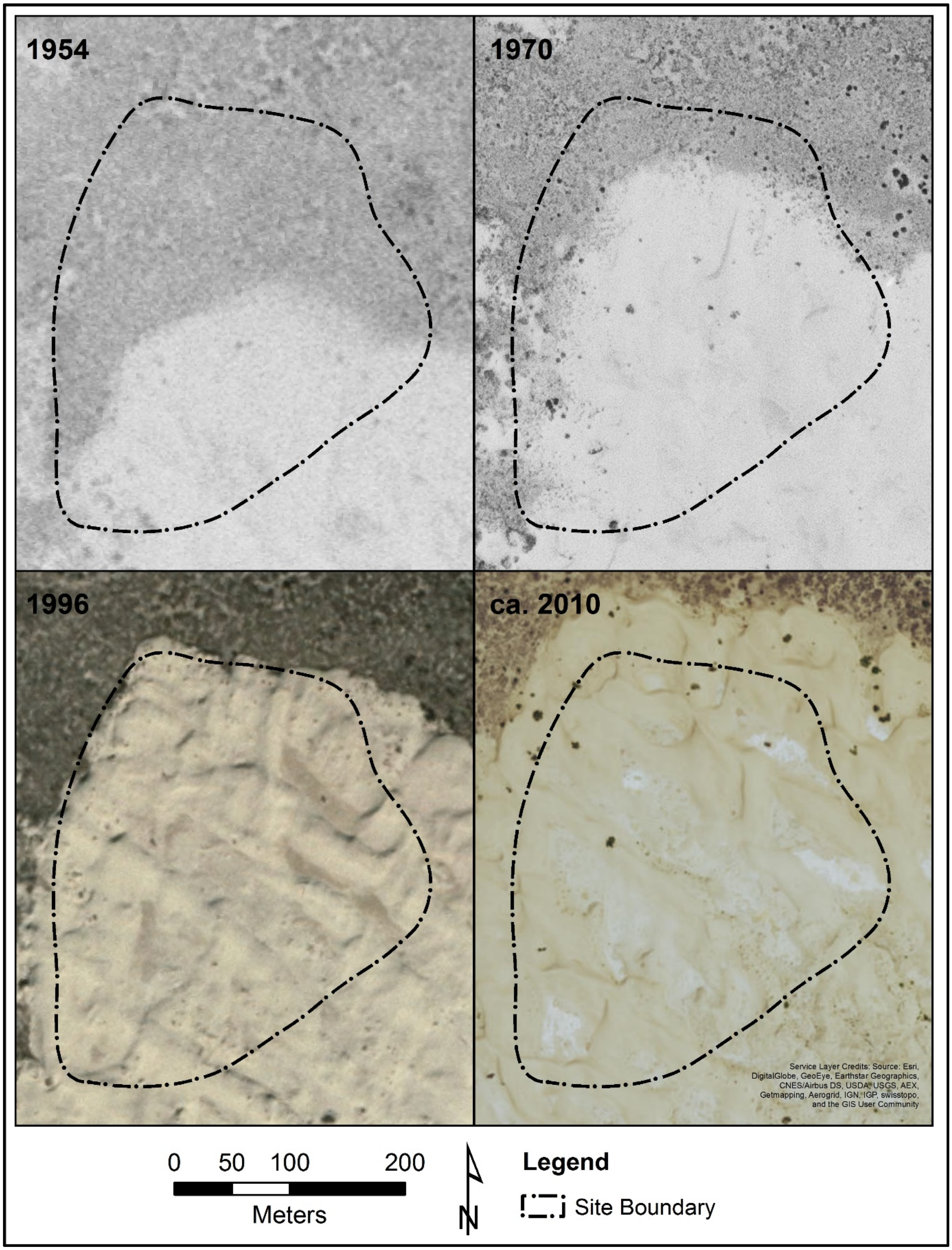

Figure 6.3. The Shifting Sands site boundary depicted on georeferenced aerial imagery showing the movement of the dune field to the north-northwest over the past 60 years. Imagery dates from 1954, 1970, 1996, and ca. 2010 (DigitalGlobe 2010; Texas Orthoimagery Program 1996; USGS 1954, 1970).

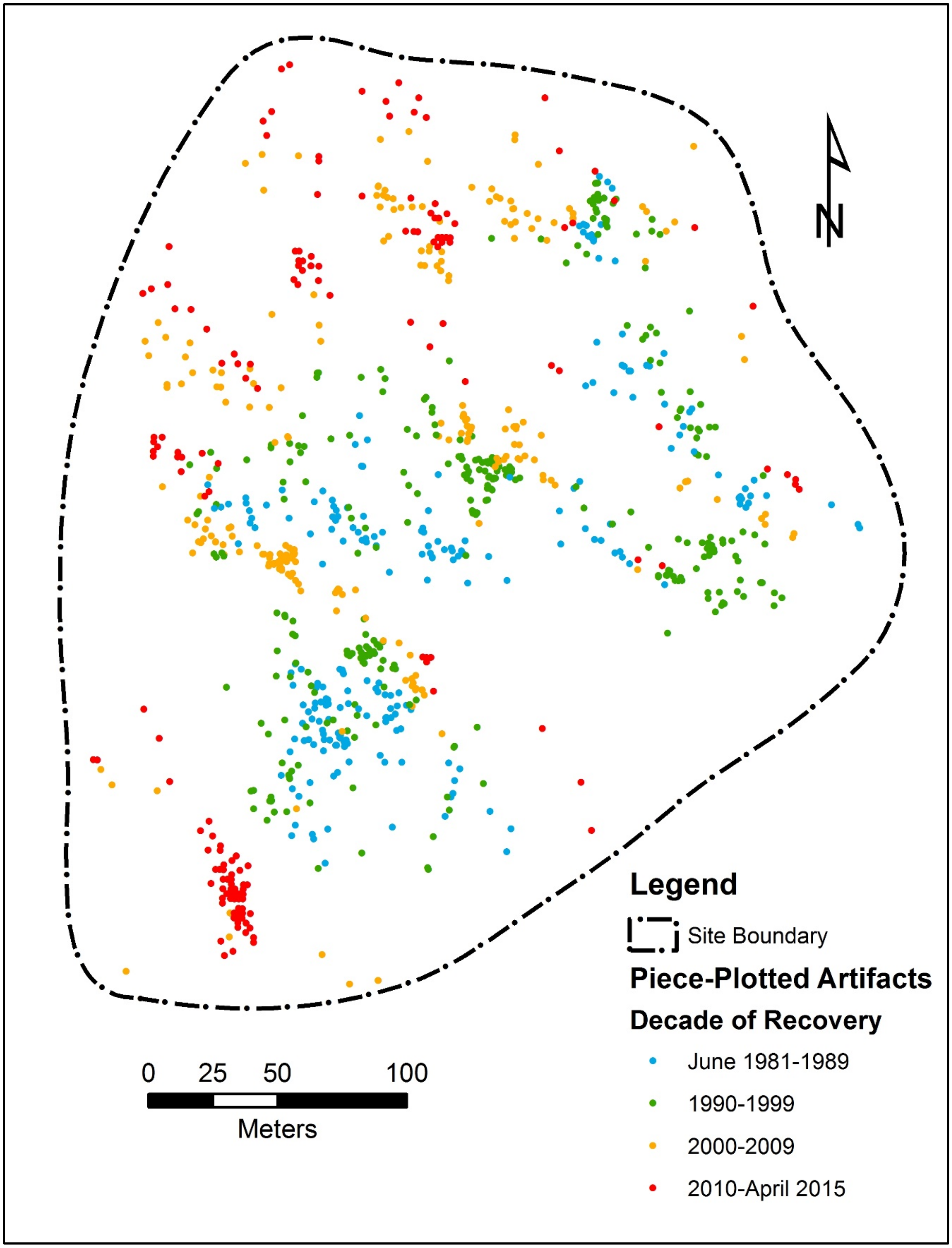

Figure 6.4. All artifacts Rose piece plotted between June 1981 and April 2015 depicted relative to the site boundary by decade.

During his many visits to the site, Rose noted that in situ Folsom-aged items were eroding from a laminated reddish clay and sandy deposit (Hofman et al. 1990:223; Rose 2011b). Subsequent study by Vance T. Holliday has identified how these deposits fit into the overall stratigraphy of 41WK21 (Holliday 1997). Holliday's work was informed by and generally confirmed Green's (1961) stratigraphic study of the Monahans Dunes area. However, not all of the nine stratigraphic units Green identified were observed at 41WK21 (Holliday 1997, 2001).

The Ogallala Formation in the vicinity of 41WK21 is overlain by the Blackwater Draw Formation and lacustrine sediments (Holliday 1997:130, 2001:101; Muhs and Holliday 2001:84). The Blackwater Draw Formation is a sandy Pleistocene eolian deposit that occurs across the Southern High Plains (Holliday 2000). Green (1961) referred to this formation as the Judkins Formation (Unit I) based on an earlier study by Huffington and Albritton (1941). Blackwater Draw Formation sediment is derived from the Pecos River valley, and the formation is the product of a long-term cyclical pattern of deposition, stability, and erosion that continues today (Holliday 2000; Rich and Stokes 2011). A lake, pond, or marsh covered the Winkler Valley vicinity prior to late Quaternary eolian sand accumulation. As a result, Blackwater Draw Formation sediments in the area are gleyed, and there is some secondary manganese accumulation (Green 1961; Holliday 1997:130).

At 41WK21, the Blackwater Draw Formation is overlain by a "noncalcareous, tan sand that grades upward into a marl" (Holliday 1997:133). Marl is an indurated sedimentary deposit that contains a large amount of clay and calcium carbonate. The tan sand and marl correspond to Green's (1961) Units IV and V (Holliday 1997:Table 3.19). The marl at 41WK21 precipitated in shallow ponds and around seeps and is consequently discontinuous (Green 1961; Holliday 1997:133). At 41WK21 it has been observed lining or ringing blowouts and in a few small hummocks in the base of the blowouts (Hofman et al. 1990:223) (Figure 6.1). Although extinct megafauna remains have been recovered from the Blackwater Draw Formation, lacustrine deposits, and marl (Green 1961; Hofman et al. 1990; Holliday 1997), no artifacts have been recovered from these layers (Rose 2011b).

At 41WK21, the marl is overlain by "compact, reddish-brown, loamy sand" (Holliday 1997:134). This layer is generally less than one meter thick and exhibits a soil (A-Bw or weak A-Bt) at its top. Green (1961) considered these sediments two units: VI and VII, but only Unit VIIb is present at 41WK21 (Green 1961:Figure 13; Holliday 1997:137). The soil indicates an old dune surface that had stabilized and allowed pedogenesis. Above the soil is a layer of interbedded eolian tan sand and reddish clay bands or lamellae up to 2 m thick (Unit VIII) (Green 1961; Holliday 1997). The clay bands are very visible when compared with the dune sands separating them (Figure 6.5). They are thin (a few millimeters to a few centimeters) and may have formed through the translocation of clays down through the dunes or, alternatively, they may reflect episodes of rainfall that stabilized the dune surfaces and allowed the accumulation of silt and clay (Green 1961:32; Hofman et al. 1990:223; Holliday 1997:135).

Figure 6.5. Interbedded sand and clay lamellae near 41WK21. The rock on the shelf above the lamellae is an in-situ chipped stone core.

Paleoindian artifacts and weathered bone occur in the lower portion of these interbedded eolian tan sand and reddish clay bands and in the soil below it (Amick and Rose 1990; Hofman et al. 1990; Holliday 1997; Rose 2011b). Rose (2011a:3), who has documented the stratigraphic location of many of the artifacts he has collected, stated: "Careful stratigraphic observation and collection of eroding artifacts from the light brownish-red laminated sandy deposit has demonstrated that this distinct stratum is largely attributable to the Folsom-Midland occupations of the site." In other words, the artifacts from this deposit consistently date from the Folsom period.

In his field notes, Rose documented if the artifact was laying on red laminate, reddish-tan, brown, or tan sand for 987 artifacts. A few additional artifacts were identified on white sand.

Of these 987 artifacts, 756 were recovered from the surface of red laminate or reddish-tan sands, confidently recovered from these interbedded sand and clay layers (Unit VIII).

An optically stimulated luminescence (OSL) (central age model) age on sediment from this unit dates it to 10,600±1,200 years ago (Feathers et al. 2006). The soil and cross-bedded deposits (Units VII and VIII) date from the late Pleistocene and early Holocene. Based on radiocarbon ages from nearby archaeological sites, the deposits began to aggrade around 11,000 ^{14}C yr. B.P. About that time the region became warmer and had less available surface water, which led to less vegetation and a destabilization of the landscape (Holliday 2000:7). This "Folsom Drought" was widespread between about 10,900 and 10,200 ^{14}C yr. B.P. and eolian sedimentation was significant (Holliday 2000:7). Rich and Stokes (2011:235) also determined that sedimentation was occurring in the Monahans Dune field during the Folsom period. It seems unlikely that humans would have occupied fully active dune fields (see Mayer 2003), and Holliday (1997:135) found no obvious attractions for humans to the Andrews Dunes during Folsom times. On the other hand, it is likely the 41WK21 region had interdunal ponds that may have attracted both bison and humans, and blowouts are known to have been used as bison traps (Amick and Rose 1990:3; Frison 2004:76-79, 2013:12; Jodry 1999; Wheat 1971).

Overlying Unit VIII are Holocene dune sands, which are more than 5 m thick. These sediments were assigned Unit IX by Green (1961). Through mineralogy and geochemistry, Muhs and Holliday (2001:82) discovered that most late-Holocene dunes in the Southern High Plains were created from locally derived sediment from the Blackwater Draw Formation, not the Pecos River valley as had been assumed. This means that when vegetation was removed from areas of the Blackwater Draw Formation, sediment was eroded from its surface by wind and became additional sediment for dune formation (Muhs and Holliday 2001). Rich and Stokes (2011) found that this sedimentation happened in several episodes throughout the Holocene.

Site Formation Processes and Implications

Site 41WK21 was discovered in a blowout in an active dune field. Eolian forces are the most obvious and the most significant site formation processes at the site. Eolian processes affected the site prior to burial and again as the artifacts were exhumed, but wind is not the only natural process to have affected the site. Several other processes, including alluviation, mass wasting, cryoturbation, argilliturbation, and bioturbation, also are considered here. A discussion of anthropogenic site formation processes such as trampling and collecting also is pertinent to a discussion of 41WK21.

Because the site is in a dry climate it is unlikely to have been significantly altered through alluvial processes. Ponds are known to form between dunes and in heavy rainfall events temporary streams can form. However, the sediments at 41WK21 do not indicate ponded water, and intermittent streams would be localized. Water may affect a site by moving smaller artifacts downstream. At Shifting Sands, artifacts of various sizes are intermixed. There is no evidence of size sorting created by alluvial processes.

When they are found "in situ," artifacts from 41WK21 are consistently found in the same stratigraphic position. However, because most of the artifacts from the site have eroded out of place, it is difficult to determine the angle of the slope on which they rested. The cultural materials were buried by eolian sand shortly after deposition, and mass wasting probably did not affect them. In southwest Texas, the depth of frost penetration is only 12-25 cm (see Wood and Johnson 1978:Figure 9.9). Because 41WK21 was buried under about 5 m of sand and is in an arid location, we can safely exclude cryoturbation as a significant formation process. The deposits containing the Folsom-Midland artifacts are loamy sand, and they are overlain by alternating bands of sand and clay. The clay is not sufficient to have affected the cultural deposits through argilliturbation.

Bioturbation, chiefly from arthropods (although some larger animals also are present), must have occurred at 41WK21 (Figure 6.6). In dune settings, bioturbation may be caused by extensive root systems and by burrowing animals, including beetles, crickets, and digger wasps (Machenberg 1984:24).

Figure 6.6. Wildlife observed at 41WK21 during one visit on March 21, 2010.

Extensive root systems are needed for plants to reach and gather the water they need to survive in dry environments (Figure 6.7). Hence roots can extend great distances and may disturb sediments and artifacts. Roots extend both vertical and horizontal into sediments and can completely destroy sedimentary structures (Ahlbrandt et al. 1978:846). Since roots decay, archaeologists must look for root molds and casts to identify potential root disturbance. We cannot identify the telltale signs of bioturbation in many parts of 41WK21 because the sediment that once surrounded the artifacts has been removed through deflation.

Figure 6.7. A mesquite tree at 41WK21 after wind erosion has exposed approximately 61 cm (2 ft) of the roots. Richard Rose is in the foreground.

While the site was occupied, and for some time thereafter, humans and other animals likely trampled the cultural materials at 41WK21. In sandy sediments, artifacts may be easily buried by trampling and breakage also can occur. The vertical integrity of artifacts that were buried due to trampling was compromised, and some kicking and movement on the surface is expected. This horizontal movement is concerning and not very predictable, but the vertical integrity was further compromised later, so the effect of trampling on the vertical integrity at this site is a moot point. Therefore, we conclude that trampling likely had an effect on the lateral movement of artifacts at 41WK21, especially as high dunes may have had defined pathways, which were heavily traveled.

Rose has visited 41WK21 several times each year since its discovery; this is important for the preservation of horizontal integrity of artifacts. He is able to record the horizontal provenience of artifacts shortly after they are exposed. If the artifacts were left on the surface, they may be further disturbed by wind and trampling prior to collection.

As described above, 41WK21 has been greatly affected by eolian processes. Wind was likely a factor prior to burial, during burial, and in exposing the artifacts. The distance cultural materials may have been displaced by wind is impacted by the time that elapsed between when the cultural materials were deposited and when they were buried. Wind is only known to transport small artifacts, but since small pieces of chipped stone are common at 41WK21 its impact is relevant. For example, approximately 25 pieces of debitage less than 1 cm in maximum dimension were collected during a short site visit in 2010, and a tiny disk-shaped bone bead has been collected from Blowout Area 6 at 41WK21 (Hofman et al. 2000). Eolian processes at 41WK21 were not strong enough to remove the small artifacts but it may have moved them. Based on her experiments, Wandsnider (1988) concluded that if a site is buried relatively quickly it is unlikely that wind action prior to burial significantly moved the items horizontally (Wandsnider 1988). It appears that once the site was buried by eolian sand it was not uncovered again until recently. If it had been exposed and reburied we would expect to see "in situ" artifacts already laying on a deflated surface. Instead they have been observed in the soil and bands of sediment above the deflation-resistant surface.

Deflation removes the matrix from around artifacts and leaves behind artifacts on a lower lag surface. This process destroys a site's vertical stratigraphy and, at multicomponent sites, mixes the components. The vast majority of the artifacts collected form 41WK21 are from one or few Folsom/Midland components. Only five Later Prehistoric diagnostics have been found at the site, and all of them were in the Holocene dune sand (Rose 2011b:301). Additional evidence that the artifacts are Paleoindian in age is the patination on the Edwards chert at the site. Patination of Folsom/Midland artifacts at 41WK21 is variable as some are heavily patinated while others do not appear patinated at all; however, the patination is commonly only on one surface. Some instances of refits have been between patinated and not patinated artifacts. This indicates that some materials were exposed on the surface for an extended period. This period may have been either before their initial burial or as a result of being exposed at some point prehistorically. Recent artifacts from the site do not exhibit the same patination that some of the Folsom/Midland artifacts exhibit. Therefore, we interpret the artifacts from the site to be Paleoindian in age; but, if multiple Paleoindian components are present at 41WK21, that information will be extremely difficult to determine.

The extensive refitting evidence from 41WK21 supports the interpretation that the majority of the artifacts are from one or few Folsom/Midland components. More than 120 refit sets have been identified in the 41WK21 assemblage. Although many of the refits consist of two or more artifacts from the same blowout area, approximately 15 of these linkages have been identified that link blowout areas together. All of the blowout areas have been connected to at least one other blowout area through refits. The refitting data suggest the whole 41WK21 site area was occupied at the same time (Rose 2011b).

Site 41WK21 has been collected as artifacts are naturally eroded out of their context or naturally exposed. Very limited excavation has taken place at the site. This has both advantages and disadvantages. The significant disadvantage is a loss of vertical integrity. The advantage is that artifacts have been collected from a large area with minimal manpower. The most transformative site formation process at 41WK21 is eolian. However, it is unclear the extent of disturbance this process has had on the horizontal integrity of the site. Because the horizontal proveniences of many of the artifacts have been recorded, the potential to examine patterning at this site and make conclusions about disturbance, as well as human behavior, remains.

The Artifact Assemblage at 41WK21

More than 27,600 artifacts were recovered from 41WK21 between its discovery in June 1981 and April 2015. This includes approximately 26,472 pieces of non-diagnostic debitage and 1,168 tools and channel flakes. The vast majority of the tools are chipped stone; however, some ground stone tools and hematite also have been recovered (Rose 2011b:Table 1). In addition to these artifacts, some bone fragments, one bone tool, and a single bone bead (Hofman et al. 2000; Rose 2011b) have been collected from the site. The chipped stone artifacts from 41WK21 are nearly all made of Edwards chert; the remainder of the assemblage includes items of quartzite and chalcedony. Edwards chert sources are east of 41WK21, which ties the site occupants to the east for procurement of lithic material. The pattern for Folsom era people to transport Edwards chert west (and north) is common; therefore, it is unsurprising that so much of the material is present at 41WK21 (Hofman 1999b).

The majority of the tools and some debitage from 41WK21 have been mapped. A total of 961 mapped artifacts were recorded in Rose's notes. Of these, seven are red ochre, 21 are faunal items including bone and teeth fragments, 20 are ground stone and red ochre, and 913 are chipped stone artifacts. Problems with a few of these items precluded their mapping, but a total of 958 artifacts, two bonebed areas, and a single hearth were mapped based on Rose's notes (Figure 6.8).

Mapped chipped stone items (n = 911) include some debitage, but are primarily tools. A range of tool types are represented, including, but not limited to bifaces, combination tools, knives, scrapers, and utilized flake tools (Table 6.1). The distribution of these artifacts is depicted in Figure 6.9.

Table 6.1. Mapped chipped stone artifacts from 41WK21 (n = 911).

Artifact Type	Count
Biface	31
Burin	6
Channel flakes	68
Chopper	3
Combination Tool	7
Core	8
Debitage	109
Endscraper	156
Gouge	2
Graver	64
Knife	5
Point and preforms	230
Radial break tool	6
Side scraper	21
Spokeshave	2
Ultrathin	8
Uniface	16
Utilized flake tool	169

Endscrapers

A total of 217 complete and fragmentary endscrapers have been recovered from 41WK21. This number includes eight items that are part of refit sets that together make up an endscraper. Therefore these eight are removed and a total of 209 endscrapers are represented in the assemblage. The majority of these tools, n = 153, were piece-plotted; 56 were not mapped. In addition, a second piece of some refits also was mapped. Of the 56 endscrapers that were not piece-plotted, 14 had only provenience that the artifact came from the site. Most of these (n = 12) were artifacts that Rose documented in another person's collection from the site.

Table 6.2 summarizes the general blowout area location of all 217 complete and fragmentary endscrapers from the site. Blowout Areas 2 and 3/3A have each yielded nearly 50 endscrapers. This basic enumeration of endscrapers and other chipped stone tools led researchers in 1990 to suggest Blowout Areas 2 and 3 were locations where kill/butchery and tool manufacture and retooling took place and the other areas were locations of hideworking (Hofman et al. 1990:235). Alternative interpretations are discussed in depth below.

Table 6.2. Count of complete and fragmentary endscrapers recovered from 41WK21 by blowout area.

Blowout Area	Endscrapers (count)
2	49
3/3A	47
3B	9
4	15
5	32
6	22
7	29
Unknown	14
Total	***217***

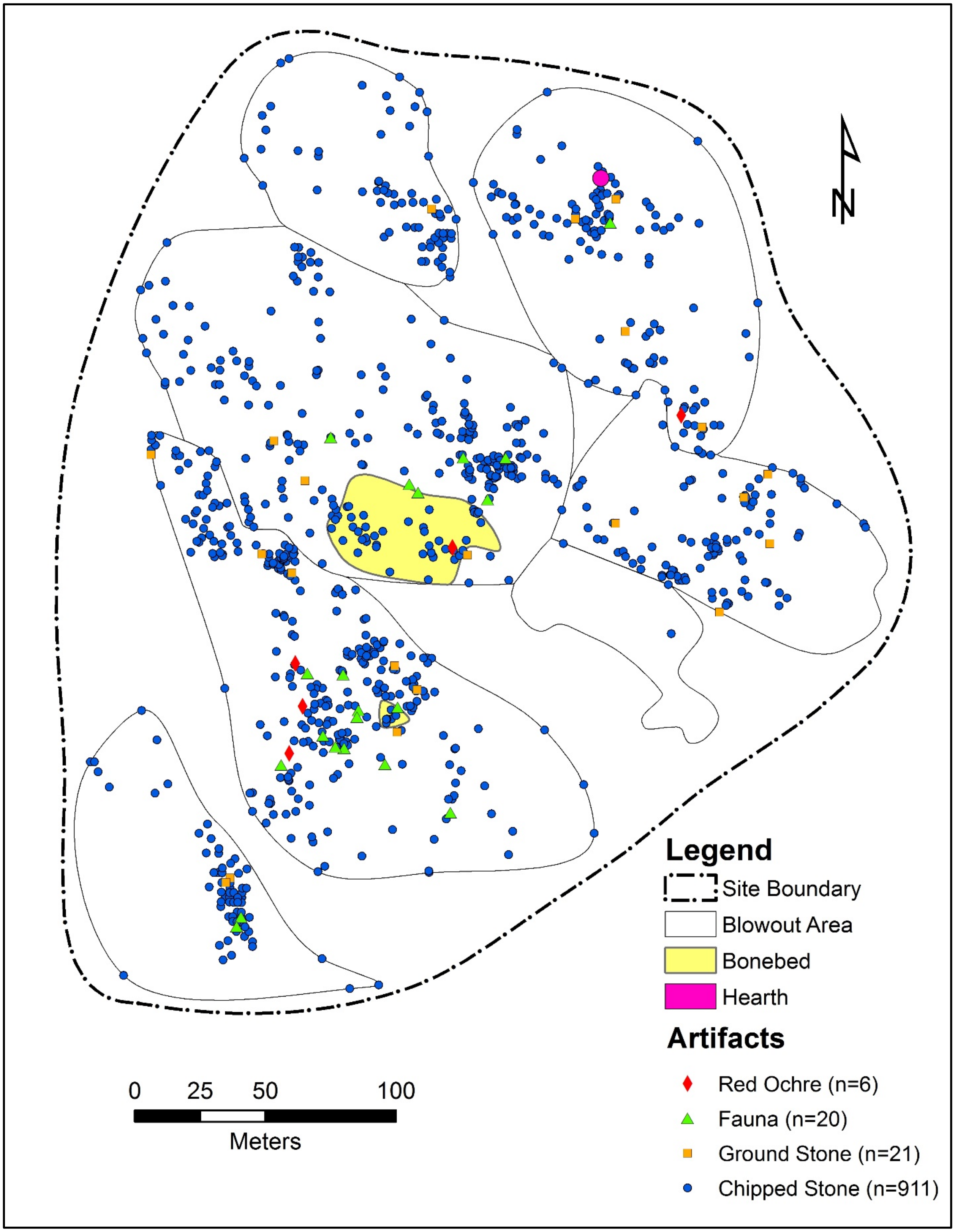

Figure 6.8. Map of the Shifting Sands site depicting the piece-plotted artifacts (n = 958) by material and the features (a hearth and two bonebed areas) mapped by Rose.

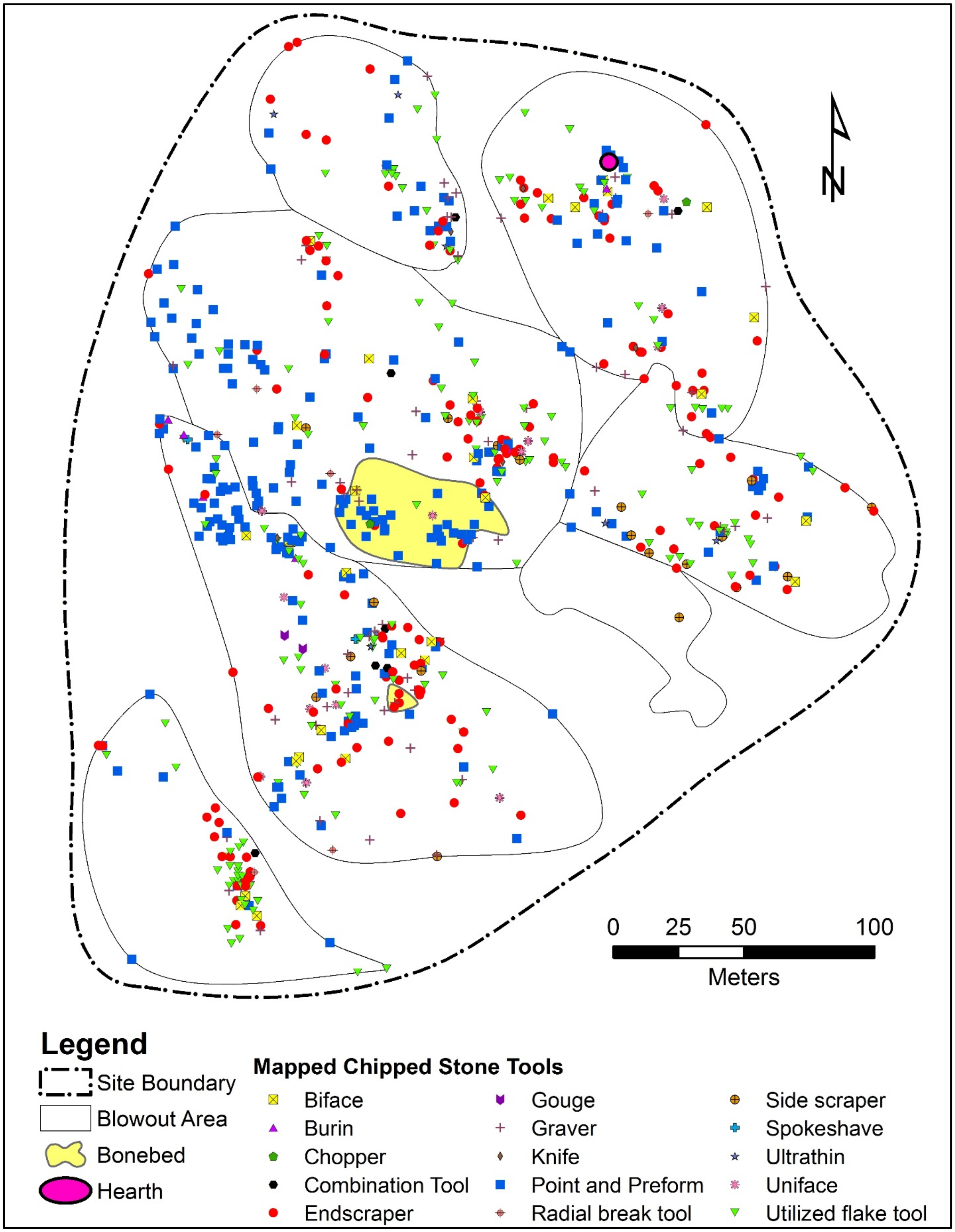

Figure 6.9. All mapped chipped-stone tools depicted by type.

Basic attribute analysis has been accomplished on 197 endscrapers, 147 of the mapped items and 50 of the others. Approximately 80 percent (n = 161) of the analyzed endscrapers are complete. The others are either proximal (n = 22) or distal fragments (n = 14). Distal endscraper fragments are perhaps most likely to be found where the scraper was in use and broke; whereas, proximal fragments may be found where the item broke, or where retooling took place. Complete endscrapers may have been exhausted or lost where they were being used or where they were retooled. In some cases use and retooling may have occurred in the same location. At 41WK21, distal fragments are few in number and found throughout the site area (Figure 6.10). No distal fragments are found near the hearth, and only one was mapped west of the bonebed, where few scrapers were found overall. Slightly more distal fragments were identified near the small bonebed and the southern endscraper concentration than elsewhere. Proximal endscraper fragments also were recovered from across the site area.

Similarly to the rest of the chipped stone assemblage, endscrapers from 41WK21 are overwhelmingly made on Edwards chert; only eight items were made of quartzite and chalcedony. With exposure to UV light, Edwards chert can become patinated, and 75 of the Edwards artifacts in this category exhibited patina on one or both sides.

Maximum length, width, and thickness measurements were taken for the analyzed artifacts. All specimens were measured, but measurements on incomplete artifacts were not included in analyses. Complete measurements of length, width, thickness, and weight were used to determine the descriptive statistics for endscrapers presented in Table 6.3. In general, these results indicate the endscrapers at 41WK21 are slightly larger and heavier than those at the Rio Rancho and Cattle Guard Folsom sites (Jodry 1999:Table 32; Ruth 2013:Table 9.8).

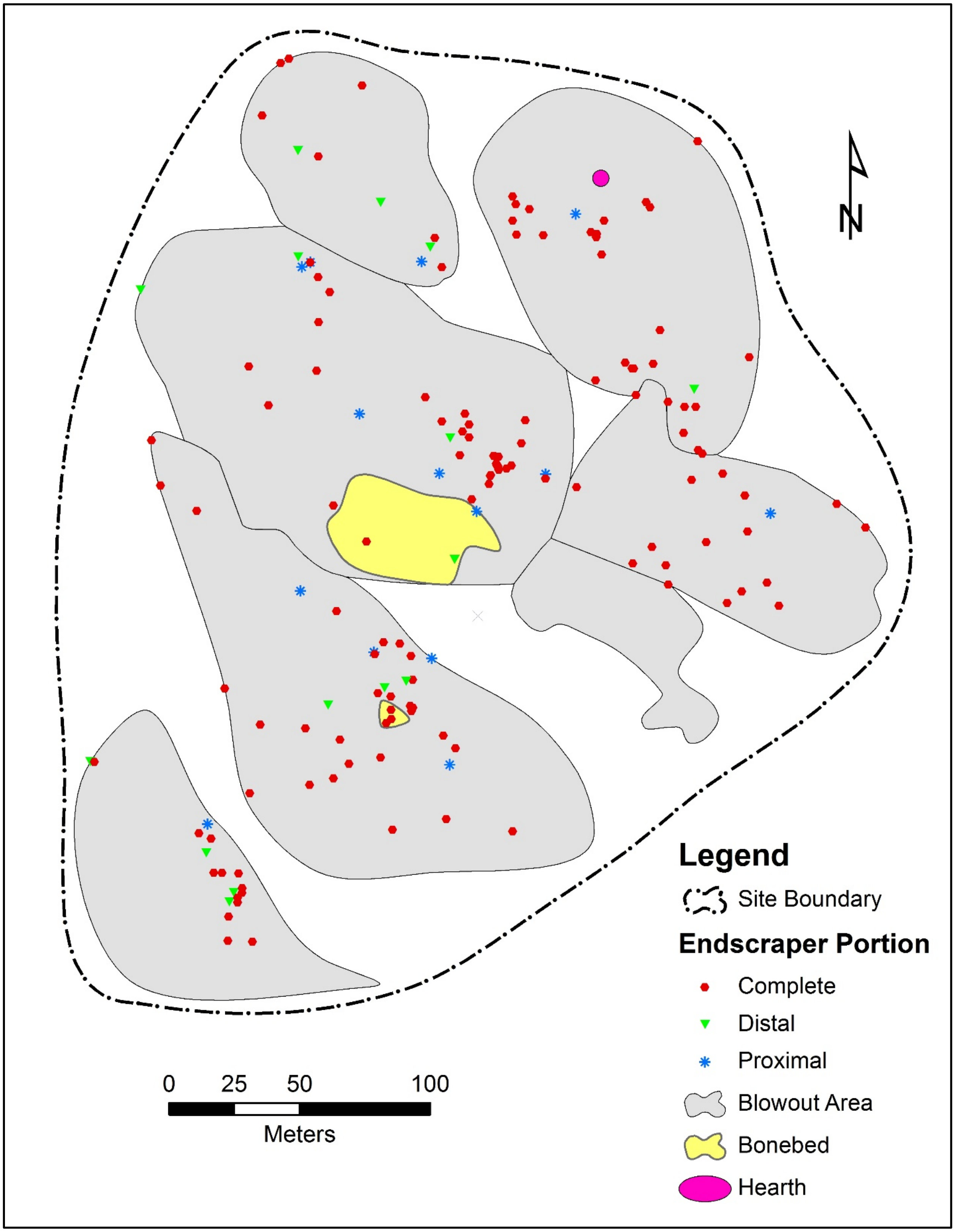

Figure 6.10. The distribution of endscrapers mapped at 41WK21 by portion and blowout area.

Table 6.3. Measurements of endscrapers from 41WK21.

Variable	Count	Range	Mean	Standard Deviation
Length (mm)	162	21.91-88.94	37.40	14.91
Width (mm)	168	18.22-53.63	31.93	6.13
Thickness (mm)	156	3.71-21.05	8.37	2.94
Weight (g)	99	2.90-54.00	13.67	10.47

In the 41WK21 assemblage, length is the attribute with the largest range and standard deviation; this is not surprising as it is the attribute that changes the most during the life of endscrapers. The longest endscraper from 41WK21 was nearly 89 mm, and this is likely its approximate original length. With each resharpening, the length of a scraper decreases about 2 mm, but the width and thickness vary less (Morrow 1997:78; Shott and Weedman 2007; Sahle et al. 2012). Over 90 percent (n = 148) of the endscrapers from 41WK21 entered the archaeological record when they were between 20 and 50 mm long, and the majority of those were discarded when they were between 30 and 40 mm long, presumably at the end of their use life (Figure 6.11). Boyd (2015) recorded similar results with complete endscrapers from 41WK21. Most of the endscrapers were hafted; it is not surprising that there would be some variation in when the end of a usable tool occurs because of different hafts. The 8.6 percent (n = 14) endscrapers that are more than 50 mm long are assumed to have been lost prior to the end of their use life.

Rose recorded the blowout areas of 149 of the complete endscrapers and 13 of the >50 mm long endscrapers. I have examined from which blowout these larger (>50 mm) endscrapers were recovered. Blowout Area 2 has the most of these tools (n = 4), as well as the most endscrapers overall (n = 36). Areas 3/3a, 3b, 4, 5, and 6 each have one or three of these larger artifacts. None of the >50 mm long endscrapers were recovered from Blowout Area 7. If these longer artifacts were lost during use, we can assume hideworking took place in each of these areas. Blowout Areas 4 and 7 have the highest percentages of the shortest endscraper length category (20-30 mm). It appears endscrapers in these areas were used intensively until their use life was exhausted.

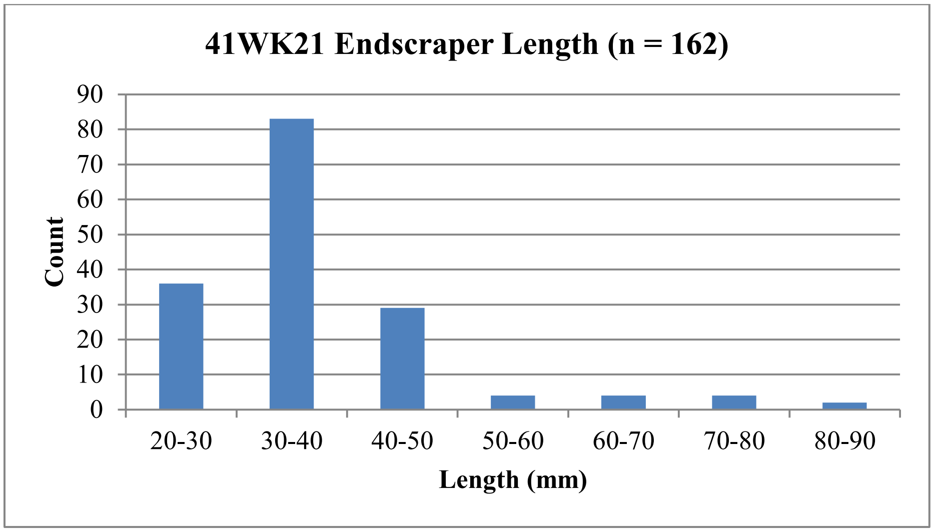

Figure 6.11. The number of complete endscrapers recovered from 41WK21 by length category.

Some researchers have described "thick" and "thin" scrapers from Paleoindian sites, but a review of the data from 41WK21 indicates this distinction is not recognizable in the distribution of thickness measures at the site (Figure 6.12). The majority of the scrapers are between 20 and 40 mm wide and 5-10 mm thick and no bimodal distribution is present.

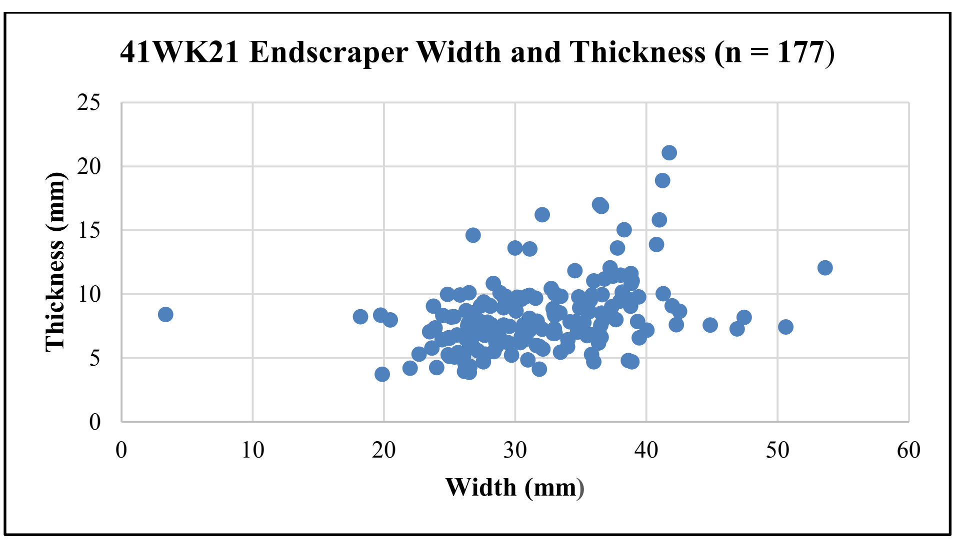

Figure 6.12. Scatter plot of thickness and width of endscrapers with both measurements (n = 177) from 41WK21.

As described in Chapter 5, spurs on the distal lateral edges of endscrapers were created intentionally and sometimes used as gravers. Of the 175 endscrapers that retain a distal end, 121 (69 percent) exhibit one or more spur. The remaining 54 (31 percent) do not have any spurs. Most of the spurred endscrapers have only one spur, some have two, and one has three. The third spur may have been incidental as the user attempted to create a notch on the lateral edge of that artifact, or it may have been an intentional third spur.

Thermal alteration was observed for 184 specimens and only six (3.3 percent) exhibit any evidence of thermal alteration. Given this low incidence of burned endscrapers, it is likely the thermal alteration was incidental, perhaps a result of endscrapers located near hearths at the time they were discarded. The presence of cortex is recorded for 185 endscraper specimens. The majority of them (n = 138, 74.6 percent) do not have any cortex. Of the 47 that did exhibit cortex, seven only have cortex on the platform.

Outline morphology has been recorded for 131 of the complete endscrapers from the site. They are classified using the types in Morrow (1997:Figure 2): triangular, tapered, parallel-sided, convergent, irregular, and double-ended. In the 41WK21 assemblage, triangular shaped endscrapers are the most common (n = 87), tapered (n = 25) the next most common, followed by parallel-sided (n = 12). Irregular, double-ended, and convergent scrapers are represented by three, two, and two endscrapers respectively. Figure 6.13 depicts a variety of outline morphologies for Edwards chert endscrapers from Blowout Area 5 at the site.

Figure 6.13. A variety of outline morphologies are present in the Edwards chert endscraper assemblage from 41WK21. This image depicts triangular (numbers 527, 5133, 5147, 5163, 5131, 52, 53, 5141, 5122, and 524), parallel-sided (513, 54, and 5172), tapered (515 and 523), convergent (526) scrapers from Blowout Area 5.

In the sample of endscrapers where blank type could be determined, amorphous core flakes are the most common. Core reduction flakes are determined to be the blank for 55 endscrapers, biface thinning flakes for 38, and blades for eight. In addition, one tool was made on a biface. This information was either not recorded or is indeterminate for the other endscrapers.

Seven of the 41WK21 refit sets include endscraper fragments (Table 6.4). These refits sets are all made up of two (n = 5) and three (n = 2) artifacts. Two of the endscraper fragments are piece-plotted for three of these refits (Figure 6.14); the other refits are not mapped or only one piece of it is mapped. Two of the refitted endscrapers extend across blowout area boundaries. A fourth refit set, Number 87, which consists of a scraper and a flake from which it was removed also is depicted on the endscraper refit map (Figure 6.14). The average refit distance for the four endscraper refits depicted on Figure 6.14 is 98.85 m.

Table 6.4. Refit Sets from 41WK21 that include endscrapers.

Refit Set Number	Specimens	Refit Distance (m)
8	294a/294b	NA
45	635/2195/2244	194.25
66	258/2292	NA
70	3175/3212/3217	39.03
85	313/6154	122.32
87	5129/5178	39.8
88	3195a/3195b	NA

Refit Set 70 consists of three artifacts, two of which are visible in Figure 6.15, the third piece of the refit (Specimen 3175) is a small sliver that broke off the proximal end (Specimen 3212). It appears that the right lateral edge of this endscraper was originally the working edge; however, at some point the artifact was radially broken and the orientation of the artifact changed 90 degrees. This endscraper may have been in the process of manufacture when it broke. Using the final orientation, the proximal end (Specimen 3212) broke and was abandoned then the left lateral edge of the distal end (Specimen 3217) was reworked, presumably for the haft. After this the artifact would have been used, resharpened, and eventually abandoned. Both manufacture and discard of this tool took place in Blowout Area 3, only approximately 40 m from one another.

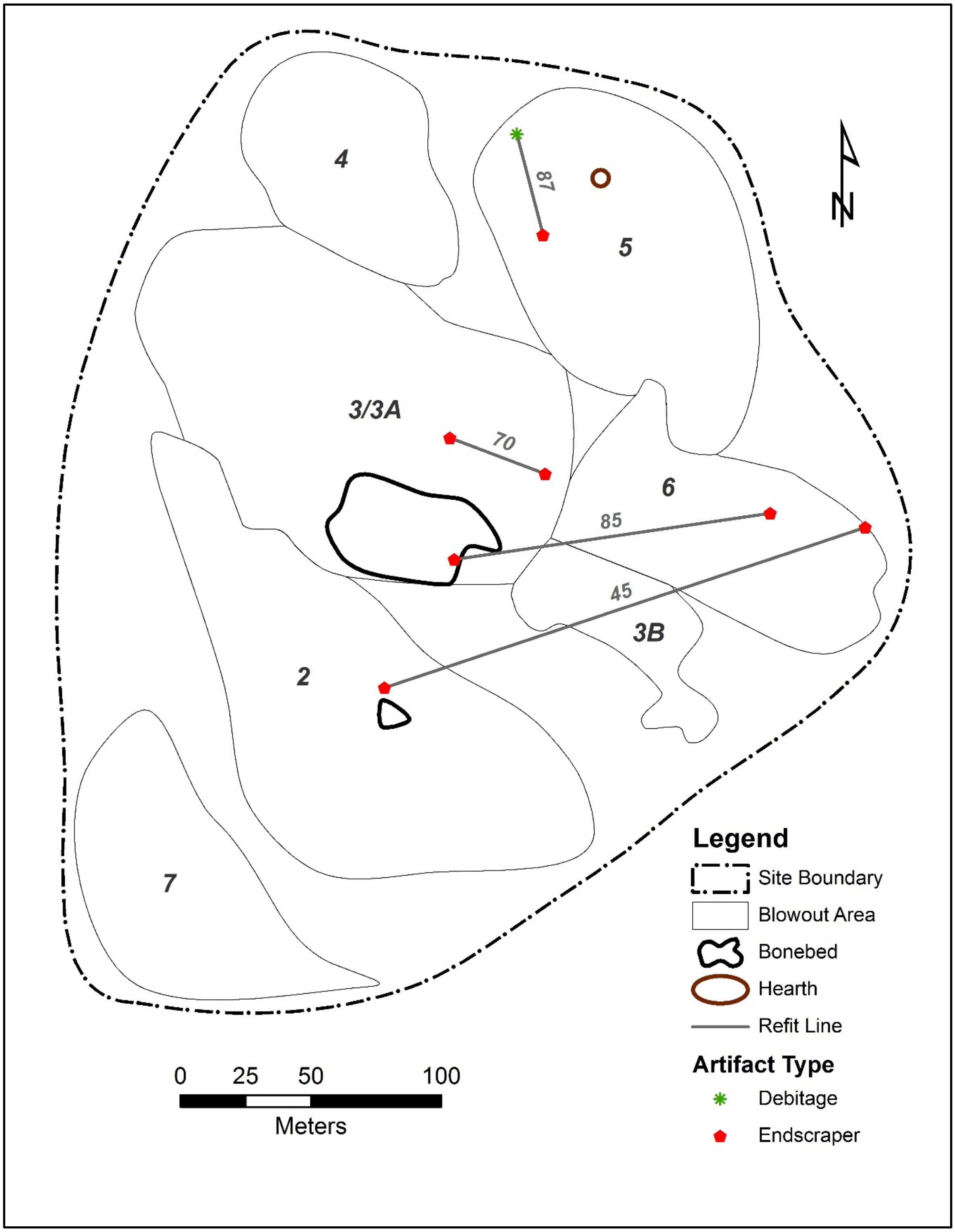

Figure 6.14. Four endscrapers have been refit, three to other portions of the scraper and one to a piece of debitage. These refit sets (45, 70, 85, and 87) are depicted in this map.

Figure 6.15. Photograph of Specimens 3212 and 3217, Refit Set 70. Inset is a close-up of the post-breakage retouch along the left lateral margin on Specimen 3217.

Refit Set 87 is an endscraper (Specimen 5129) and a flake (Specimen 5178) from which it was removed before it was made into a tool (Figure 6.16). Cortex is visible on both of these specimens; battering and striations were noted on the cortex and it appears this core experienced some damage during transport or prior to reduction. This damage may have been either incidental or from use. Unlike most of the endscrapers from 41WK21, this scraper does not appear to have been modified to fit in a haft and may have been handheld. If so, the cortex along the left dorsal may have served as backing.

Figure 6.16. Photograph of Refit Set 87 (Specimens 5129 and 5178).

Debitage

Rose (2011b:301) has reported that his 41WK21 collection includes more than 20,400 pieces of debitage. Rose, Jack Hofman, and I examined 9,693 pieces of debitage that are not cataloged but sorted by blowout area and collection year. Another 219 pieces of debitage are included in Rose's field notes and assigned a number; however, only 180 of those also are piece-plotted and displayed on maps.

The sample of debitage examined includes nearly half (n = 9,912) of the total debitage collected from the site. We sorted all of the debitage collected between May 2010 and April 2015 (n = 6,172) as well as all the debitage from Blowout Area 7. Dr. Dan Amick had sorted the Blowout Area 6 debitage from 1981-1991 prior to our visit and therefore we only examined those that had been identified as platform remnant bearing flakes (PRBs), those categorized as non-PRBs were not re-examined. All of the debitage we examined were assigned to one of four categories: scraper retouch flakes, bifacial reduction and retouch, indeterminate PRBs, and non-PRBs.

Scraper retouch flakes are present in each of the blowout areas, albeit in varying amounts. In the last five years, the majority of the debitage (n = 3,671, 59.5 percent) has been collected from Blowout Area 7, which also yielded the most unifacial retouch flakes (Table 6.5; Figure 6.17). Proportionally, Blowout Areas 7 and 5 both have more unifacial retouch flakes. Since May 2010, nearly 30 percent of the Blowout Area 7 debitage has been unifacial retouch flakes. Blowout Area 5 also had more than 20 percent of this type of flake. The others all have fewer than 20 percent of their assemblage in this category.

Table 6.5. Summary of the analyzed chipped stone debitage from May 2010-April 2015.

Blowout Area	Uniface Retouch (count)	Biface Retouch (count)	Other with Platform (count)	No Platform (count)	*Total (count)*
2	50	77	68	110	***305***
3/3A	59	245	158	207	***669***
4	117	431	237	454	***1,239***
5	42	52	43	51	***188***
6	18	30	28	24	***100***
7	1,079	411	923	1,258	***3,671***
Totals	***1,365***	***1,246***	***1,457***	***2,104***	***6,172***

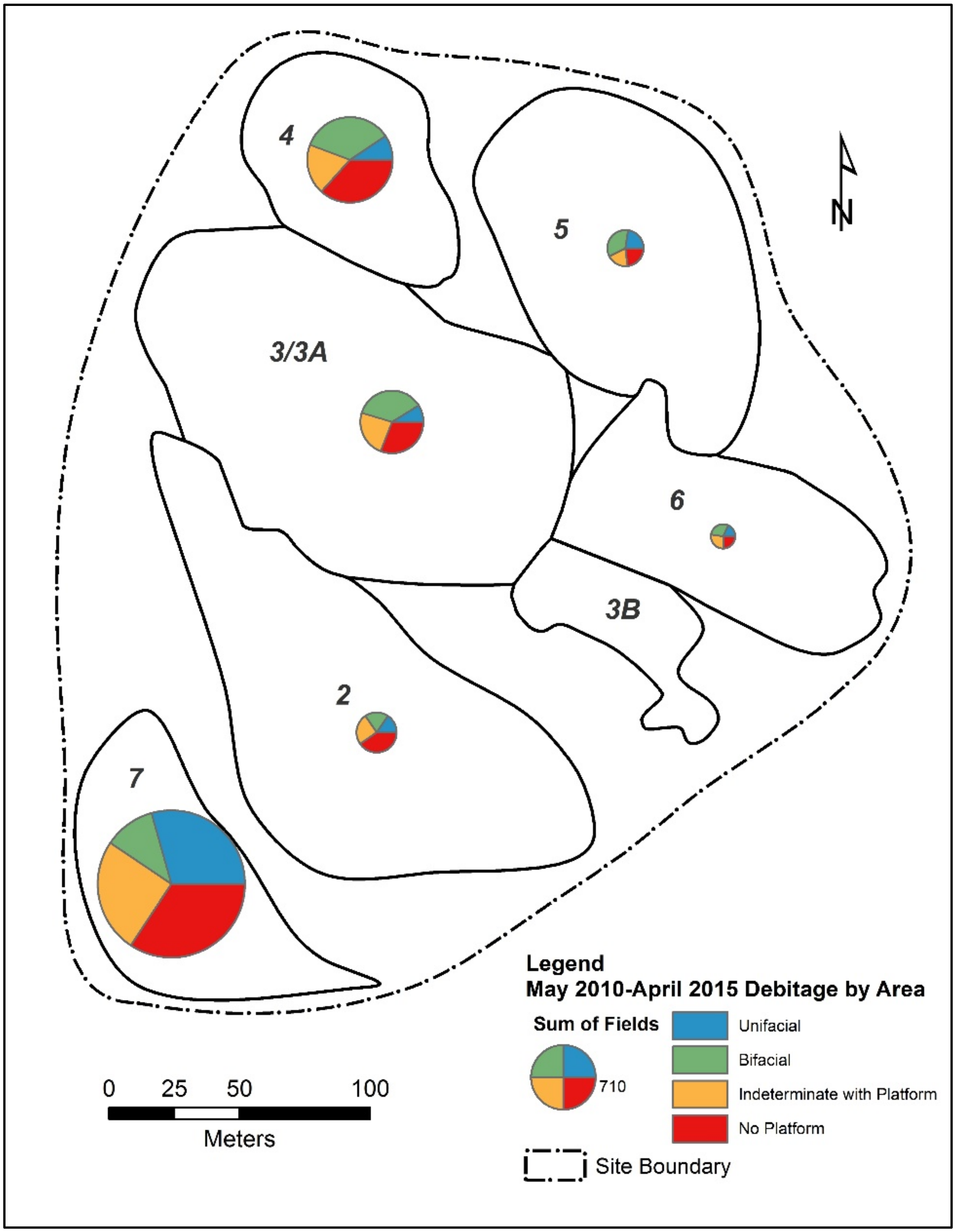

Figure 6.17. Pie charts depicting counts of debitage collected between May 2010 and April 2015 by blowout area and flake category. Pie charts are sized to represent the total count per area for that period.

Between 25 and 36.6 percent of the debitage collected in the last five years from Blowout Areas 2, 3/3A, 4, 5, and 6 is identifiable as bifacial reduction and retouch (Table 6.5; Figure 6.17). Bifacial tools were worked and/or retouched in each of these areas. Blowout Area 7, in contrast, only has 11.2 percent identifiable bifacial debitage. This is not surprising given the emphasis on unifacial retouch in Blowout Area 7.

All unifacial, bifacial, and indeterminate PRBs for Blowout Areas 6 and 7 since 1981 are depicted in Figure 6.18. Non-PRB flakes are excluded from this analysis because not all of the Blowout Area 6 non-PRB flakes were examined. The pie charts on this map depict that unifacial retouch flakes are more common in Blowout Area 7 while bifacial flakes dominate the Blowout Area 6 assemblage.

The vast majority of the uniface retouch flakes identified in the 41WK21 assemblage (n = 1,946) are Type 1 scraper retouch flakes (Figure 6.19). Few Type 2 retouch flakes are noted: one from Area 2 and two from Area 6. Unifacial retouch flake Type 3 is a transverse rejuvenation of the end of a scraper. Four of these are noted in the portion of the 41WK21 assemblage that was examined: one from Area 2, one from Area 5, and two from Area 6.

During examination of the scraper retouch flakes, analysts observed that the artifacts could be divided into groups based on the tool from which they appeared to have been removed. However, neither division of the artifacts based on this observation, nor attempts to refit scraper retouch flakes to endscrapers, were undertaken as part of this study. Analysts also noted cortex on some of the scraper retouch flakes (Figure 6.20), indicating they came from an endscraper with cortex on its dorsal side. A few of the endscrapers from 41WK21 do exhibit cortex.

This general categorization of the debitage at this site indicates that both unifacial and bifacial tool maintenance was happening across the site at 41WK21. It also provides some interesting clues as to where more unifacial resharpening occurred. All of the debitage, however, is collected by blowout area and these areas are likely not representative of the site's structure. Spatial analysis, discussed below investigates how to better characterize the site structure.

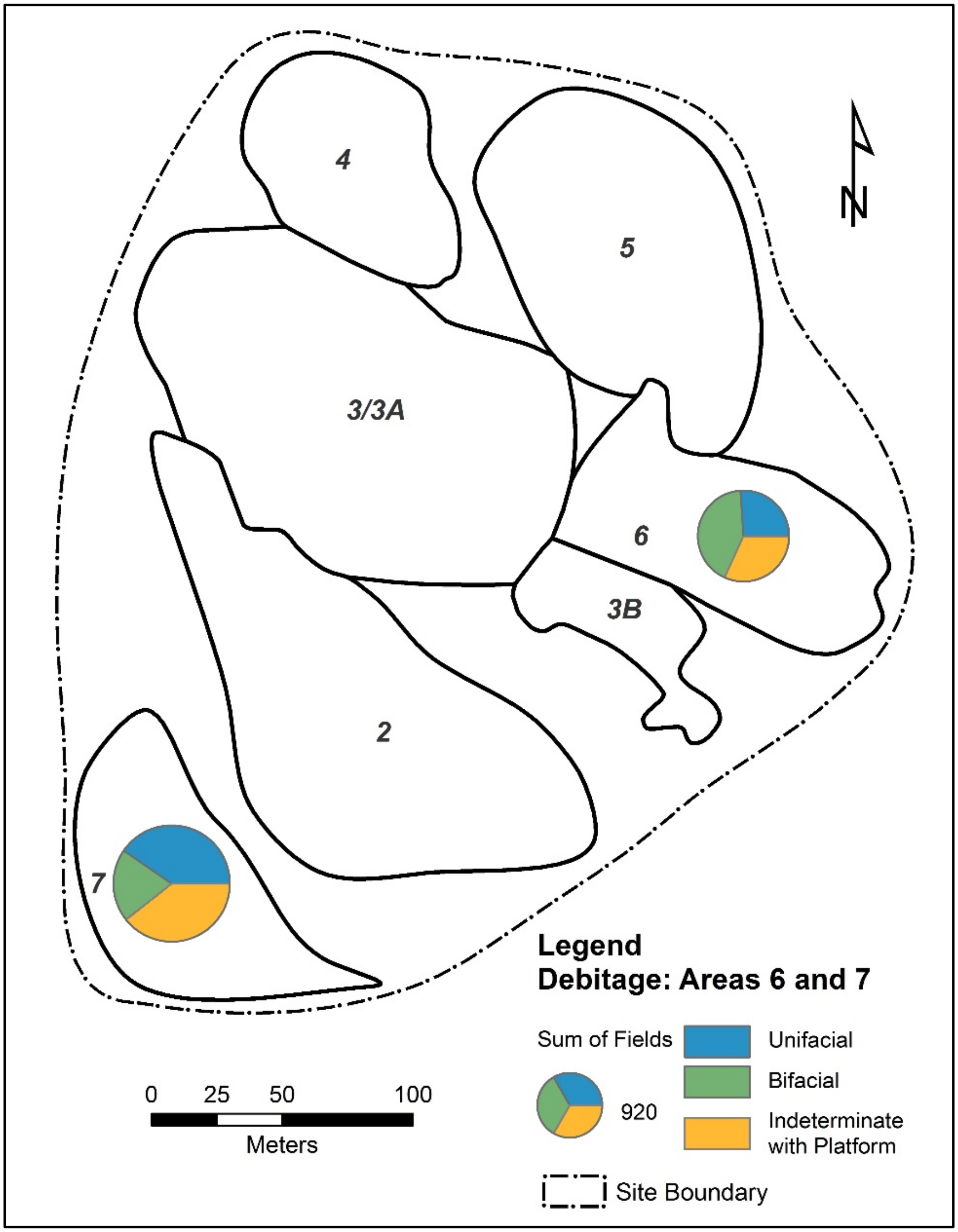

Figure 6.18. Pie charts depicting counts of scraper resharpening flakes, bifacial thinning flakes, and platform remnant bearing flakes of indeterminate reduction trajectory collected from Areas 6 and 7 since 1981. Pie charts are sized to represent the total count of debitage per area.

Figure 6.19. A sample of Edwards chert scraper retouch flakes from Blowout Area 6 collected between May 2010 and April 2015.

Figure 6.20. Example of scraper retouch flakes that all appear to have come from one tool with cortex on its dorsal side.

Spatial Analysis

Debitage from 41WK21 has been collected relative to natural dune blowouts. The mapped items have also been designated by blowout area; however, these items are mapped individually and therefore can be examined for patterns independently from the blowout areas. Defining areas of the site that are indicative of past behaviors, instead of based on natural processes, is a primary goal of spatial analysis at 41WK21.

Before delving into the spatial analysis, a note about the continued importance of the blowout area boundaries is warranted. Blowout areas depicted on the maps in this chapter were created using data from Rose's notes, piece-plotted artifacts, datum locations, and a shapefile of the blowout boundaries in April 2010 (Figures 6.21 and 6.22). These boundaries represent the minimum amount of area blown out at the site over the past 35 years. When these data are combined to form area boundaries, it is clear the majority of the site area has been exposed and collected (Figure 4.6). Notably, there is a division between Blowout Areas 2 and 7, and small areas between 3/3A, 5, and 6 as well as 3/3A, 4, and 5. Rose (Personal communication, email, November 23, 2015) confirmed these areas appear to have not yet been exposed in a blowout. He also noted that a datum was never installed in area 3B. As a result of no datum in that area, many of the 3B artifacts were not mapped and this area was likely larger than is shown on the blowout area map (Figure 4.6). This explanation of the blowout areas is important as we examine patterns in the data; some patterns may change slightly as the rest of the site is blown out and documented and some spatial analysis is impacted by gaps in the data.

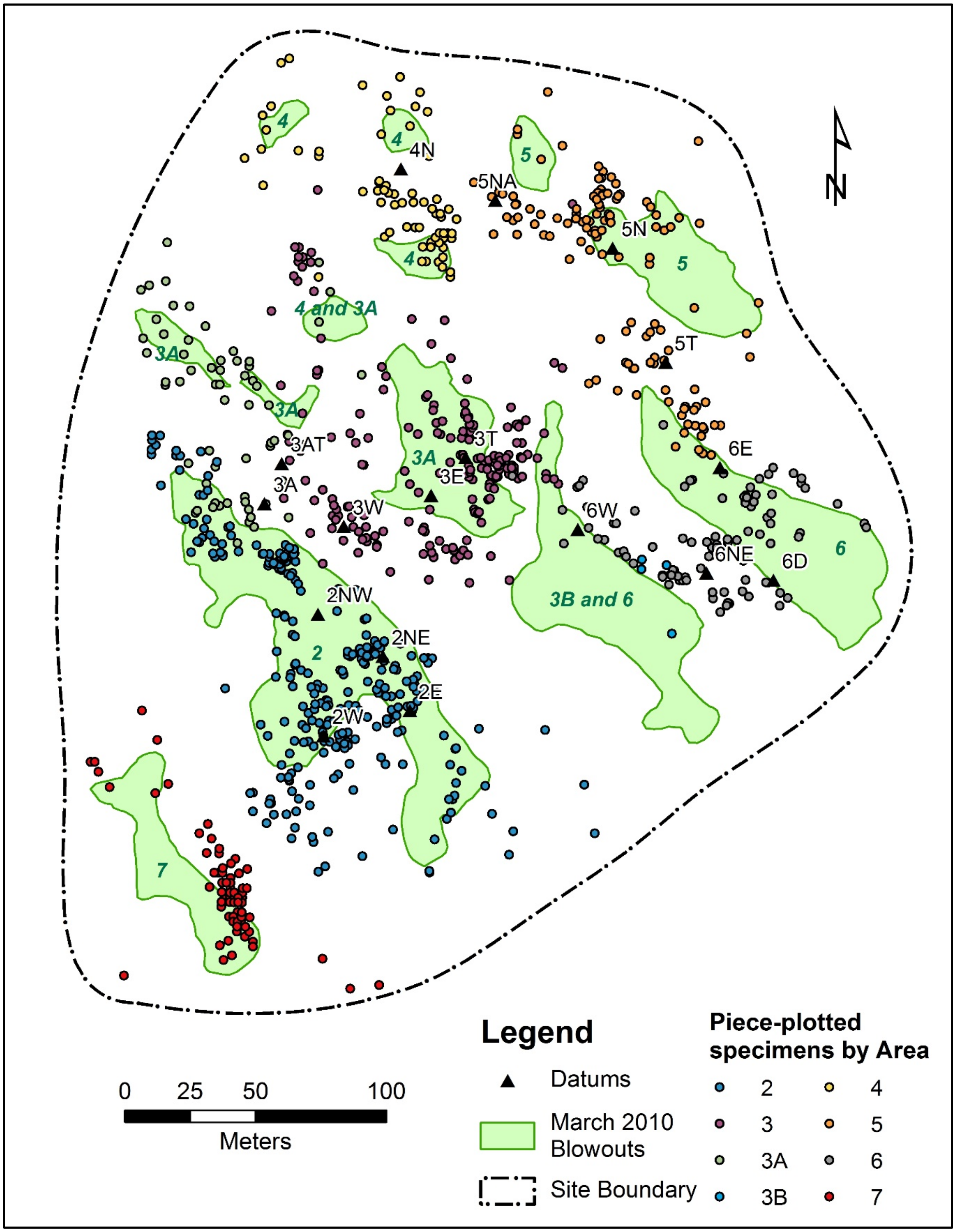

Figure 6.21. Map depicting the data used to define blowout area maps. Rose's notes, piece-plotted artifacts, datum locations, and the shapefile of blowouts mapped using a sub-meter GPS in April 2010, were used to delineate the approximate extents of blowouts at Shifting Sands.

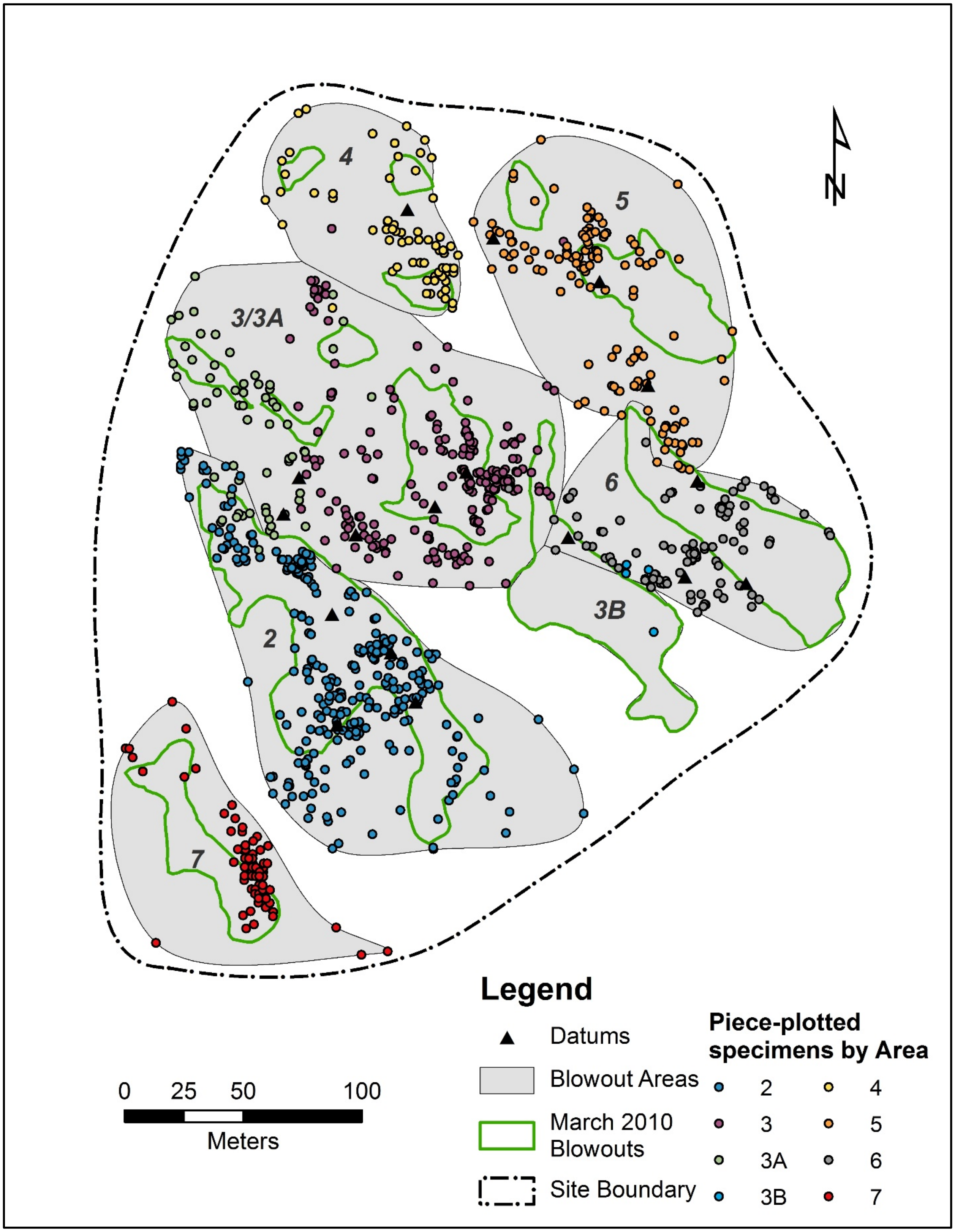

Figure 6.22. Piece-plotted artifacts, datum locations, and the shapefile of blowouts mapped using a sub-meter GPS in April 2010 overlain on the Blowout Areas created using these data.

As described above, Rose mapped nearly 1,000 artifacts including red ochre, fauna, ground stone, and chipped stone (Figure 6.8). In addition to these artifacts, three features are described and mapped in his notes. The mapped features consist of one hearth and two bonebed areas. The mapped hearth is located in Blowout Area 5 and was identified by a carbonized stain in the same stratigraphic level as Folsom artifacts. It was 65 cm in diameter (enlarged on maps in this study for visibility) and an irregular circular shape. The stain extended about 20-25 cm below the surface and a rodent burrow was noted running through the feature. Undoubtedly, other hearths existed at the site. Hearths are believed to have been present in several blowout areas based on the presence of thermally altered artifacts, but, for now, the discussion of hearths is limited to the mapped one in Blowout Area 5. The other two features are both labeled bonebeds: the larger one is in Blowout Area 3/3A while the smaller one is in Blowout Area 2. Bone preservation at 41WK21 is not good, and generally only small bone fragments have been recovered (Hofman et al. 1990:233). The limited assemblage of identifiable bone was predominately bison with an antelope molar from the larger Blowout Area 3/3A bonebed also identified. The larger bonebed area is approximately 30 m north-south by 60 m east-west while the smaller feature is only about 12 m in both directions. These larger and smaller concentrations of bone may be the location of a kill and a small processing area respectively; however, given the lack of preservation, we cannot be sure these are the activities that created the bonebeds.

Hofman (1999:136-137) completed a study of several Paleoindian sites in which he determined the minimum number of bison in the bonebed was greater than the number of points in each case. In 1999, he identified 53 complete and fragmentary projectile points from Blowout Area 3 in the vicinity of the larger bonebed at 41WK21 (Hofman 1999b:136-137). Indeed, a total of 29 whole and fragmentary projectile points have been recovered in the two 41WK21 bonebeds. An additional 24 points were mapped within 20 m of the bonebeds. This confirms Hofman's (1999) estimate of 53 points in the vicinity of the bonebeds. Although some of these points are complete or nearly complete (n = 11), the majority are fragments (n = 42). Using points in and near the bonebeds as a proxy, it appears more than 50 bison were killed and butchered at 41WK21 (Hofman 1999b:136-137).

Site Structure

To examine patterns in the piece-plotted artifact data, I ran KDEs using all chipped stone at varying radii (10 to 75 m). This process allowed me to determine which radius was most indicative of the spatial patterning. The 35 m KDE appeared to provide the best information about artifact clustering while limiting the number of clusters to a manageable number. The results of this analysis presented using natural breaks and seven classes suggest there are approximately seven clusters of artifacts at 41WK21 (Figure 6.23). These clusters are of varying densities and are presented with the blowout areas overlain to remind us of the areas where data has not yet been collected. Three of the most dense artifact concentrations are located to the immediate northeast, west, and south of the larger bonebed feature. This suggests that these concentrations were activity areas related to the bonebed. There is a concentration of artifacts just south of the hearth, but it is not as dense as those in the center of the site area.

An overall artifact pattern at 41WK21 that is immediately noticeable was that there are four approximately evenly distributed groups from the northeast to southwest with the bonebed in the middle. This pattern, which also is evident in the KDE, prompted additional inquiry into the composition of those clusters, in what ways are they similar and/or different? This question is explored in the cluster discussion below.

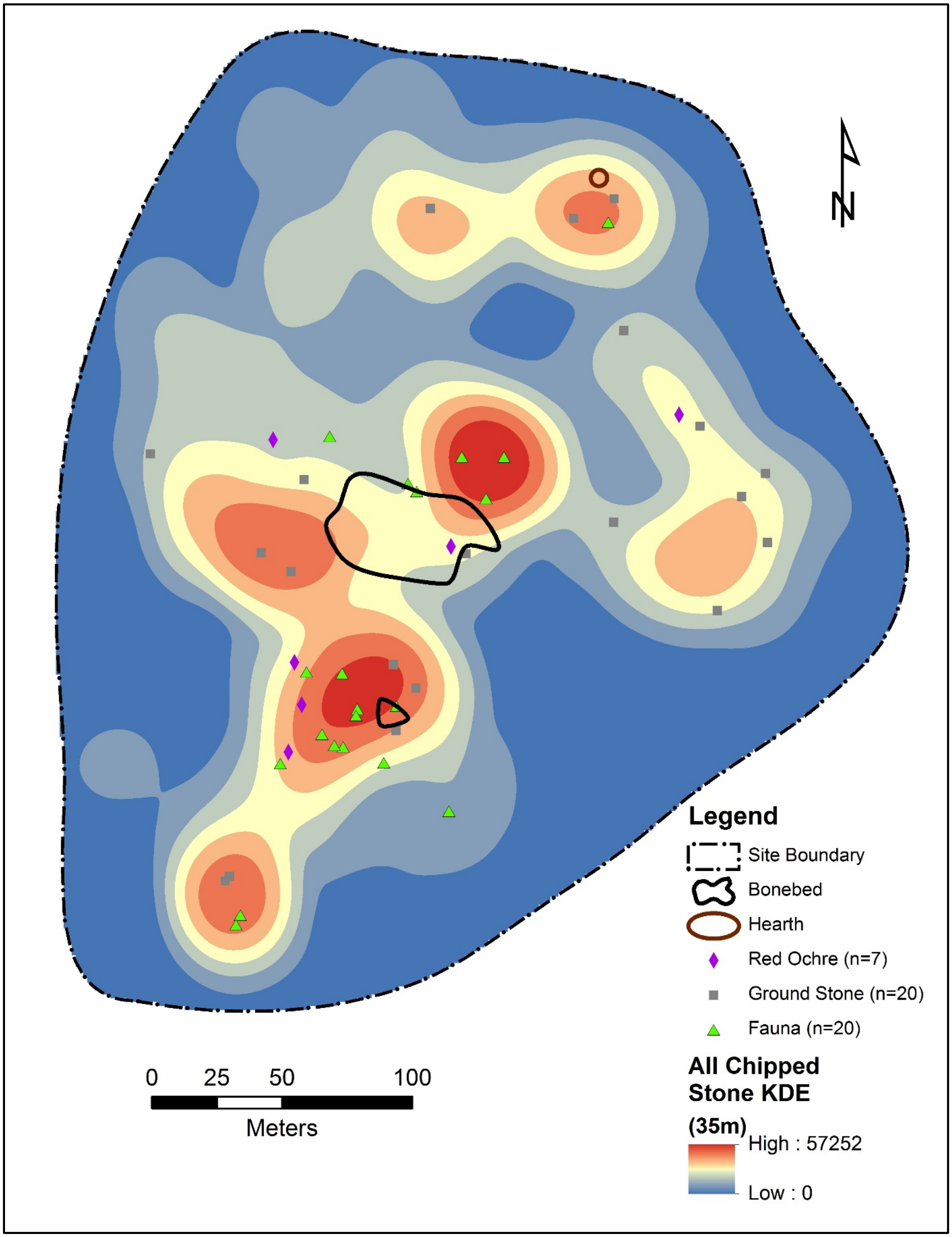

Figure 6.23. All chipped stone (n = 911) kernel density estimate overlain by the mapped red ochre, fauna, and ground stone artifacts.

Additional examination of the chipped stone KDE relative to the mapped features and other artifacts can give us a better idea of site structure. Figure 6.23 depicts piece-plotted red ochre, fauna, and ground stone over the chipped stone KDE. In this image we see the faunal materials are largely near the center of the site, near the bonebed features. Ground stone artifacts appear to be more widely dispersed and are found in every KDE cluster. The few red ochre items are primarily mapped near the center of the site area.

KDEs provide a useful way to visualize and explore the density of artifacts; however, statistical analysis of the patterning also should be accomplished (Hill et al. 2011). To do this, I conducted TwoStep Cluster Analysis in SPSS using all piece-plotted chipped stone. This type of analysis assigns each item to a cluster. TwoStep can determine the number of clusters itself or the analyst can assign the number of clusters requested. I ran the cluster analysis for 4-8 cluster solutions. Based on the cluster quality and cluster statistics provided in SPSS, the best solutions for the data were the seven, and perhaps five, cluster solutions. After importing the results of the cluster analysis into GIS, I examined the results of both of these solutions. Differences between the five and seven cluster solutions were observed in the vicinity of Blowout Areas 5 and 4 where the five cluster solution grouped the northern artifacts in Blowout Area 5 with the southeastern part of Blowout Area 4 while the seven cluster solution separated these areas. Secondly, the five cluster solution grouped artifacts in the southern part of Blowout Area 2 with artifacts in Blowout Area 7 whereas the seven cluster solution separated them. Based on the available data, the seven cluster solution appears to be the most useful way of examining the artifacts at 41WK21 and it is used in subsequent analyses (Figure 6.24). For convenience, each of these clusters is assigned a letter designation. It is important to remember, however, that the patterns may change some after the portions of the site are blown out; in that case the five cluster solution, or even another solution, may be the best.

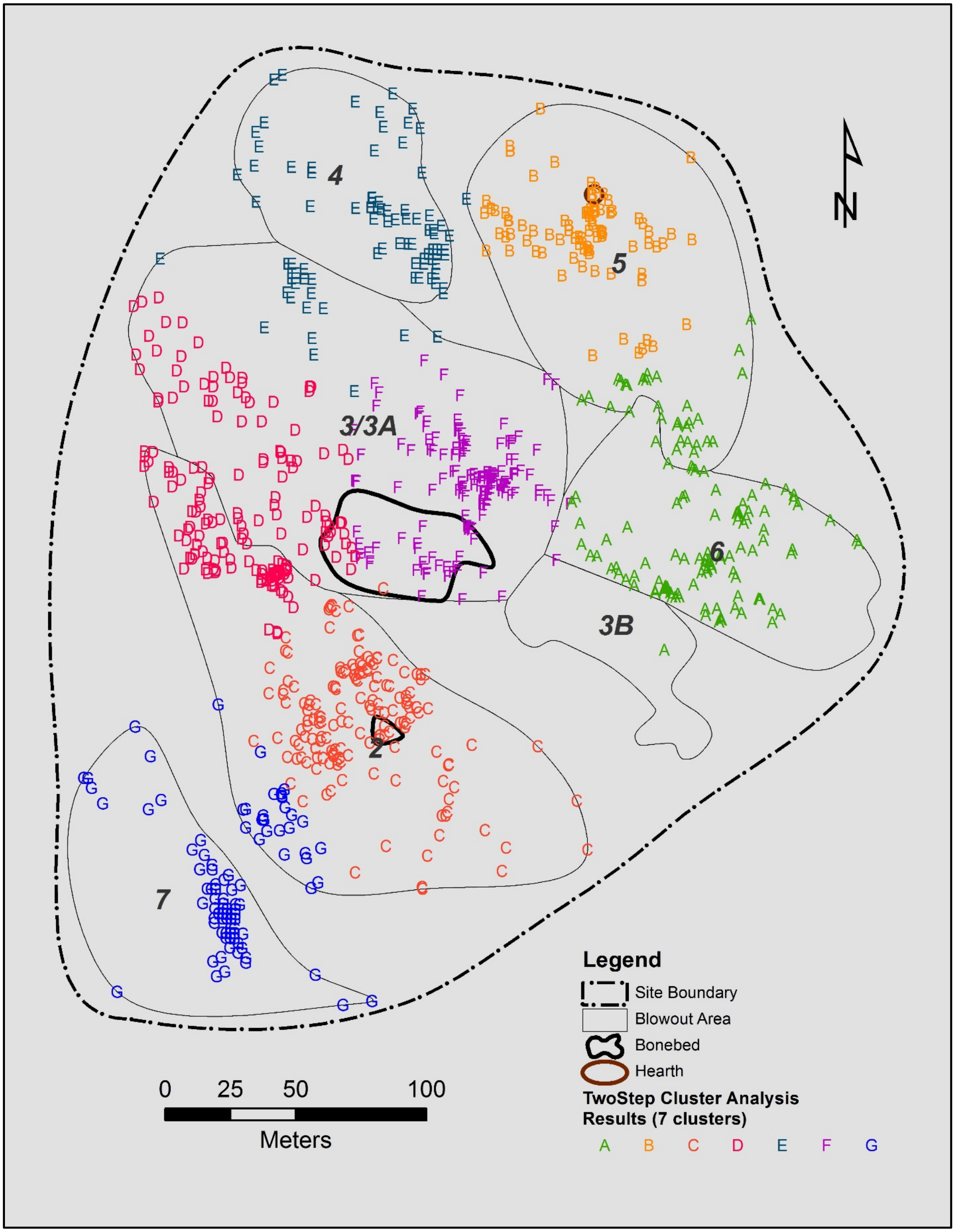

Figure 6.24. TwoStep Cluster Analysis (7 clusters) results displayed on the site base map by their letter designations.

A comparison of the seven cluster TwoStep solution and the 35 m chipped stone KDE shows they are very similar (Figure 6.25). Both of these spatial analysis methods identified clusters of artifacts in seven areas of the site. The TwoStep clusters range in size from 87 to 171 artifacts, with each making up between 9.5 and 18.8 percent of the total number of chipped stone artifacts (Table 6.6). In general, both the KDE and TwoStep clusters have an amorphous to circular shape; however, Cluster A is notable in that it has a distinctive shape. Few artifacts are mapped in the center or on the west edge of Cluster A. This distinctive shape is explored further in the individual clusters discussion below.

Table 6.6. Summary of seven clusters TwoStep solution.

Cluster	Area of Cluster Artifacts (m^2)	Number of Artifacts	Percent of Total Artifacts
A	9,786	131	14.4
B	5,607	87	9.6
C	8,894	171	18.8
D	7,802	169	18.6
E	9,423	94	10.3
F	6,798	151	16.6
G	9,631	107	11.8

To investigate the location of hideworking activity areas at 41WK21, I plotted the endscrapers and a single mapped scraper retouch flake relative to the blowout areas (Figure 6.26). Although this map appears to depict some clustering of these tools, a 35 m KDE map depicts the varying density of these tools across the site better than a simple artifact plot (Figure 6.27). A comparison of the endscraper KDE with the all chipped stone KDE reveals similar clustering in some areas while others are dramatically different.

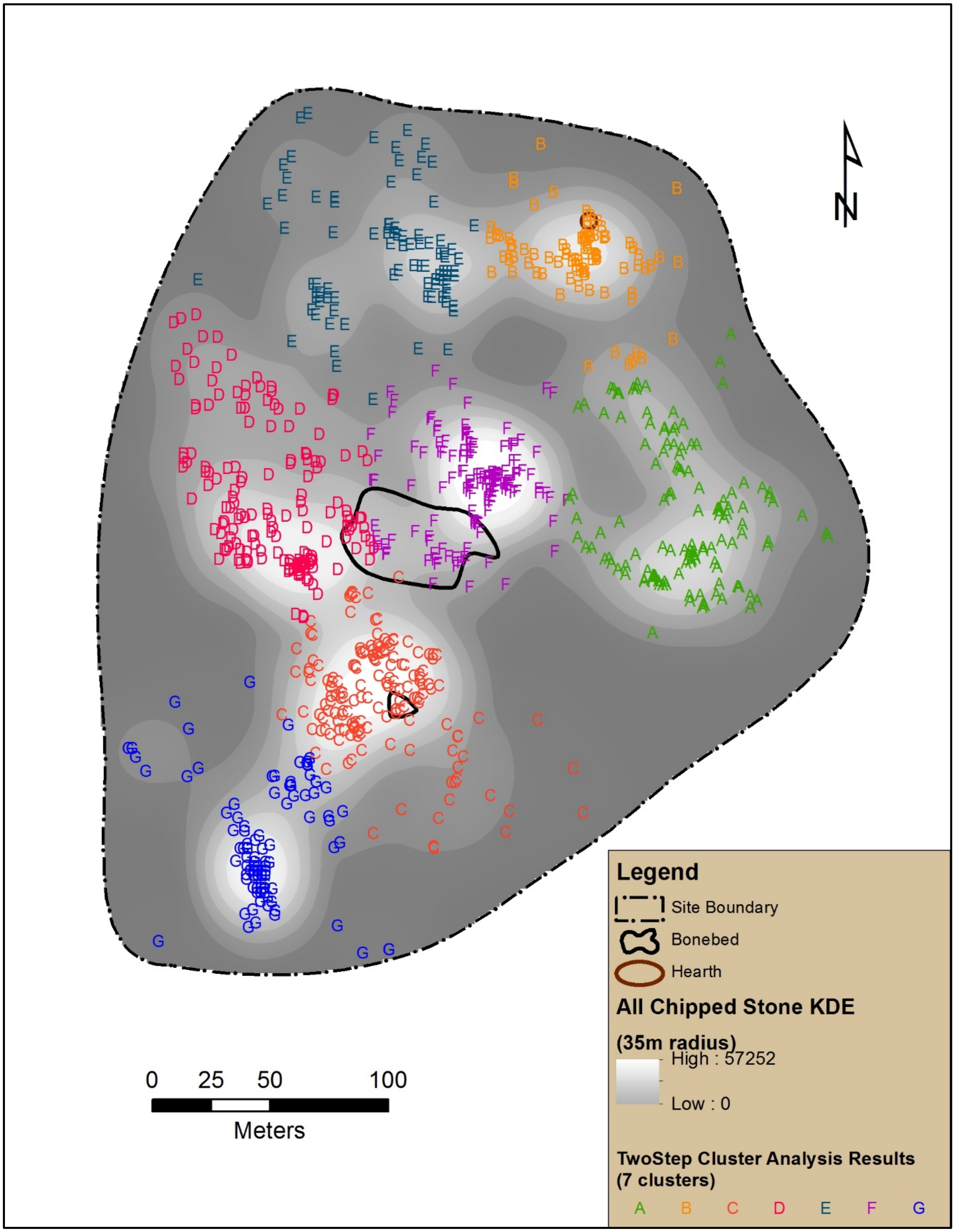

Figure 6.25. TwoStep Cluster Analysis results (7 clusters) displayed on the all chipped stone KDE (35 m) for Site 41WK21.

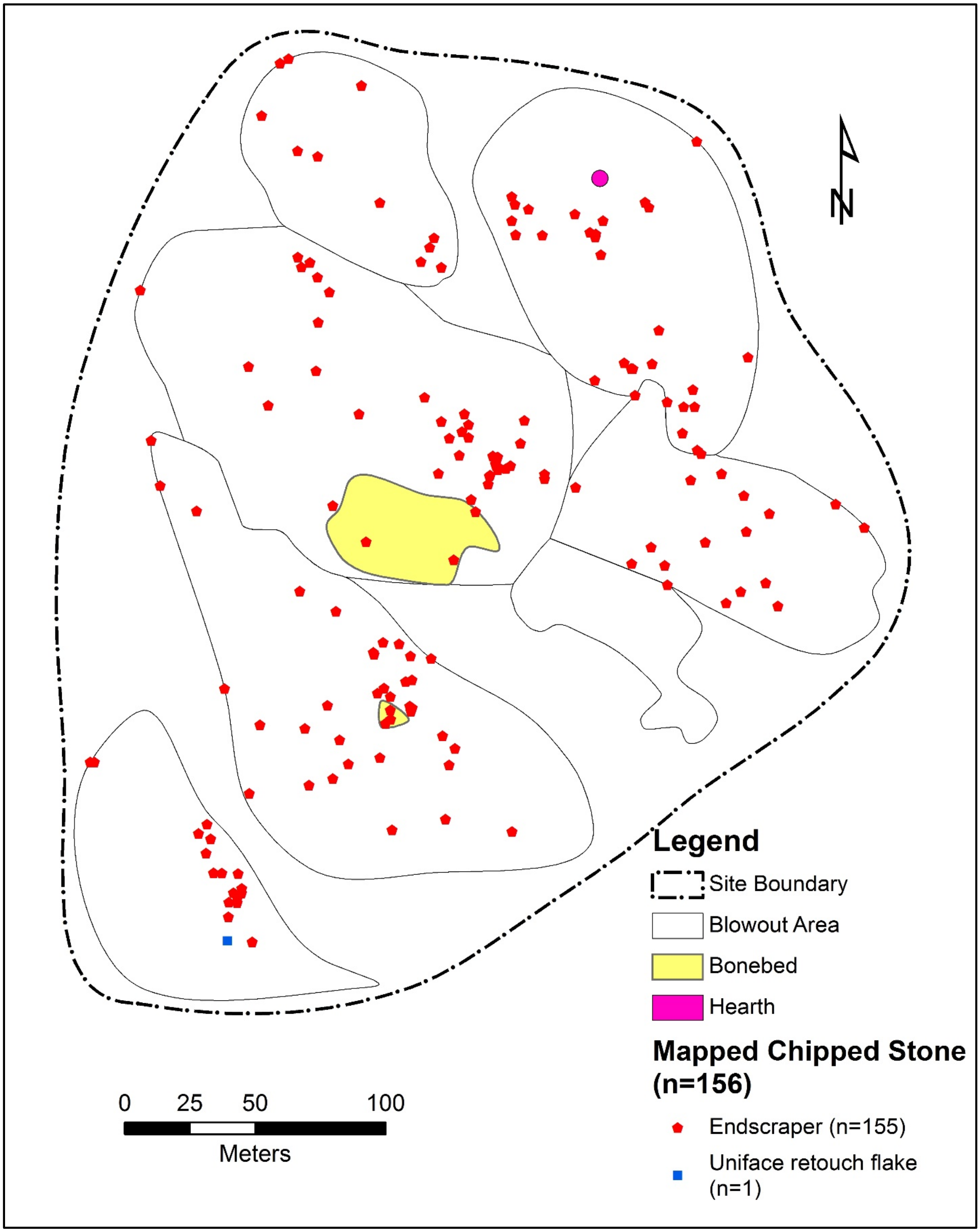

Figure 6.26. Map depicting the locations of mapped endscrapers and a single mapped scraper retouch flake.

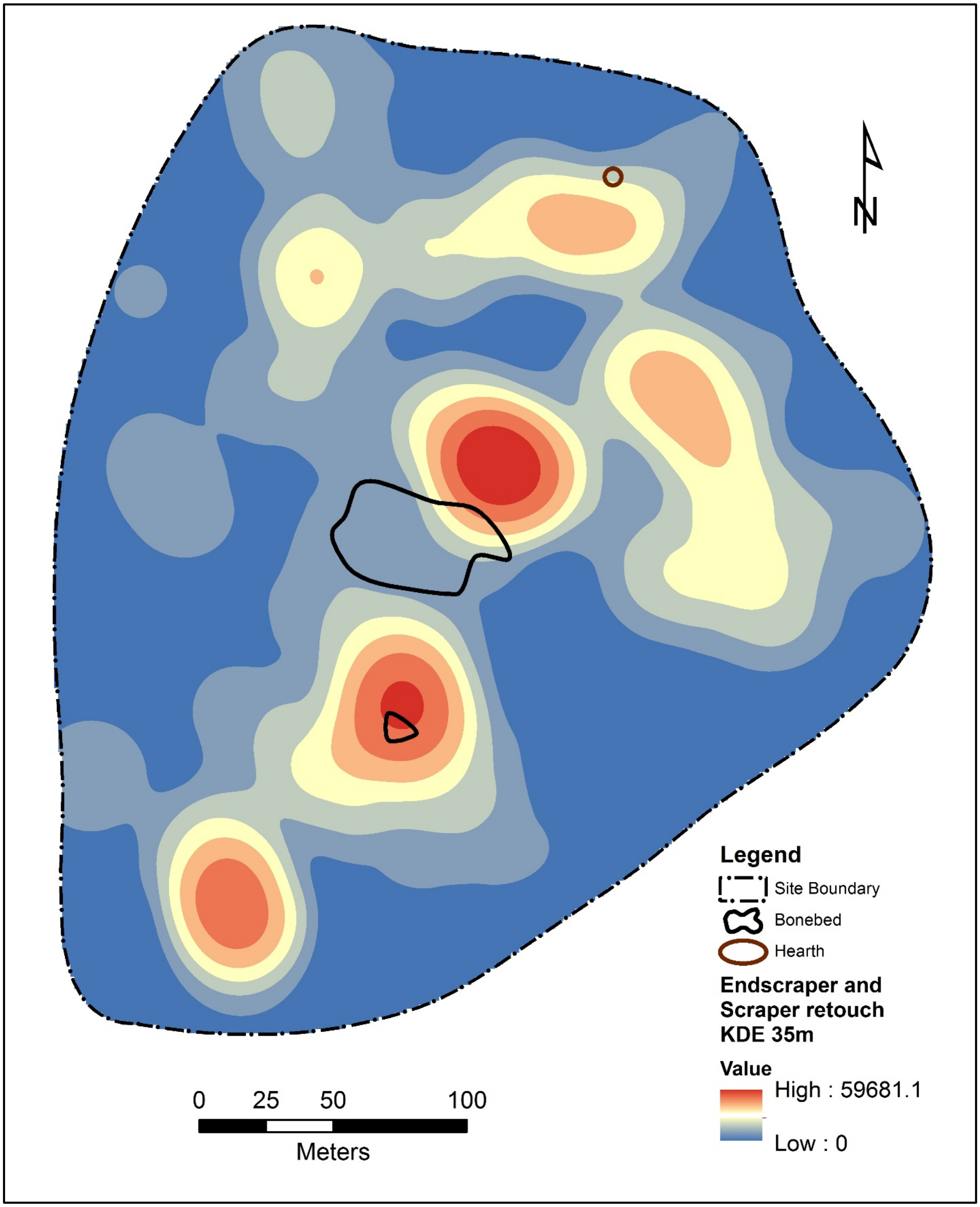

Figure 6.27. KDE using endscrapers and a single mapped scraper retouch flake (n=156).

These differences can be further explored by comparing the endscraper KDE with one created with only projectile points, preforms, and channel flakes. While the endscraper KDE indicates where hideworking tools were lost or discarded, the points, preforms, and channel flakes indicate areas where projectile point use, manufacture, and discard took place. Figure 6.28 depicts the 35m KDE for these point related artifacts. Some areas of this map are dramatically different from the endscraper KDE; concentrations of artifacts that are missing from the endscraper map, such as the one west of the bonebed, are clearly concentrations of these types of artifacts.

Another difference is the northwestern portion of the site, west of the hearth area, where points, preforms, and channel flakes are more common between two concentrations of endscrapers (Figures 6.27 and 6.28). On the other hand, some similarities with the endscraper KDE are present; areas in the vicinity of the hearth and the smaller bonebed area register on the points, preforms, and channel flakes map, albeit not at the same density as the endscraper map (Figures 6.27 and 6.28).

To determine if there is a difference between where projectile points were manufactured and used at 41WK21 (Hofman 1999b; Sellet 2004, 2013), I separated the projectile points, preforms, and channel flakes into three categories. One category included tips, complete, and nearly complete points that may represent where points were used, the second category included point base fragments, preforms, and channel flakes that may indicate locations of point manufacture (Figure 6.29) (Hofman 1999b:122). The third category included those artifacts that, due to incomplete portion data, I could not classify in either of the first two categories.

The results of this exercise suggest that some areas of point manufacture and use may be differentiated at 41WK21. The overall pattern of a concentration points, preforms, and channel flakes west of the bonebed is unchanged, but when these items are divided we can observe variation in that area. Point production artifacts are concentrated between two areas of artifacts that may be more indicative of point use (Figures 6.30 and 6.31). The distribution of artifacts in this area is discussed in more detail in the Cluster D section below.

Both point production and point use artifacts are recorded in the vicinity of the hearth, but the western concentration is more apparent on the production map while the area near the small hearth is denser on the use map. Overall, points, preforms, and channel flakes exhibit the most similarity with endscrapers near the mapped hearth, a pattern that is expected if the hearth represents a domestic space used by multiple people involved in a number of activities. Endscrapers and point production artifacts are both present northeast of the large bonebed; however, endscrapers are significantly more dense there (Figures 6.27 and 6.30).

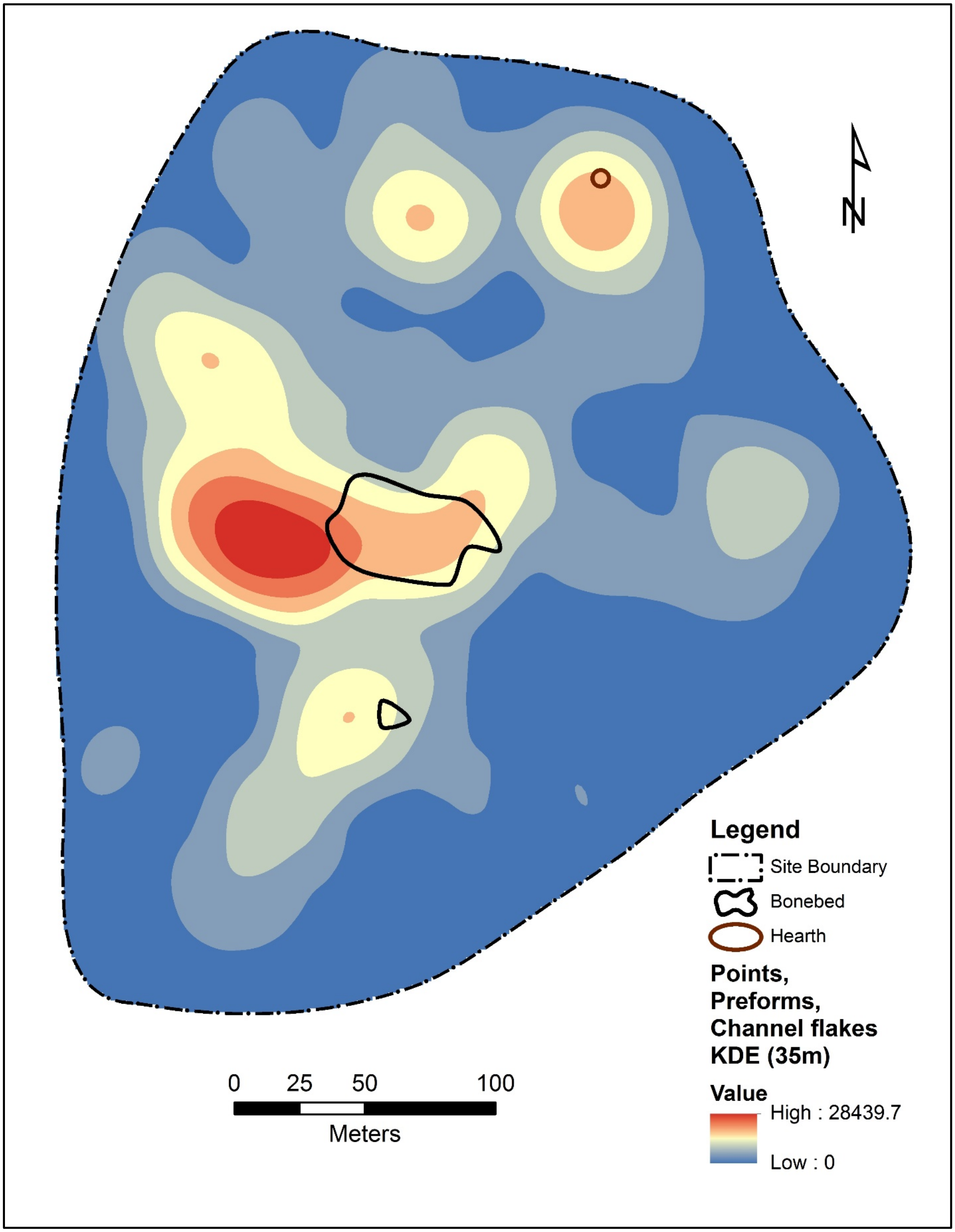

Figure 6.28. KDE using points, preforms, and channel flakes (n=292).

Figure 6.29. Distribution of points, preforms, and channel flakes at 41WK21 divided by items associated with production and those associated with use.

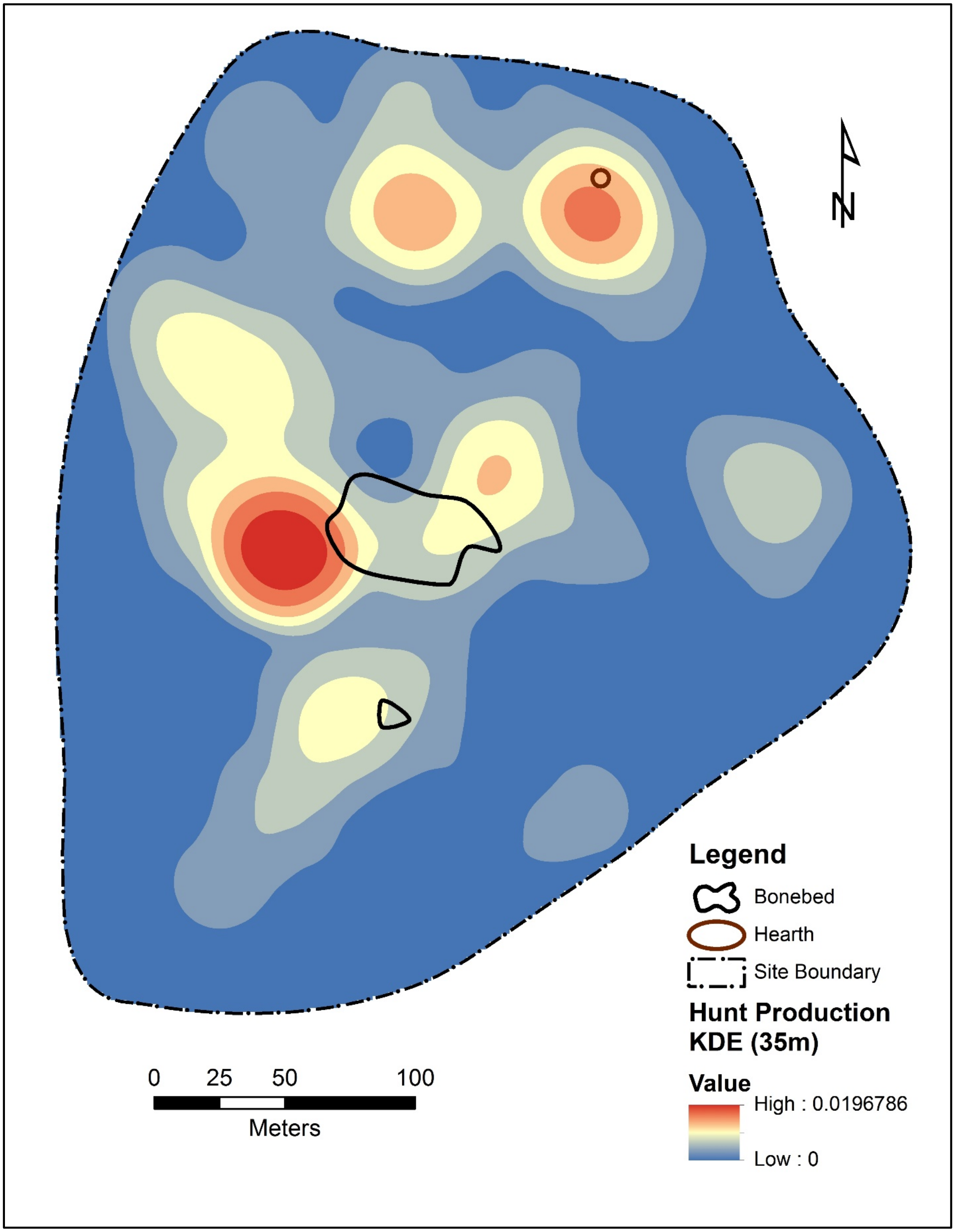

Figure 6.30. Site 41WK21 point bases, channel flakes, and preforms displayed as 35 m radius KDE.

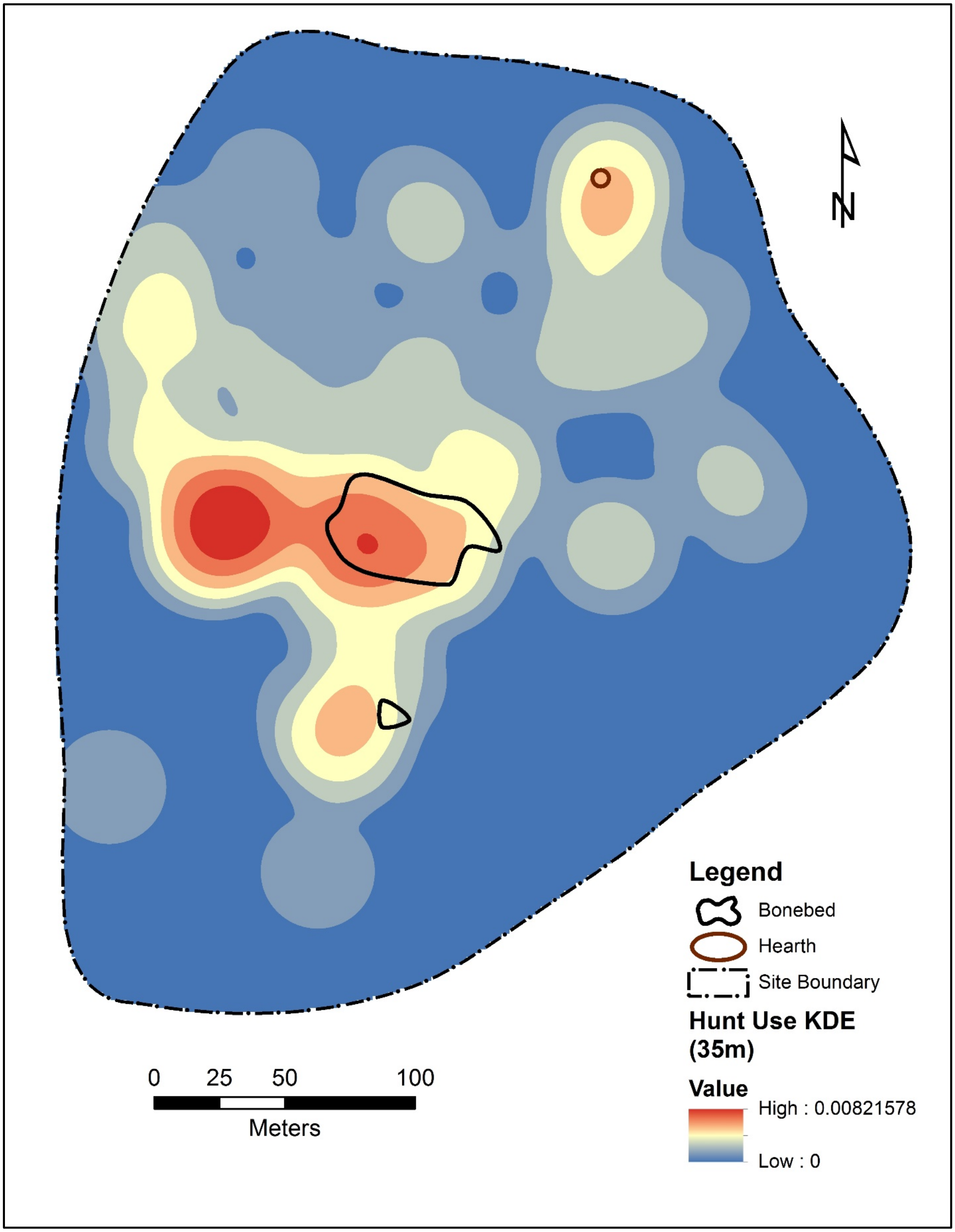

Figure 6.31. Site 41WK21 complete and nearly complete points as well as tips displayed as 35 m radius KDE.

Examining the artifact composition of the TwoStep clusters can illuminate the different activities likely to have taken place throughout the site. Next, I do this by evaluating the composition and artifact distribution observed in each of the seven TwoStep clusters.

Cluster A

Nearly 15 percent of the mapped artifact assemblage is assigned to Cluster A, in the east-central portion of the site (Figure 6.24). The majority of these artifacts are from Blowout Area 6, a minority are from Blowout Area 5.

In Cluster A, endscrapers are the most common tool type (22.9 percent of the cluster; 19.23 percent of the total endscrapers) followed by utilized flake tools (19.85 percent of the cluster; 15.48 percent of the utilized flakes) (Table 6.7). Other artifacts potentially used in hideworking, including gravers (n = 10; 15.63 percent of gravers) and knives (n = 1; 20.00 percent of knives) are present, but not in high numbers. Among artifacts that may be associated with hideworking, slightly more than half of all side scrapers (n = 11), and a quarter (n = 2) of the ultrathins at 41WK21 are assigned to Cluster A.

The spatial extent of the artifacts in Cluster A is approximately 63 x 100 m with the long axis trending northwest to southeast. In contrast to the other clusters, which are generally circular or oval shaped, this cluster exhibits a U-shape, or perhaps even a hollow rectangular shape where artifacts are mapped around an area largely devoid of them. The interior area where few artifacts were recovered measures about 37 x 70 m. Artifacts are plotted on three sides of this shape and also may be present in the western area that has not blown out yet. If artifacts from Cluster F also are considered, the U-shape of Cluster A is even more convincing (Figure 6.24).

Table 6.7. The composition of TwoStep clusters by count of artifact type and percent of the artifact type total.

Artifact Type	Cluster A		Cluster B		Cluster C		Cluster D		Cluster E		Cluster F		Cluster G		*Total*	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	*Count*	*Percent*
Biface	4	12.90%	5	16.13%	6	19.35%	6	19.35%	2	6.45%	3	9.68%	5	16.13%	***31***	***100.00%***
Burin	--	0.00%	1	16.67%	--	0.00%	4	66.67%	--	0.00%	1	16.67%	--	0.00%	***6***	***100.00%***
Channel	3	4.41%	12	17.65%	8	11.76%	19	27.94%	16	23.53%	7	10.29%	3	4.41%	***68***	***100.00%***
Chopper	--	0.00%	1	33.33%	--	0.00%	2	66.67%	--	0.00%	--	0.00%	--	0.00%	***3***	***100.00%***
Combination Tool	--	0.00%	1	14.29%	3	42.86%	--	0.00%	1	14.29%	1	14.29%	1	14.29%	***7***	***100.00%***
Core	5	62.50%	--	0.00%	1	12.50%	--	0.00%	1	12.50%	1	12.50%	--	0.00%	***8***	***100.00%***
Debitage	21	19.27%	6	5.50%	38	34.86%	7	6.42%	5	4.59%	21	19.27%	11	10.09%	***109***	***100.00%***
Endscraper	30	19.23%	16	10.26%	32	20.51%	9	5.77%	18	11.54%	30	19.23%	21	13.46%	***156***	***100.00%***
Gouge	--	0.00%	--	0.00%	2	100.00%	--	0.00%	--	0.00%	--	0.00%	--	0.00%	***2***	***100.00%***
Graver	10	15.63%	5	7.81%	15	23.44%	6	9.38%	10	15.63%	11	17.19%	7	10.94%	***64***	***100.00%***
Knife	1	20.00%	1	20.00%	--	0.00%	1	20.00%	1	20.00%	1	20.00%	--	0.00%	***5***	***100.00%***
Point	17	7.39%	20	8.70%	29	12.61%	91	39.57%	17	7.39%	39	16.96%	17	7.39%	***230***	***100.00%***
Radial break tool	--	0.00%	1	16.67%	--	0.00%	3	50.00%	--	0.00%	--	0.00%	2	33.33%	***6***	***100.00%***
Side scraper	11	52.38%	--	0.00%	5	23.81%	1	4.76%	--	0.00%	4	19.05%	--	0.00%	***21***	***100.00%***
Spokeshave	--	0.00%	--	0.00%	1	50.00%	1	50.00%	--	0.00%	--	0.00%	--	0.00%	***2***	***100.00%***
Ultrathin	2	25.00%	--	0.00%	2	25.00%	--	0.00%	3	37.50%	1	12.50%	--	0.00%	***8***	***100.00%***
Uniface	1	6.25%	2	12.50%	5	31.25%	2	12.50%	--	0.00%	4	25.00%	2	12.50%	***16***	***100.00%***
Utilized flake tool	26	15.48%	16	9.52%	24	14.29%	17	10.12%	20	11.90%	27	16.07%	38	22.62%	***168***	***100.00%***
Grand Total	***131***	***14.40%***	***87***	***9.56%***	***171***	***18.79%***	***169***	***18.57%***	***94***	***10.33%***	***151***	***16.59%***	***107***	***11.76%***	***910***	***100.00%***

The shape of this cluster may be result of a natural or cultural obstacle present at the time the site was occupied. That area may have been covered in dune sands or water, both of which would have been a barrier to people using it. Alternatively, an activity that does not require many tools, or uses perishable ones, may have occurred there. Finally, an activity such as hideworking that takes up significant space may have occupied in that area. The interior area is approximately 2,590 square meters. Assuming an area of about 25 square meters to work a large hide, around 100 hides could be worked in this area at one time.

At the Bull Brook site, cultural materials were arranged in a rough rectangular shape with an interior area of about 90 x 130 m that contained fewer artifacts (Robinson and Ort 2013). In that case, endscrapers dominated clusters that were further from the interior area. The Cluster A artifacts were examined for any evidence of a similar pattern (Figure 6.32). The endscrapers in Cluster A are found both close too and more distant from the interior area; however, they were more concentrated on the northern side of the interior area while artifacts on the eastern side appear to be distributed in three groupes (Figure 6.32).

The central grouping on the eastern side of Cluster A contains one point, one endscraper, three gravers, and six utilized flakes. It contrasts with the group just north of it, which contains one side scraper, one endscraper, and five points. It appears different activities may have taken place in each of these eastern groups.

Blowout Area 6 is one of the areas where PRB flakes were analyzed to determine if they were from bifacial, unifacial, or indeterminate retouch (Figure 6.18). As much of this cluster is from Blowout Area 6, I examined the number of these flakes to compare with the tool counts. Bifacial thinning flakes account for 42.13 percent (n = 768) of the debitage from this blowout

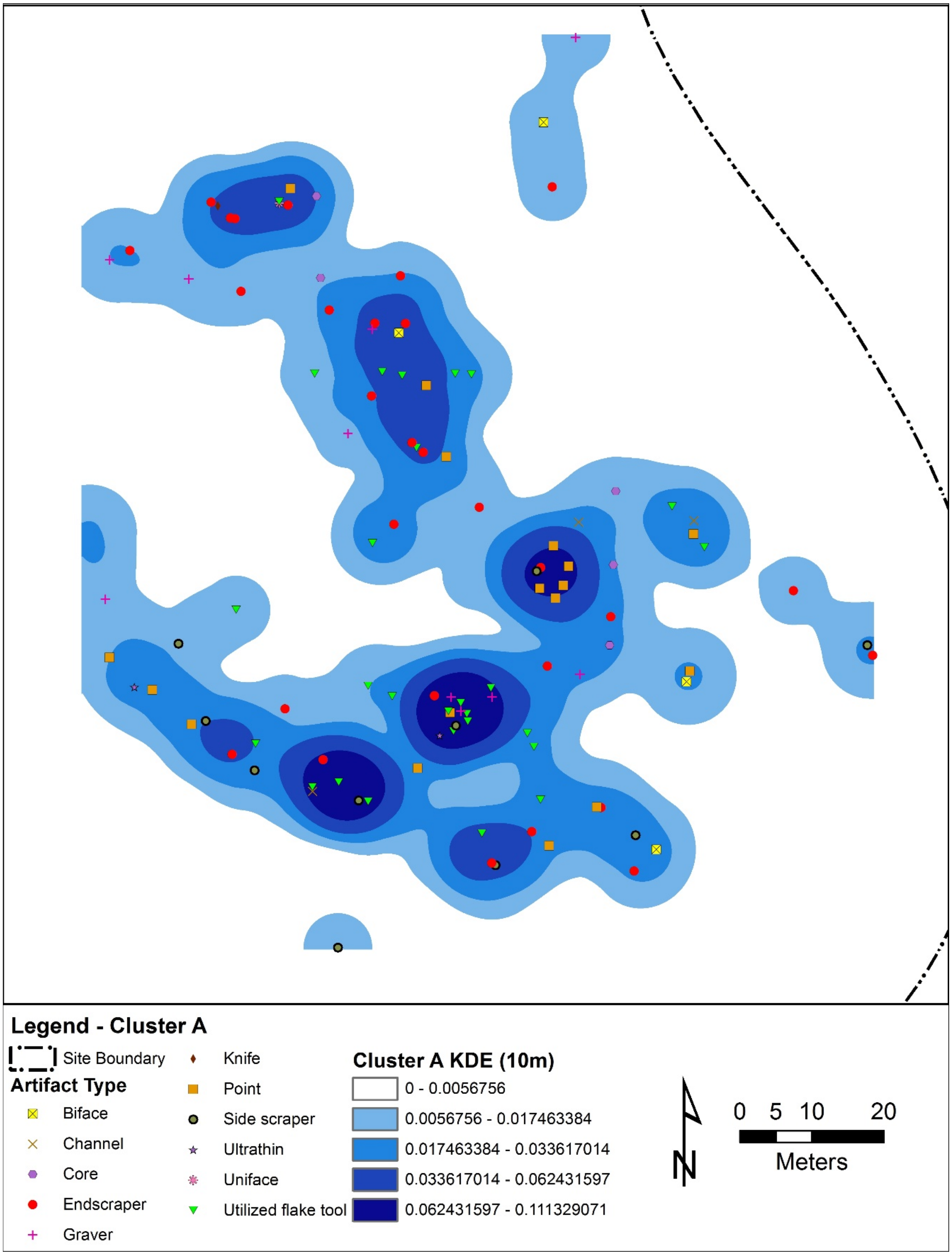

Figure 6.32. TwoStep Cluster A artifacts depicted by artifact type on a 10 m radius KDE of the same artifacts.

area, while 31.82 percent (n = 580) were indeterminate, and only 26.06 percent (n = 475) were unifacial retouch. This was somewhat surprising given that endscrapers were the most common artifact type in the cluster. However, this may be explained by understanding the different ways the data was collected. Nearly half of the endscrapers were recovered from the northern part of the cluster and that potion was actually in Blowout Area 5. Another explanation for the bifacial debitage could be that the northeastern group described above was the location of a bifacial tool production or retooling area. Although no preforms were identified in this cluster, two channel flakes were recovered in the vicinity of the point group (Figure 6.32). Finally, five cores, three of them in the vicinity of the northeastern group, are included in Cluster A. Although this is few cores, only eight were mapped across the entire site; so, the cores in this cluster account for more than half the cores at the site. The presence of cores indicates flintknapping likely occurred here.

Because of its position on the eastern edge of the site, there are areas north and east of Cluster A that have not been blown out yet. In addition, Blowout Area 3B, south of Cluster A, is dramatically underrepresented in these analyses. Because a datum was not installed in that area, we do not have mapped artifacts. This does not mean there were no items recovered from Blowout Area 3B.

Cluster A contains approximately 20 percent of the endscrapers from 41WK21 and endscrapers are the most common artifact in the cluster assemblage. This cluster also exhibits a spatial patterning that would allow for a significant number of hides to be processed in an interior area. In addition, other artifact types we might expect in a hideworking assemblage, such as utilized flake tools and gravers, are fairly common. Although it appears hideworking was taking place in this area of the site, it was not the only activity. Knapping of or discard of bifacial tools and points took place primarily in the northeastern area of the cluster.

Cluster B

Cluster B contains the fewest number of artifacts in any cluster at 41WK21 (n = 87; 9.5 percent of the total). It is located in the northeastern portion of the site and includes the single mapped hearth (Figure 6.24). As described above, this hearth consisted of a carbonized stain that was roughly circular, 65 cm in diameter, and about 20-25 cm deep. All of the artifacts assigned to Custer B were mapped in the central and northern parts of Blowout Area 5.

In Cluster B, points and preforms are the most common tool types (22.99 percent of the cluster; 19.23 percent of the points and preforms), but both endscrapers and utilized flakes are well represented (Table 6.7). A total of six preforms and 14 points were recorded in this cluster. In addition, 12 channel flakes (13.79 percent of the cluster; 17.65 percent of channel flakes) also were recovered in this cluster. Several other tool types were recovered in small numbers; however, no side scrapers or ultrathins were identified in Cluster B.

The spatial extent of the artifacts in Cluster B is approximately 84 x 96 m. The densest concentration of artifacts in this area is a group of artifacts about 20 x 35 m south of the hearth (Figure 6.33). Cluster B artifacts are concentrated south of the hearth in general; using the hearth as the center, I divided the area into four quadrants, northwest, northeast, southeast, and southwest. Only three artifacts are mapped northeast of the hearth and six northwest of it. In contrast, 32 artifacts are mapped to the southeast and 46 to the southwest. A prevailing wind from the south or southeast or a natural barrier such as a dune may have prohibited people from using the north side of the hearth. Alternatively, a structure in the vicinity may have influenced where activities took place and therefore where artifacts accumulated around the hearth (Stapert 1989).

Although they appear to have been somewhat ephemeral, hearths have been documented and/or interpreted at several Folsom sites (Surovell and Waguespack 2007:Table 8.1). Hearth-centered activity areas commonly include artifacts that indicate a variety of activities took place in the area. This is unsurprising as fire provides heat and light and serves as a location where people of all ages and genders commonly gather (Surovell and Waguespack 2007; Zink 2007). In addition, hearths are often in or near habitation structures. An in-depth analysis of the distribution around this hearth is beyond the scope of this study, but would certainly elucidate more about how this area of the site was utilized. Other Folsom sites with hearth-centered activity areas should be considered for comparison in a study of this hearth area.

Visual observation of the distribution of artifacts in this area suggested a pattern wherein points and preforms are closer to the hearth area than endscrapers (Figure 6.33). Indeed, Cluster B endscrapers average 29.88 m from the center of the hearth while points and preforms average only 20.76 m from the same point. The endscraper nearest the hearth was 16.4 m away while the nearest point was 0.5 m from the hearth. Analysts of both the Verberie and Pincevent assemblages from France noted scrapers more distant from hearths than other tool types, albeit at smaller overall scales (Audouze 2010; Carr 1985; Keeler 2010; Stapert 1989).

There are several reasons endscrapers may have been deposited near hearths. For example, the tools may be brought to the hearth area for sharpening or replacement when they were exhausted. They also may be at hearths because a single hide was being worked in the vicinity of the hearth, also the finishing of hide products (e.g. trimming holes, decoration, and smoking) may take place near hearths. Finally, deposits of endscrapers in the vicinity of hearths may be the result of cleaning and discard (Simek 1984). At an average distance of 30 m from this hearth, however, the endscrapers in Cluster B are more likely to have been discarded or lost near where hides were being actively worked than in association with the hearth.

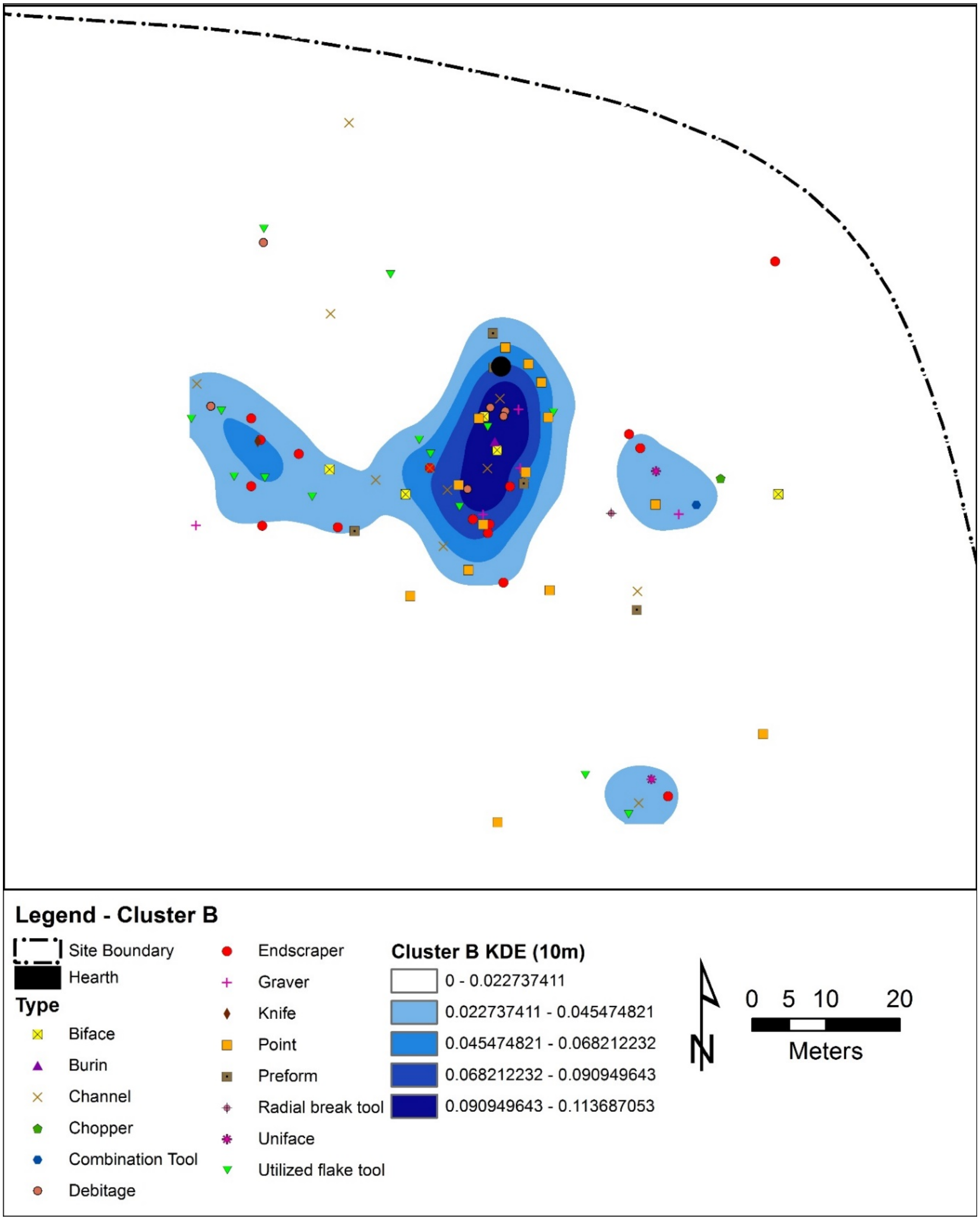

Figure 6.33. TwoStep Cluster B artifacts depicted by artifact type on a 10 m radius KDE of the same artifacts.

Because of Cluster B's position in the northeastern part of the site, areas to the north and east have not blown out yet. In addition, smaller areas to the west and south will become exposed over time. Continued mapping of these areas as blowouts migrate will give us a better idea of whether or not Cluster B is on the edge of the site.

Cluster B contains 16 endscrapers (10 percent of the endscrapers) from 41WK21. Although points and preforms are the most common artifact in the cluster assemblage, it appears a variety of activities were taking place in this area of the site. The production of projectile points is suggested by the recovery of 12 channel flakes and six preforms. This variety as well as the spatial patterning may be explained by the presence of a hearth. Endscrapers are located south, southwest, and southeast of the hearth in areas where there would have been space to work hides, although not on the scale the interior area of Cluster A may have offered.

Cluster C

The largest cluster of artifacts as defined by the TwoStep analysis is Cluster C, which includes 18.8 percent (n = 171) of the total assemblage. Cluster C is in the south-central portion of the site, south of the large bonebed and including the smaller bonebed area (Figure 6.24). As described above, this small bonebed area was approximately 12 x 12 m. All but one of the Cluster C artifacts was from the central and southeastern portion of Blowout Area 2.

Hofman et al. (1990:235) hypothesized Blowout Area 2 was an area where "lithic tool production, retooling of projectiles, and light duty expedient tasks" took place. In addition to the mapped artifacts and the smaller bonebed, human teeth were found in this area (Hofman et al. 1990) (Figure 6.34). The teeth and enamel fragments were recovered in anatomical order and are probably from a young person, tentatively a girl, around 14 years old (Owsley and Bruwelheide 1999). Four teeth and several enamel fragments were recovered and their analysis indicates at least two periods of nutritional and/or disease stress while the person was living (Owsley and Bruwelheide 1999). No evidence of a burial pit feature was recorded in association with the teeth, but a concentration of red ochre was observed nearby. Additional studies of these teeth are planned. The recovery of human teeth helps to illustrate the diversity of activities in this area.

Although their spatial extents differ, Hofman et al.'s (1990) Blowout Area 2 would have included nearly all of the Cluster C artifacts. In Cluster C, debitage (n = 38; 22.22 percent of the cluster) was the most common mapped artifact type. Nearly 20 percent of the cluster was composed of endscrapers (n = 32; 20.51 percent of the endscrapers) and in similar numbers the points and preforms (n = 29; 12.61 percent of points and preforms) also are represented (Table 6.7). Only five preform fragments and eight channel flakes (4.68 percent of the cluster; 11.76 percent of channel flakes) were assigned to this cluster. These relatively low quantities of point production artifacts suggest that was not the primary task in this area of the site. As the only area where debitage was the most commonly mapped item, it is likely some lithic tool production or the discard of that activity occurred here; however, caution with this interpretation must be used since debitage was not systematically mapped at 41WK21. Utilized flake tools and gravers were present in Cluster C, and five side scrapers and two ultrathins were mapped there (Table 6.7). Cluster C contains 14 types of artifacts; all but four of the artifact types used in this study.

The total spatial extent of the artifacts in Cluster C is fairly large (111 x 116 m), but the concentration of artifacts is about 62 x 63 m, roughly circular, and includes the smaller bonebed area (Figure 6.34). Within the concentration of artifacts, there are many different types. Visual inspection of the artifact distribution shows that endscrapers are concentrated in the eastern portion of the cluster. Points and preforms, as well as channel flakes, are more common in the western areas. Despite this pattern, the artifact types are found throughout Cluster C. Five artifacts are mapped in the smaller bonebed: three endscrapers, a channel flake, and a piece of debitage.

Cluster C may indeed be an area where tool production, retooling, and light duty expedient tasks took place (Hofman et al. 1990:235). Given the variety of tools identified here, it appears several activities took place in close proximity. The area east-southeast of the concentration has a light artifact distribution that contains 10 endscrapers and 25 artifacts total. This location, apparently on the periphery of the site, had significant room to process multiple hides.

As Blowout Area 2 continues to migrate north-northeast, it will be interesting to see what the area between Cluster C and the main bonebed holds (Figure 6.24). The northern outliers of Cluster C are largely points and preforms; as these are near Cluster D this is unsurprising, for an explanation see the next section.

Cluster D

Cluster D (n = 169; 18.6 percent of total) contained nearly as many artifacts as Cluster C. The Cluster D artifacts were originally mapped in the west-central and southwestern part of Blowout Area 3/3A and the northwestern portion of Blowout Area 2 (Figure 6.24). The western portion of the large bonebed contains several Cluster D artifacts.

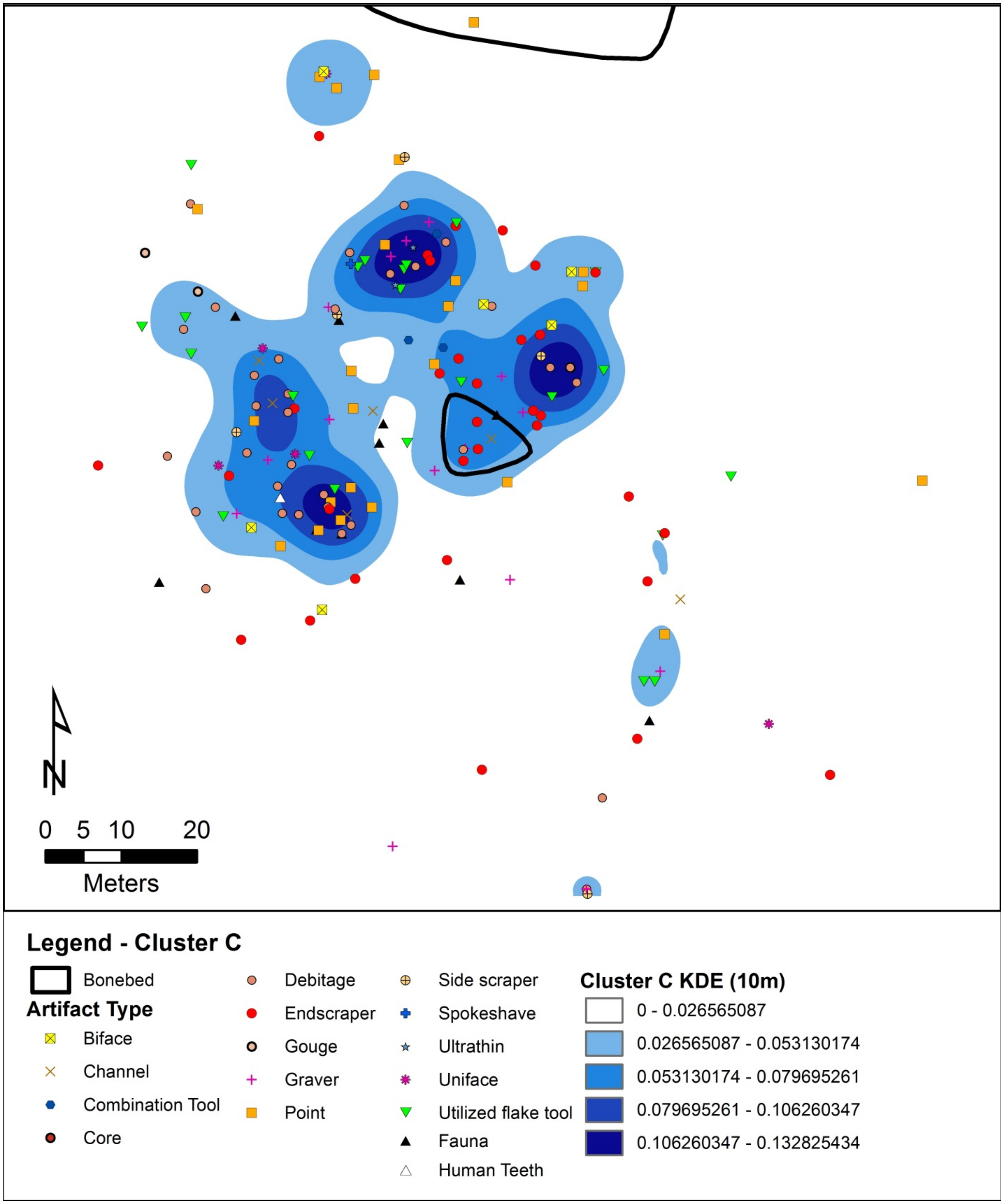

Figure 6.34. TwoStep Cluster C artifacts depicted by artifact type on a 10 m radius KDE of the same artifacts.

Hofman et al. (1990:235) observed that points were common in Blowout Area 3 and indeed, points and preforms dominate the Cluster D assemblage. Ten preforms and 81 points, together 53.85 percent of the Cluster D artifacts, are recorded there. These numbers account for 40 percent of the total points and preforms recovered from 41WK21 (Table 6.7). Nineteen channel flakes, 27.94 percent of the channel flakes from the site, also are mapped in this area. The only other artifact type with more than ten items in Cluster D are utilized flakes (n = 17). In contrast to these types, only nine endscrapers (5.33 percent of the cluster; 5.77 percent of the endscrapers) are assigned to this cluster (Table 6.7). The overall dimensions of the Cluster D artifacts are 77 x 137 m with the long axis trending northwest to southeast; however, the densest area of artifacts is in the south part of the cluster (Figure 6.35).

The few endscrapers are dispersed and mostly along the exterior edges of Cluster D. It is unlikely hideworking took place in this portion of the site. Although not the focus of this study, I would be remiss not to point out a spatial pattern in the points, preforms, and channel flakes of Cluster D. Projectile points are distributed across the spatial extent of Cluster D whereas most preforms and channel flakes are concentrated in the densest area of artifacts at the south end of the cluster (Figure 6.35). A similar pattern of more dispersed point patterning and more concentrated areas of preforms and channel flakes was identified at the Lindenmeier site (Sellet 2013:392-394). Additional evaluation of this pattern, as well as the distribution of points, preforms, and channel flakes across the site, should be undertaken.

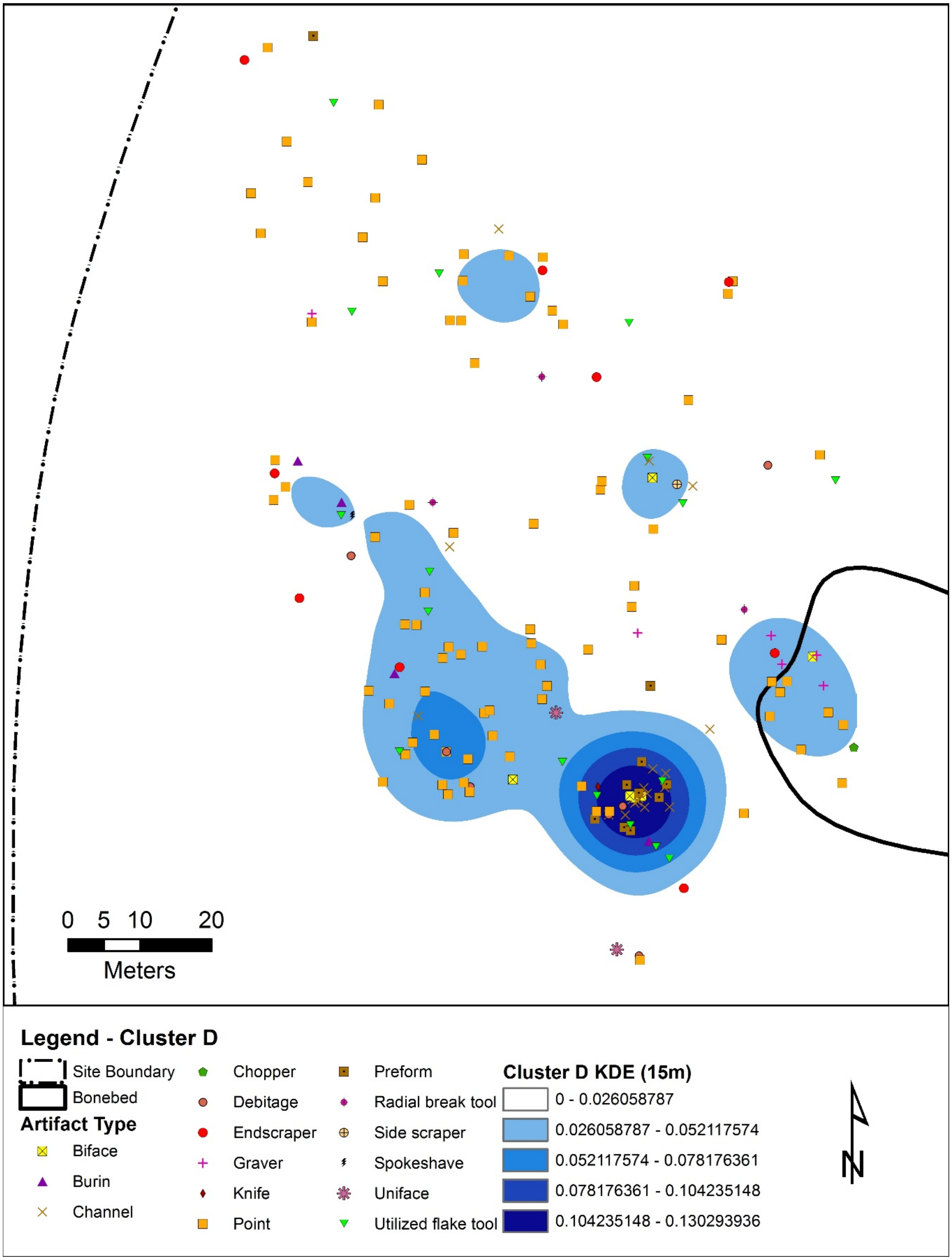

Figure 6.35. TwoStep Cluster D artifacts depicted by artifact type on a 15 m radius KDE of the same artifacts.

The concentration of preforms and channel flakes is approximately 10 x 15 m and utilized flakes (n = 3), bifaces (n = 2), points (n = 2), and debitage (n = 2) also are mapped in the area. This point production group is saddled between two less dense concentrations of completed points (Figures 6.30, 6.31, and 6.35). These items appear to be the remains of an in situ knapping location where point production was the goal.

It appears Cluster D was an area for the butchery of animals from the kill (Hofman et al. 1990) and flintknapping for point production. If, as is commonly documented among living and historic groups, males were responsible for kills and the associated hunting toolkit, this cluster provides support for a gender specific use of areas at 41WK21. This contrasts with the results of Clusters B and C, which suggested men and women were both using those area.

Cluster E

Ninety-four mapped artifacts (10.3 percent of the total assemblage) are assigned to Cluster E (Figure 6.36). This cluster is located in the northwestern portion of 41WK21 and includes all of the artifacts from Blowout Area 4, several from the northern part of Blowout Area 3/3A, and one from Blowout Area 5 (Figure 6.24).

Utilized flake tools (n = 20), endscrapers (n = 18), points and preforms (n = 17), and channel flakes (n = 16) each represent approximately 20 percent (17-22 percent) of the artifacts in this cluster (Table 6.7). Only one other tool category, gravers (n = 10, 10.64 percent of the cluster), had more than five artifacts in this cluster. The points and preforms category includes ten points and seven preforms. Interestingly, three ultrathins (37.50 percent of the ultrathins) were assigned to this cluster.

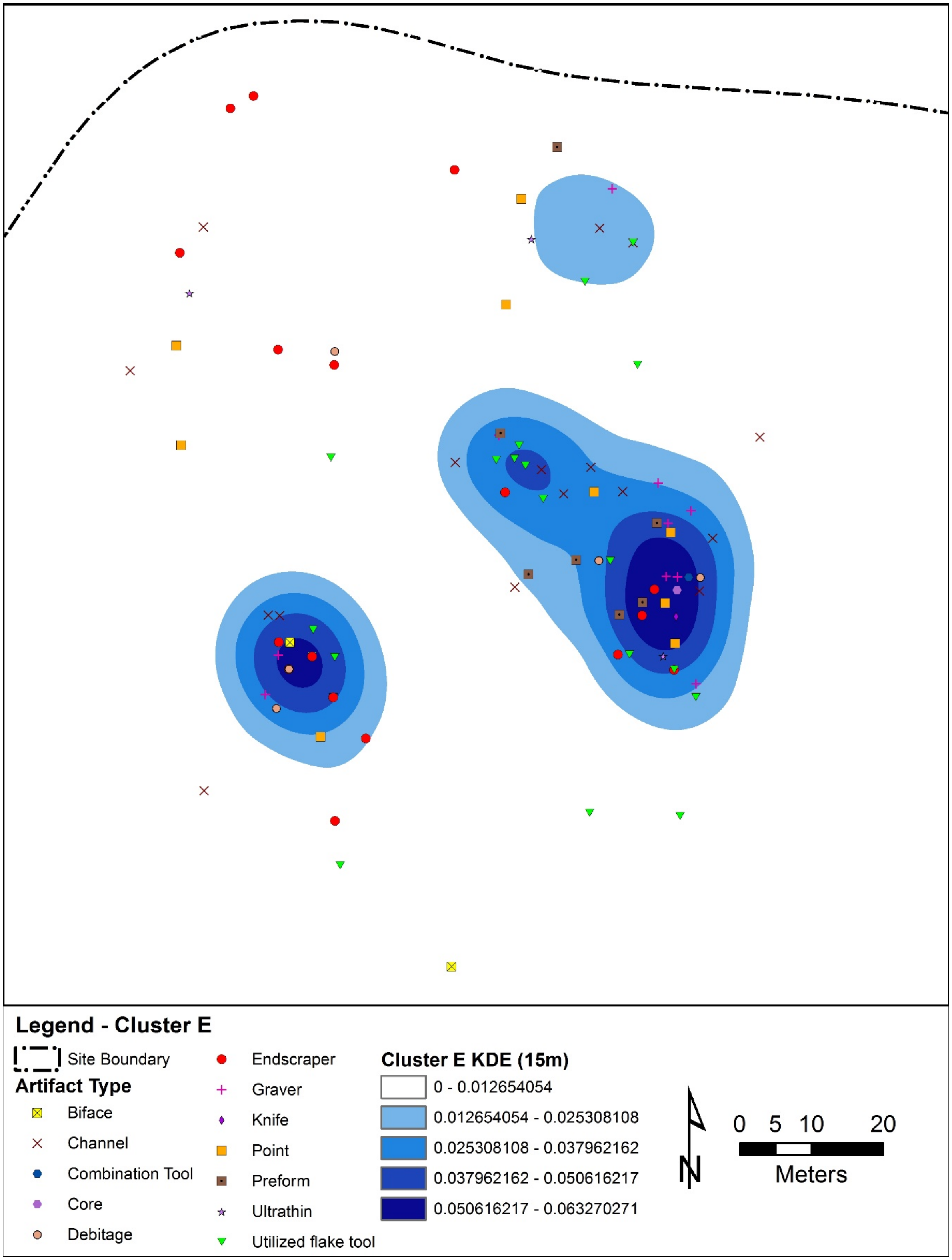

Figure 6.36. TwoStep Cluster E artifacts depicted by artifact type on a 15 m radius KDE of the same artifacts.

The spatial extent of the artifacts in Cluster E is approximately 78 x 126 m with the long axis trending north-south; however, like several other clusters, some areas within this cluster contain more artifacts than others. In the case of Cluster E, there are three dense concentrations near the middle of the artifact distribution (Figure 6.36).

The presence of a core, 16 channel flakes, and seven preforms suggests that flintknapping was a key activity in this area of the site, but like Clusters A, B, and C, the overall artifact distribution indicates a variety of activities occurred here. Six of the seven preforms are in the two eastern dense areas along with eight channel flakes. The single core is also in that area.

During visual inspection of the artifact distribution of Cluster E, I observed six endscrapers were recovered in the areas with few artifacts north of the dense groups of items (Figure 6.36). This area, which is also on the periphery of the site, may be a good candidate for hideworking; but it should be noted that the associated artifacts, consisting of points, channel flakes, debitage, and ultrathins complicate the interpretation of this area. This northern area with few artifacts is approximately 50 x 50 m, which is sufficient room for the processing of multiple hides.

Cluster F

A total of 151 mapped artifacts (16.6 percent of artifacts) are assigned to Cluster F, in the center of the site area (Figure 6.24). Most of the artifacts in the main bonebed area are assigned to Cluster F, a minority of them are assigned to Cluster D and one to Cluster C. Nearly all of the Cluster F artifacts are mapped in the eastern portion of Blowout Area 3/3A.

The most common artifact types assigned to Cluster F are points and preforms (n = 39), which account for about 25 percent of the artifacts in the cluster and nearly 17 percent of the points and preforms at the site (Table 6.7). Only two of these items were preforms, 37 are points and point fragments. Endscrapers (n = 30) and utilized flake tools (n = 27) are the next most common artifacts from this cluster. Debitage (n = 21) and gravers (n = 11) are the only other artifact types with more than ten artifacts assigned the Cluster F.

Cluster F measures about 88 x 94 m. It contains one dense artifact concentration north of the bonebed. That area is about 15 x 25 m (Figure 6.37). Artifacts from within the bonebed are mostly points. Although three endscrapers were mapped in the bonebed, two of them are near the edge of the feature. The dense concentration of artifacts north of the bonebed is similar to the concentrations of artifacts in Cluster C, where several endscrapers are present along with a variety of other tools and debitage. Both side scrapers (n = 4) and ultrathins (n = 1) are represented in small numbers in the Cluster F assemblage.

The low numbers of preforms and channel flakes in Cluster F suggest point production was not a common activity in this area, but the presence of mapped debitage indicates some flintknapping likely did occur there. Given the proximity to the larger bonebed, which is interpreted as a kill (Hofman et al. 1990), it is likely some butchering and skinning took place within the spatial extent of Cluster F. Hideworking may have taken place here as well. Although Cluster F is in the center of the site, there are areas to the north and south that have not yet been exposed by wind erosion and three areas that are relatively devoid of artifacts are located to the east (the "interior area" of Cluster A), northwest, and southeast. If few artifacts were lost during hideworking and artifacts were returned to a central area for retooling, areas largely devoid of artifacts may indicate hideworking. However, this assertion is difficult to support because it is an argument from the absence of evidence.

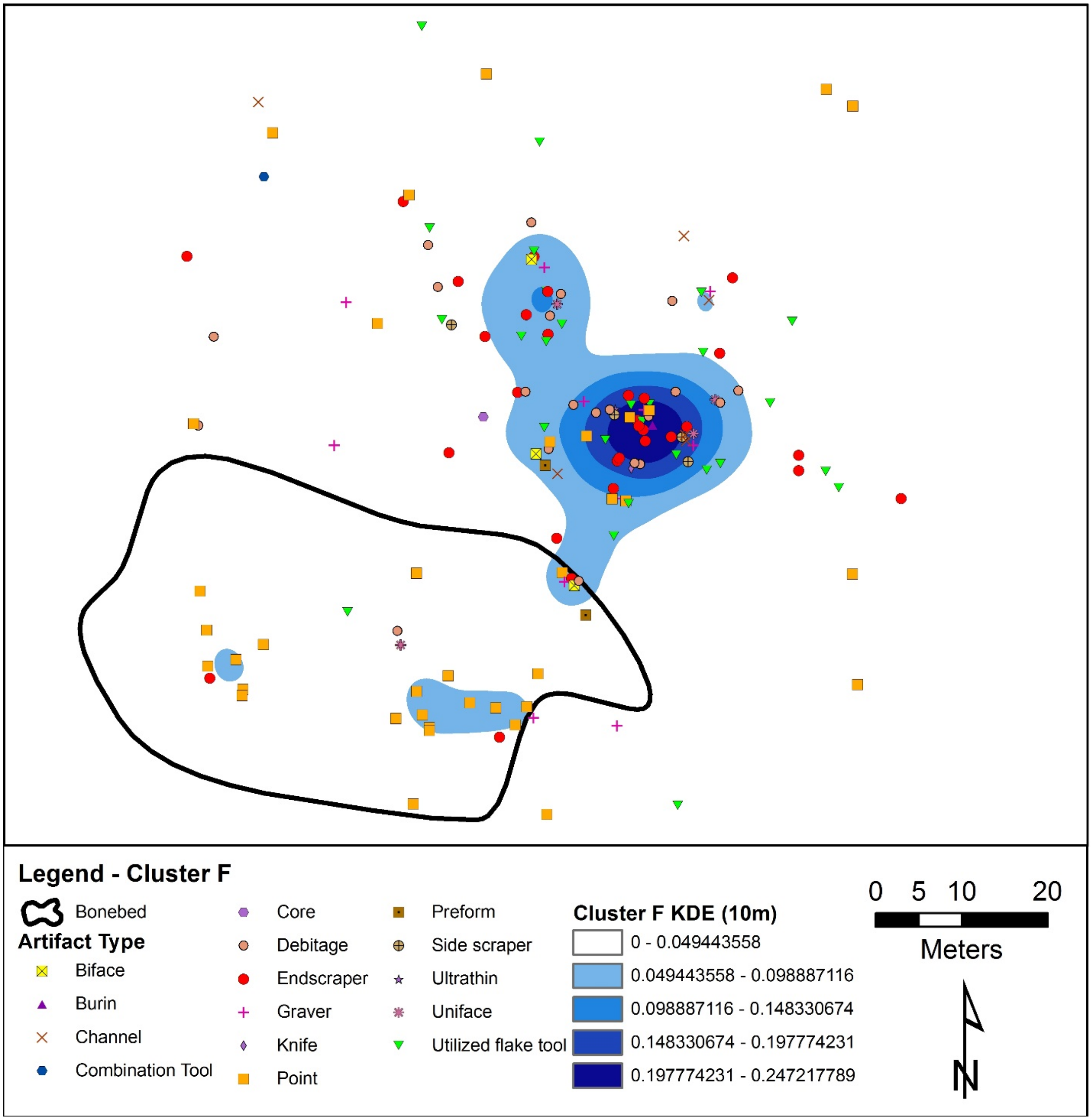

Figure 6.37. TwoStep Cluster F artifacts depicted by artifact type on a 10 m radius KDE of the same artifacts.

Cluster G

Cluster G is composed of 107 artifacts from the southwestern portion of 41WK21 (Figure 6.24). The artifacts in this cluster are mapped in Blowout Area 7 and the southwestern portion of Blowout Area 2. Blowout Area 7 has been exposed relatively recently (since 1999) and nearly all of the artifacts were mapped with a GPS, as the precision of the GPS is limited, many of the artifacts from that area appear to be on a grid. This is an artifact of the mapping tool. In addition to chipped stone artifacts, some bone and burned bone have been recorded from this blowout area (Richard Rose to Jack Hofman, letter, July 30, 2013). There is still an area of 15-35 m between Blowout Areas 7 and 2 that has not been exposed (Figure 6.38); this area will be of much interest as it is exposed. In addition, this might be an ideal area for a controlled excavation, if one were to be undertaken.

In Cluster G, utilized flake tools are the most common tool type (35.51 percent of the cluster; 22.62 percent of the tool category) (Table 6.7). Endscrapers (n = 21) and points and preforms (n = 17) accounted for 19.63 and 15.89 percent of the cluster, respectively. Only two preforms and four channel flakes are associated with Cluster G. The other artifact types contributed 10 percent or less of the cluster assemblage.

The spatial extent of the artifacts in Cluster G is approximately 99 x 119 m, but the 15 m KDE shows two concentrations of artifacts within that area (Figure 6.38). These artifact concentrations are separated by the dune area between Blowouts 2 and 7. The northern concentration in Blowout Area 2 is not as dense as the southern one in Blowout Area 7.

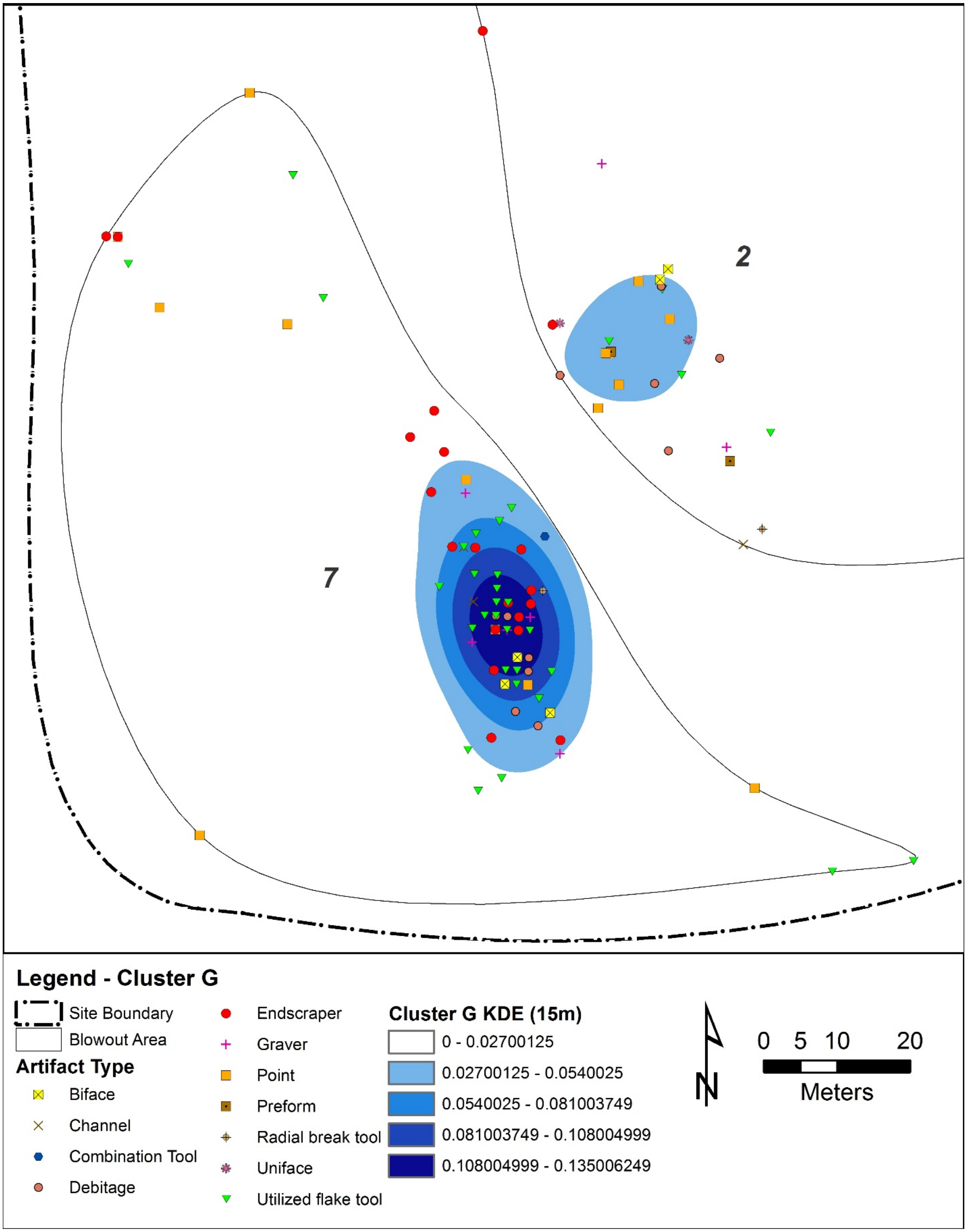

Figure 6.38. TwoStep Cluster G artifacts depicted by artifact type on a 15 m radius KDE of the same artifacts. Blowout areas also are included on this map, note areas that have not yet blown out.

The Cluster G artifacts in and near the northern concentration include both of the preforms and five of the points. Only one endscraper is near the northern concentration. Conversely, the southern concentration in Blowout Area 7 encompasses most of the utilized flake tools and endscrapers assigned to this cluster. The southern concentration is approximately 15 x 40 m with a general north-south orientation (Figure 6.38).

Blowout Area 7 is one of the two areas where the complete sample of PRB flakes have been analyzed to determine if they were bifacial, unifacial, or of indeterminate reduction trajectory (Figure 6.18). Therefore, we have counts of these items from the southern concentration and the dispersed scatter around it. A total of 2,973 flakes were collected between 1999 and April 2015 from Blowout Area 7. Unifacial thinning flakes account for 40.43 percent (n = 1,202) of this debitage, while 39.32 percent (n = 1,169) was indeterminate and 20.25 percent (n = 602) were bifacial thinning flakes. Rose (Personal communication, April 16, 2015) indicated that much of this debitage was recovered from the southern concentration.

The combination of 13 scrapers in a concentration, along with a debitage assemblage that contains a significant proportion of unifacial retouch flakes, suggests this area was the used to manufacture and resharpen unifacial tools such as endscrapers. These activities may have taken place near a hearth, but none have been mapped in Cluster G to date. Fairly large areas of Blowout Area 7 are devoid of artifacts, which makes this portion of the site, presumably on the periphery, a potential hideworking area.

Cluster G contains approximately 13.5 percent of the endscrapers from 41WK21. This information, coupled with the area's unifacial retouch flake count, make it a good candidate for a hideworking activity area at 41WK21. Utilized flake tools, which may have been used for any number of tasks including skinning, butchering, and cleaning hides, also are common in this cluster. Apparently the manufacture and resharpening of endscrapers was an important activity in this southernmost portion of the site (Figure 6.24).

Inter-cluster Distance

Using Andrews et al.'s (2008) method of measuring site size by creating a bounding rectangle, 41WK21 is 11.32 hectares. This is larger than all but one of the sites inventoried by Andrews et al. (2008). Only the Mountaineer site, at 17.03 hectares, is larger. Compared with other Folsom sites and ethnographic examples, 41WK21 is a large site, which suggests it was reoccupied and/or an aggregation site. Although the site's size suggests reoccupation, refits between different areas of the site indicate many of the artifacts were deposited during one occupation of the site.

As mentioned above, the first pattern I observed in the 41WK21 chipped stone KDE was one of four clusters roughly evenly distributed from the northeast to southwest across the site. Given that the cluster analysis largely corresponded with groups observed in the KDE, inter-cluster distance (ICD) has the potential to quantify this pattern. ICD is defined as the straight line distance from the center of a cluster to the center of the nearest cluster (Andrews et al. 2008:Figure 2). As this definition was somewhat ambiguous, I measured to the next closest center, always moving to another cluster instead of returning to the previous one. This created a daisy chain effect and provided me with an ICD value for each cluster, it also is consistent with Andrews et al.'s (2008:Figure 2) illustration of ICD measurement. It is important to note that this exercise in determining ICD was conducted to gain a sense of how 41WK21 compares with other Folsom sites. Because the researchers of each site study identified clusters in different ways, the data are not directly comparable.

Using the centroids of the TwoStep clusters, ICD measurement resulted in six distances where the average ICD was 89.69 m and the range was from 83.12 to 105.01 m. When compared to the ICDs presented in Andrews et al. (2008:Figure 8), 41WK21 has one of the larger ICDs with a fairly small range and standard deviation (coefficient of variation = 10.4807).

Although 41WK21 has one of the larger ICDs, other Folsom sites have been demonstrated to have similar distance between areas. For example, the Waugh site in Oklahoma contains a hearth area and likely contemporary bonebed about 100 m distant from one another (Hofman 1995, 2006; note this is not the distance used by Andrews et al. [2008] for the Waugh site). At the Lubbock Lake site, Andrews et al. (2008) report a ICD of 130.18 m, larger than that from 41WK21.

Andrews et al. (2008:474) proposed that sites that are the remains of a single occupation would have a low ICD and variation while reoccupied sites would have higher ICD measurements with more variability because "it is unlikely that groups will camp in exactly the same place as previous occupations" (Andrews et al. 2008:474). Site 41WK21 certainly fits the category of a large site with a relatively high ICD, which is suggestive of reoccupation. Low variation around the mean, however, suggests the site was not reoccupied; but rather, it was an aggregation site that was occupied by several separate groups at the same time or it was occupied by one large co-residential group. The refit data mentioned above supports the interpretation that all areas of the site were occupied at the same time. These ideas are further discussed below.

A Hideworking Assemblage?

The model developed for hideworking activity areas indicates that, in addition to endscrapers, several other tools types may be associated with hideworking. To see if these other tools categories corresponded spatially with endscrapers I assigned them all to a "Hide Group."

The Hide Group (n = 225) included gravers, key-shaped perforators, and both bifacial and unifacial knives in addition to endscrapers. Examining a KDE of the distribution of Hide Group artifacts as a whole reveals both similarities and differences with the endscraper group alone (Figure 6.39). The addition of other Hide Group artifacts extended the concentration of artifacts near the hearth to the west, but other areas were unaffected or had a very similar distribution to that of the endscraper KDE.

Another type of artifact that may be associated with hideworking is ultrathins. Eight of these items from 41WK21 are mapped. If these artifacts were used as jerky knives, as has been suggested (Jodry 1998), they may be expected to be found in the vicinity of hideworking tools. Figure 6.40 depicts the location of these specialty tools overlain on the endscraper KDE from the site. Ultrathins are fairly dispersed across 41WK21. Three ultrathins were mapped in the vicinity of endscraper concentrations while the other five were not. To see if these tools corresponded to other tools patterns, I also compared the distribution of ultrathins to the points, preforms, and channel flakes, but there was even less correlation between those categories than between ultrathins and endscrapers. Because of the small sample of ultrathins from the site, these results are anecdotal. Additional study of the spatial distribution of ultrathins may yet yield a better understanding of this distinctive tool type.

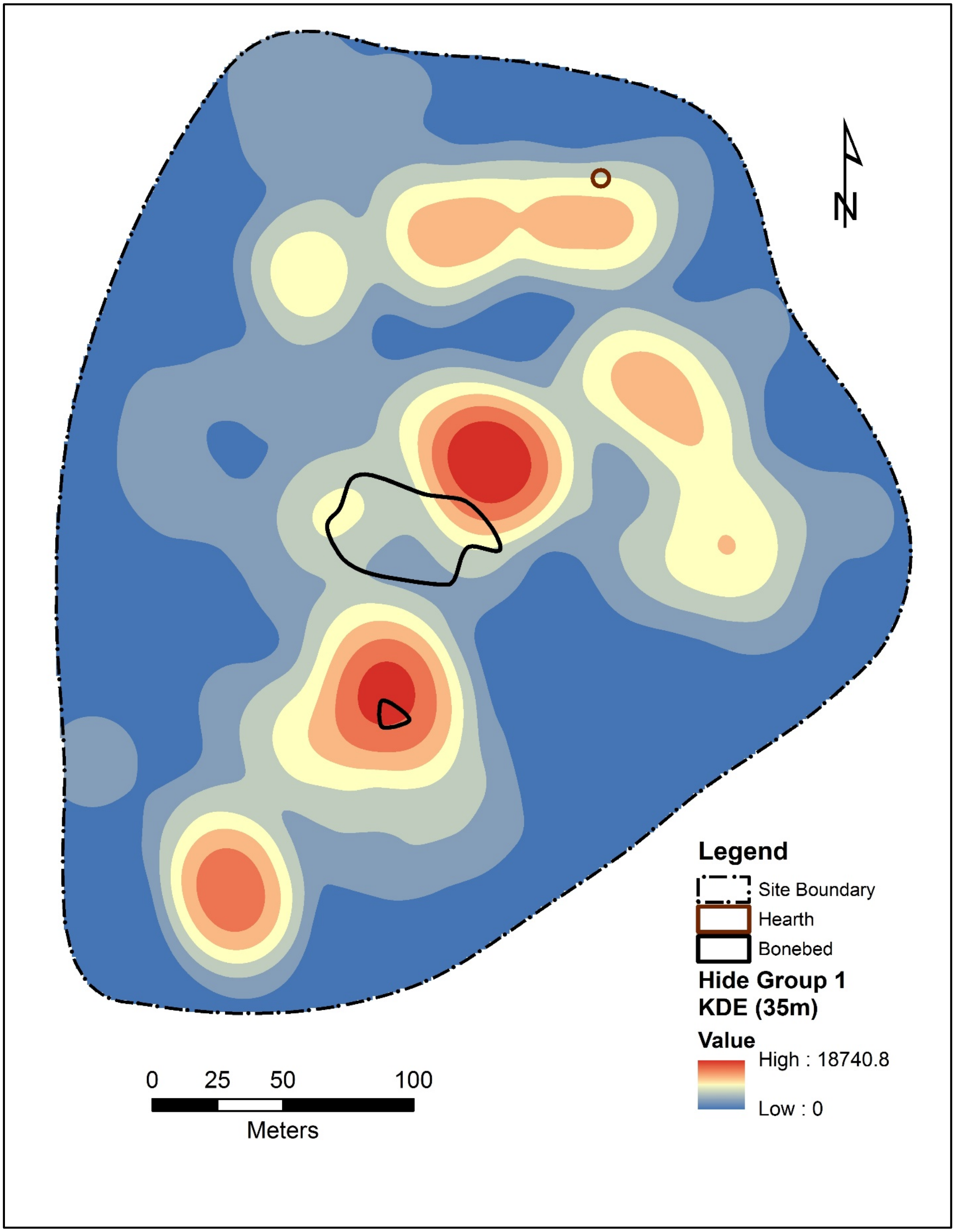

Figure 6.39. KDE using all Hide Group artifacts (n=225).

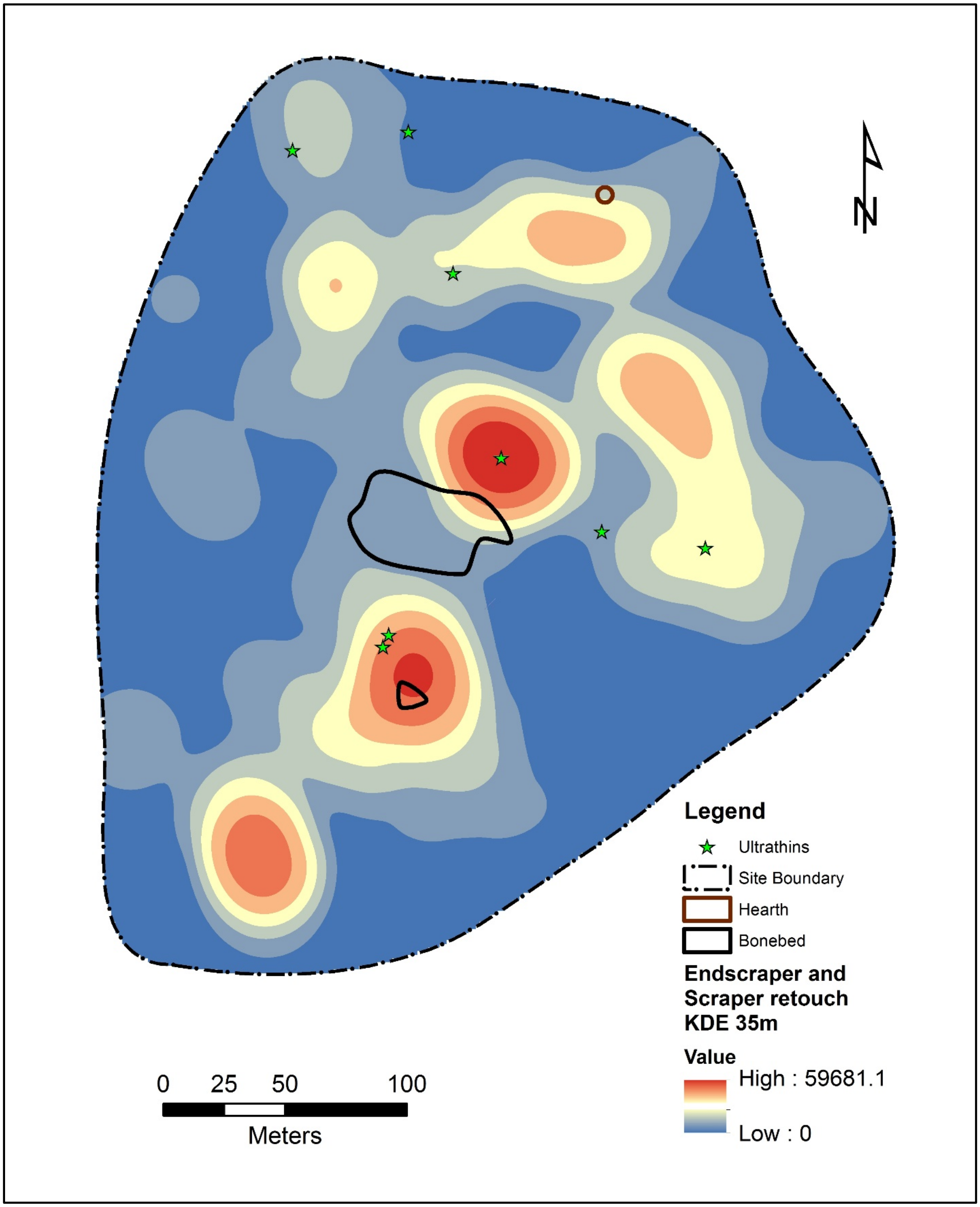

Figure 6.40. Mapped ultrathins at 41WK21 compared to the endscraper and scraper retouch KDE.

Chapter 7. Summary and Conclusions

This research utilized information from subject-side and source-side data sources to develop ideas about how prehistoric hideworking activity areas may be recognized in the archaeological record, and two Folsom/Midland Paleoindian sites were examined for evidence of these patterns. Lithic and spatial data from both sites indicates hideworking was practiced, albeit in ways that left different archaeological signatures.

Hideworking Activity Areas: A Model

I began this study with a series of four research questions which I shall revisit here. The first two questions dealt with the development of a model for recognizing hideworking activity areas and asked what kinds of information could be used in archaeological model creation:

(1) How can ethnographic analogy and middle-range theory inform our ideas about the identification and use of hideworking areas?

(2) What do we know about hideworking activity areas from ethnohistoric, ethnographic, and archaeological data?

To address these questions, I reviewed how analogy has been and is most productively used in archaeological interpretations. Then, I developed a model using both subject-side and source-side data to help recognize the presence, location, and nature of hideworking activity areas.

The model hypothesized that, as hideworking required a variety of specific tool types, concentrations of hideworking tools may have accumulated in areas where hides were processed. Endscrapers are generally good indicators of hideworking; however, they may be found where they were used, resharpened, or discarded. I also proposed that evidence of small-scale hideworking would be found near hearths and residential areas while large-scale hideworking may be found at a distance from those areas.

Sites 14SN106 and 41WK21

The third research question asked what we can learn from evidence of potential hideworking activity areas at sites 14SN106 and 41WK21. Site 14SN106 is a buried Folsom site in western Kansas. It is one of three buried Paleoindian sites at the Kanorado Locality. The site is near Middle Beaver Creek and was discovered in alluvial sediments. The artifact assemblage consists primarily of artifacts from a relatively small Main Block excavation where endscrapers dominate the tool assemblage. Site 41WK21, the Shifting Sands site, is located in a dune field in western Texas. Many Folsom and Midland diagnostic artifacts have been recovered from 41WK21. More than 1,000 tools and 20,000 artifacts have been recovered from this site. The artifact assemblages and site settings of these two sites are quite different, but they have several key similarities.

Lithic analysis at both sites identified expected elements from a hideworking artifact assemblage. Endscrapers and their resharpening flakes are common at both sites. Other flake tools also were identified in the chipped stone assemblage; less durable materials were not well represented from these sites. Both of these sites became known to researchers as a result of erosion.

Site Formation Processes

It is the archaeologist's challenge to identify the site formation processes that have affected cultural material. This type of study is becoming more standard as archaeologists generally recognize the significance of site formation processes. Efforts to understand these processes can begin before fieldwork, and should continue through careful observation in the field and during the analysis of cultural deposits. Both natural and anthropogenic site formation processes have been detected at 14SN106 and 41WK21. These Folsom-aged Paleoindian occupations on the High Plains have not escaped disturbance from sedimentation, pedogenic processes, and exposure.

Site 14SN106 was found as a result of anthropogenic channelization of Middle Beaver Creek and natural erosion, whereas deflation revealed the artifacts from 41WK21. Site 14SN106 has been primarily impacted by faunalturbation, digging, and erosion. During excavation every attempt was made to collect and screen material from krotovinas separately from the rest of the matrix being excavated. In addition, artifacts were mapped in situ whenever possible. These data help investigators detect any vertical or horizontal distributions that may be the result of bioturbation (or other site formation processes). Therefore, the excavation methods were designed to minimize the amount of noise from faunalturbation in the data. We acknowledge that some information has been lost due to natural site formation processes. Data also were lost as a result of channelization of Middle Beaver Creek and the erosion of the artificial cutbank. Unlike bioturbation, there is no way to account for this loss of data.

It is likely that 41WK21 also was affected by bioturbation, and additional research may reveal the extent of this disturbance. Wind is the most significant force driving site formation processes at this site. During its burial by eolian forces, the site likely retained its integrity with minimal disruption. However, deflation during the Holocene and modern times has destroyed much vertical integrity for the artifacts collected from blowouts. Because the artifacts were collected shortly after re-exposure, they are assumed to retain some horizontal integrity.

More work on site formation processes is needed, especially at 14SN106. During excavation archaeologists recorded data and collected materials that can answer several questions about the formation processes at that site. As analysis continues, this information will be considered and evaluated. At 41WK21 additional refitting and study of potential faunalturbation will help researchers better understand site formation. This study of site formation processes shows the impacts they have had on artifact distributions at 14SN106 and 41WK21. As a result of this study, I am better equipped to understand the human behavior that created the initial artifact distributions at these sites.

In summary, the site formation processes at both sites have been identified and vertical disturbance is fairly extensive; however, horizontal spatial data yields patterns believed to be related to the human activities that created them.

Site Structure at 14SN106

The Main Block at 14SN106 is a single component hideworking activity area. There is one concentration of artifacts that was a scraper resharpening and exhausted tool discard location. Because of the number of very small flakes from that area, it is believed it is an in situ activity area, but it also is possible these items were knapped elsewhere into a container and dumped in this location. Few bones were recovered from the Main Block, but a preliminary examination of where medium and large animal bones were recovered suggests a different pattern than that of the chipped stone.

It is assumed hideworking activity areas did not occur in isolation. The bison skeleton in Area C, approximately 110 m from the Main Block, may be part of a kill that yielded hides to be processed. In addition to a kill, there may be additional activity areas (e.g. hearth-centered) not yet identified.

Because this locale appears to have been used for hideworking almost exclusively, it is a good site at which to study the artifact composition of a hideworking assemblage. Examples of other sites that consist entirely or largely of a hideworking activity area are the Sandy Ridge site (Jackson 1998) and the Lanning site (Andrews 2010:285-288). At Sandy Ridge, the main activity appears to have been scraper resharpening near hearths; however, hearth-centered activities may vary by season and scraper resharpening may not have always occurred near hearths. At the Lanning site in Colorado, archaeologists have interpreted the site as a short-term animal processing location where scrapers and gravers/awls were found in two clusters that also yielded a significant quantity of debitage (Andrews 2010:287). Choppers and hammerstones, perhaps used in butchering were found in another cluster. In addition, points, preforms, and channel flakes have been identified at the Lanning site, but they are outnumbered by the probable animal processing tools. Several other Paleoindian sites contain areas where hideworking is the dominant activity along with other activity areas (Ferring 2001a; Jodry 1999; Robinson et al. 2009; Robinson and Ort 2013; Witt 2005).

Site Structure at 41WK21

Site 41WK21 is a large (more than 11 hectares) site with a variety of tools distributed across the area. Using artifact type assignments and spatial analysis, the mapped chipped stone artifacts from 41WK21 were explored by examining overall site artifact distribution and KDE maps as well as using TwoStep Cluster Analysis.

More than 90 percent of the complete endscrapers from 41WK21 were discarded when they were between 20 and 50 mm long; however, the remaining 8.6 percent were more than 50 mm long at the time of discard. It is assumed these longer endscrapers were lost prior to the end of their use life while the shorter endscrapers were discarded at the end of their use life. The longer endscrapers were recorded in several blowout areas across the site: 2, 3/3a, 3b, 4, 5, and 6. None of the longer endscrapers were recovered in Blowout Area 7; it appears endscrapers were used intensively until they were exhausted in that area. These scrapers could not be divided into thick and thin categories so their spatial locations by that attribute were not examined.

TwoStep Cluster Analysis at 41WK21 assigned artifacts to seven clusters. The average distance between the centers of these cluster ranges from about 83 to 105 m. Based on the artifact composition and spatial distributions within those clusters, I offer interpretations of the activities that may have taken place in each (Table 7.1).

Table 7.1. Probable activities by TwoStep cluster. This study focused on the recognition of hideworking activity areas. Other patterns also were noted. With additional study additional activities may be assigned to each cluster.

Cluster	Overall Size (m)	Associated Features	Identified Probable Activities
A	63 x 100	--	Hideworking; knapping - production of bifacial tools and some unifacial tools
B	84 x 96	Hearth	Hideworking; knapping - likely both production and retooling or resharpening; heating and/or cooking
C	111 x 116	Small bonebed	Hideworking; butchering (including skinning); knapping - most mapped debitage from this area, likely multiple tool types
D	77 x 137	West portion of larger bonebed	Kill and butchering (including skinning) activities; knapping - point production
E	78 x 126	--	Hideworking; knapping - likely multiple tool types
F	88 x 94	Most of larger bonebed	Hideworking; kill and butchering (including skinning) activities; knapping - as evidenced by the presence of debitage
G	99 x 119	--	Hideworking (southern concentration); knapping - mostly unifacial tool production and resharpening but, also bifacial tool production and/or resharpening

Between 18 and 23 percent of the chipped stone artifacts from Clusters A, B, C, E, F, and G are endscrapers. Only in Cluster D were endscrapers minimally represented (5.33 percent of the cluster). If, as I have assumed, endscrapers at 41WK21 were primarily used for hideworking, it appears hideworking was an activity that took place in several locations across the occupation areas. Maps, including Figure 6.27, also depict this pattern. In addition, if women were hideworkers, it suggests they utilized of most of the site area for hideworking and other activities. Conversely, women may have been constrained from conducting their tasks in the vicinity of Cluster D.

At the Cattle Guard site, Jodry (1999:303) examined the percent of hideworking tools and ultrathins per k-means lithic cluster. In contrast to the 41WK21 results, in only one cluster (k-means lithic cluster 1) did these tools account for more than 10 percent of the cluster total (34.3 percent), while in the other clusters these artifacts only contributed between 2.4 and 9.5 percent of the cluster.

Some of the clusters defined at 41WK21 appear to have been related to one or two activities; on the other hand, several of them exhibited concentrations with many tool types suggestive of multiple activities. Clusters B and E, both in the northern portion of the site, contain similar quantities of several artifact types. As Cluster B is associated with a hearth, it is possible Cluster E also was situated near a hearth, or they are actually parts of one cluster. Further hearth-centered analysis of Cluster B may help us understand this pattern. Efforts to identify additional hearths at the site by examining where burned artifacts are recovered may inform us about potential hearths in the vicinity of Cluster E (Hofman et al. 1990:250).

Endscrapers constitute approximately 20 percent of the artifacts in all clusters except D; however, percentages of other artifact types are not so consistent. The percentages of other tools do not appear to coincide with endscrapers in ways that would suggest a dedicated hideworking assemblage. Two reasons for this include the use of those artifacts for a variety of activities and perhaps their location of discard. Many artifact types, including gravers and utilized knives, could function in preforming a variety of tasks. Endscrapers also may have been used in multiple activities, but use-wear analysis has generally confirmed they were most commonly utilized in hideworking (Ahler 1979; Bamforth and Becker 2009; Boszhardt and McCarthy 1999; Daniele 2003; Donahue and Fischer 2015; Hayden 1979, 1986; Keeley 1980; Loebel 2013a, 2013b; McDevitt 1994; Moore et al. 2016; Root et al. 2000; Seeman et al. 2013; Wilmsen 1970).

Like the Main Block at 14SN106, the south concentration of Cluster G at 41WK21 appears to have been primarily a hideworking area. When the northern concentration (the artifacts from Blowout Area 2) is removed from the Cluster G counts, utilized flake tools and endscrapers account for the vast majority of artifacts in the area.

Recent studies have concluded scrapers and projectile manufacturing co-occurred in areas of the Lindenmeier (Chambers 2015) and Agate Basin sites (Sellet 2004); this is consistent with several areas of 41WK21 where there is evidence for both of these activities. Although some areas (k-means lithic clusters 3, 5, and 6) of the Cattle Guard site also include both hideworking and projectile manufacturing tools, the endscrapers accounted for a small amount of the overall cluster assemblage (Jodry 1999:297-303). At the European sites of Verberie, France, and Trollesgave, Denmark (Audouze 2010; Donahue and Fischer 2015), hideworking tools were found in every area of the site. Specifically, at Verberie hideworking tools were found in the "periphery" of the hearth area, in dumps, and away from other tools (Audouze 2010:162). Although Cluster D at 41WK21 included very few hideworking tools, the other areas are consistent with these findings.

We have considered the statistically defined clusters individually for ideas about activities in different areas of the site, especially for evidence of hideworking. However, we also should consider whether the cultural materials are the result of reoccupation, aggregation, or both. The question of 41WK21 as the remains of an aggregation has been discussed (Hofman 1994). With the information available at that time, Hofman (1994:359) concluded the evidence for it as an aggregation site was "equivocal at best." This study provides additional evidence to consider.

Site 41WK21 is one of the most extensive collections from a Folsom/Midland site; it also is spatially expansive. More than 900 items are mapped and nearly all of the mapped artifacts are chipped stone tools. Given this basic information we assume clusters of artifacts indicate; (1) multiple contemporaneous social units (households); (2) site reoccupation either by different groups or the same group; or (3) a combination of these situations (cf. Donahue and Fischer 2015:320).

Evidence of occupation of 41WK21 by multiple contemporaneous social units could be the remains of a co-residential group of people who live and work together at a particular time and place, or the remains of a periodic aggregation of such groups. Aggregations are "patterned periods of group fusion" (Hofman 1994). Although periods of aggregation and dispersion are ubiquitous among modern hunter-gatherers, identifying evidence in the archaeological record (if it exists) can be challenging (Conkey 1980; Hofman 1994).

Based on ethnographic data, Hofman (1994) suggests archaeological sites that result from aggregations have dispersed residential areas (Whitelaw 1991:Figure 22, 171). As a proxy measure for this, we consider 41WK21's inter-cluster distance measurement average of 90 m, one of the largest among Folsom sites; however, Andrews et al. (2010) argue that such dispersion may be the result of site reoccupation, not aggregations.

What brought people to 41WK21? It is likely that the bonebed at the site resulted from a kill of bison while they were visiting an interdunal pond (Hofman et al. 1990:250; this study). If that was the case, the pond may have been a fixed point on the landscape where aggregations could be planned; alternatively, it may prompt people to return to the location time and again. If the family groups at 41WK21 all traveled and camped together, there would be no need to plan, but rather, a camp could be set up near kills or other resources.

Some researchers have attempted to use lithic material types to argue for aggregations, suggesting separate groups visited different sources before getting together (Bement 1999:169-170). Because almost all of the artifacts from 41WK21 are Edwards chert, whether all of the material was gathered from the same source is an unknown but testable question (cf. Speer 2013a, 2013b, 2014). The geochemical composition of artifacts from different parts of the site may suggest an aggregation of separate groups, or of a group visiting distinct sources sequentially.

Refitting data from 41WK21 may also inform our understanding of whether the site was the camp of one large group or an aggregation. At least one artifact from each of the blowout areas has been refit to an item from a different blowout. It is yet to be confirmed, but it is likely that at least one artifact from each cluster refits to another cluster. This may be because all of the clusters were occupied at the same time and groups were sharing and trading material and tools. On the other hand, the initial occupiers may have cached materials at the site (e.g. large unused flakes) and repeatedly returned to the area to use materials they knew were there. In other words, 41WK21 may itself have become a lithic material source (Hofman et al. 1990:248, 250).

Hofman (1994:352) suggests Folsom aggregations "should leave evidence of multiple roughly comparable residential units with associated features (e.g., hearths) and evidence for a wide range of activities"; however, several small family groups who traveled and operated together may leave a similar signature. The spatial analysis at 41WK21 depicts a pattern that suggests multiple social units. Of the seven identified clusters, one (Cluster D) was clearly dominated by projectile point manufacture, use, and discard. The southern portion of a second cluster (Cluster G), appears to have been primarily a hideworking locale. The other five clusters each exhibited evidence of hideworking along with a variety of other tools. As described above, the clusters were roughly evenly spaced. The variety of tools suggests several activities were taking place in each of these site areas. Although only one hearth has been mapped, evidence of staining on the marl, the location of thermally altered artifacts, and/or the presence of anvil stones (Jodry 1999), may indicate additional hearth locations. Individual hearths may be indications of separate households, architectural features, and/or intramural and extramural activities (Waguespack and Surovell 2014).

At the Cattle Guard site, a kill and camp in a dune setting similar to 41WK21, Jodry (1999:322) identified at least four, and perhaps as many as seven, hearth-centered activity areas or households. Each of these areas was identified by examining artifact density and the presence of nearby hearths. In addition, most of the household clusters included a hammerstone and anvil. Similar to 41WK21, a variety of chipped stone tools were recovered in each of the households. However, unlike 41WK21, the households are each within a few meters of one another (Jodry 1999). As has been discussed, the space between cluster centers at 41WK21 is significantly more, around 90 m. This difference in the amount of space between clusters may be the result of a number of practices. For example, the amount of space may have related to natural barriers; the amount of time anticipated at that location; or it may indicate kinship or friendship between social units. An aggregation of co-residential groups may be more inclined to set up separate camps and have their own hideworking areas. In contrast, a group of people who consistently travel together and share some tasks, such as hideworking, but retain separate hearth areas may camp more closely. Lines of inquiry that help us learn more about the composition of social units at Folsom sites should be pursued and will help researchers address these kinds of questions.

This study provides some support for the hypothesis that 41WK21 was an aggregation site; however, additional studies should be undertaken to determine the validity of this assertion. Specifically, an in-depth study of the refits at the site, which is planned, should yield additional information about which areas of the site are related and better define inter-area relationships. A study of the geochemical composition of artifacts at the site may reveal if the Edwards chert was all gathered from one source. Finally, additional research into the spatial distribution of thermally altered artifacts may support the contention that several hearth-centered residential areas are located at 41WK21.

Life at 41WK21

Based on the information presented, I hypothesize that the remains at 41WK21 were created through the aggregation of 4-5 co-residential groups who were attracted to bison who were visiting an interdunal pond. The people killed more than 50 bison at or near the pond. The area had water and, after the kill, abundant food, so the groups chose to camp at this spot for a period of at least several days.

Co-residential groups of modern hunter-gatherers are variable in size and several authors note the fluidity of their size and composition (Delson et al. 2000; Hill et al. 2011; Whitelaw 1991). Estimates of size for such groups range from 12 to more than 100; however, average group size appears to be between 25 and 40 people (Binford 2001; Hill et al. 2011; Hill et al. 2014; Kelly 1995:210-211, Table 6-2). Such a group would include children and older people as well as young and middle-aged adults.

At 41WK21, the cluster analysis results are interpreted to indicate there may have been 4-5 residential areas (Clusters A, B, C, E, and F) (Figure 7.1). If groups of between 20 and 40 occupied these areas, between 100 and 200 people are likely to have lived at the site. The distance of about 90 m between these clusters supports the interpretation that this was an aggregation site, not one where a large co-residential group camped. Each of these groups would have camped in a residential area where a variety of activities, including tool production and maintenance, cooking, crafts, and sleeping took place.

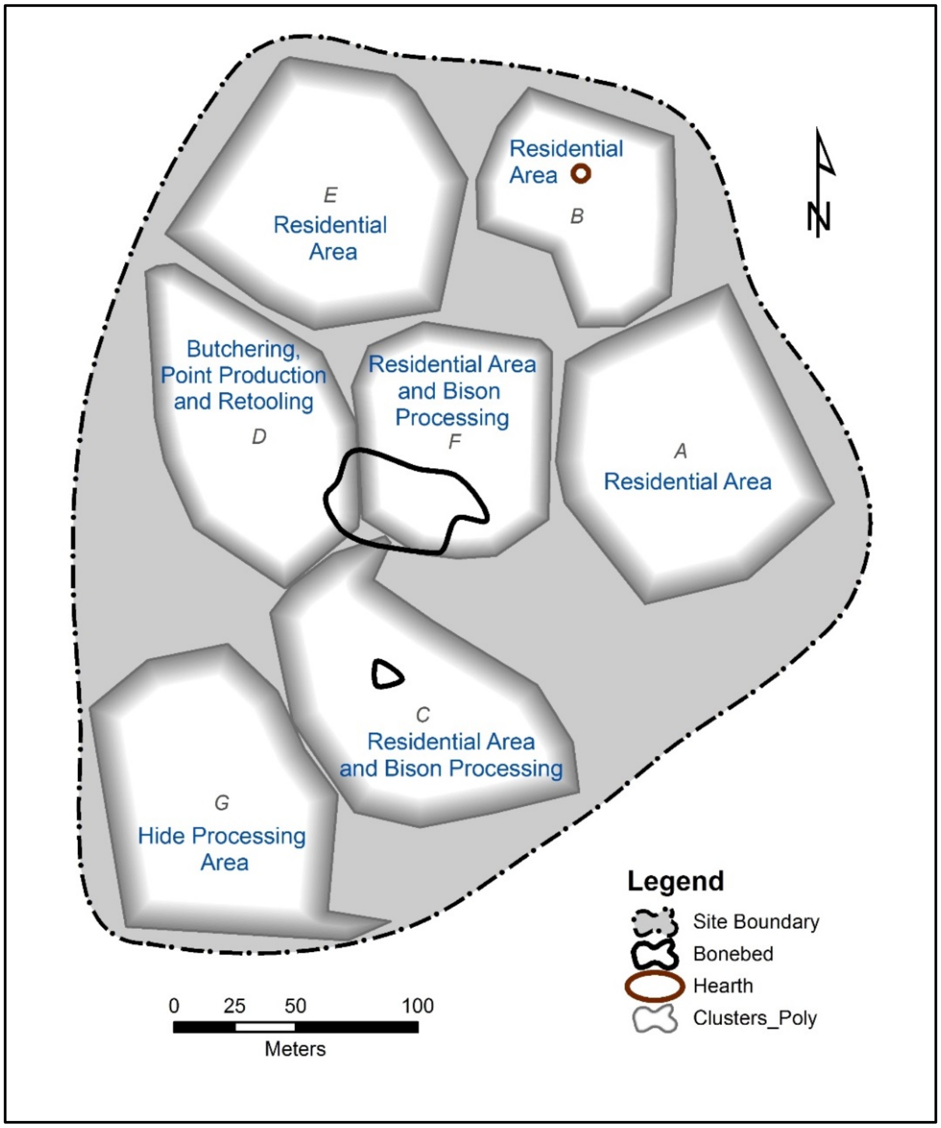

Figure 7.1. Interpretation of primary activities in each of the seven clusters identified at 41WK21.

On the other hand, the camp at 41WK21 does not appear to have been only strictly segregated by co-residential group. Cluster D is an area where projectile point manufacture and discard occurred at a higher rate than anywhere else at the site. Men are commonly associated with these tasks and no matter which co-residential group they were from this may have been a men's area. This flintknapping activity may have been preferentially conducted away from domestic spaces where foot traffic is heavy and children play. In contrast, Cluster G, at the south end of the site is dominated by hideworking and utilized flake tools. This area lacks a concentration of points, preforms, or channel flakes. As women are often the hideworkers, this may be considered a likely women's area.

Given the distribution of endscrapers, it is possible that women worked hides both in their residential areas and communally at the south end of the site. Women may have conducted this task in two areas for a variety of reasons. The function or size of the end product, socialization, and/or the number of hides to be worked all could have influenced where the activity took place. Also, some parts of hideworking and tool maintenance may have taken place away from where scraping took place. After some time, presumably after all the bison meat and hides had been butchered and processed and equipment repaired, the people of 41WK21 broke camp and moved on.

Model Evaluation

The fourth research question asked at the beginning of this document was how will these data help researchers recognize, understand, and evaluate evidence of hideworking activity areas at other archaeological sites? The model generated by this research should be evaluated, supplemented by the findings from 14SN106 and 41WK21, and applied to additional archaeological sites; it is a developing research agenda. In addition, this research has generated questions and additional avenues of inquiry related to the source-side data.

The framework developed for this study implies that researchers may recognize hideworking activity areas by examining the artifact assemblage for specific tools used in hideworking and employing spatial analysis to inspect where those tools were found. Although this may be the case, it is important to note that it is not always a straightforward process. Several tools likely made up prehistoric hideworking artifact assemblages, but some of them have not survived. No bone or antler tools have been identified at either site in question and wood tools would not preserve. Given that chipped and ground stone tools are the most likely to preserve from hideworking toolkits, additional archaeological studies should focus on those artifacts.

Although gravers/perforators/wedges and knives/bifaces/flake knives may have been used in hideworking, we must assume these tools likely also had other uses. At 41WK21, several of these tools were found in clusters with a variety of artifact types. Use-wear should be included in the study to assist in understanding the range of how these tools were employed.

Given the evidence for hideworking tools at Paleoindian archaeological sites, including 14SN106 and 41WK21, the source-side data should be reevaluated. The hideworking toolset I describe was based on ethnohistoric data with later additions from ethnographic and archaeological research. It would behoove researchers to reexamine the ethnohistoric data for evidence of the use of a more varied toolkit for hideworking, one that includes items identified through ethnographic and archaeological research.

Although the evidence from this study for the hypothesis that evidence of small-scale hideworking occurred near hearths and residential areas while large-scale hideworking may be found at a distance from those areas is not convincing, it is generally consistent with the model. An additional statement, however, may be in order. In some areas hideworking may be the only or dominant activity. Other areas, including those with a longer period of occupation, may exhibit evidence of hideworking along with other activities. A reinvestigation of the historic images to see if any of the photos depict a large number of hides being worked at a distance from residences and small scale hideworking near the residences being undertaken concurrently would be relevant. There appears to be significant variability in where hideworking took place at prehistoric sites and recognizing hideworking in the archaeological record is not clear cut. Factors such as wind direction, season, and other activities in the same area may play a role in this patterning.

The incorporation of both subject-side and source-side data into our interpretations both broadens and focuses our likelihood of recognizing hideworking activity areas. Both source-side and subject-side aspects of this model should continue to be refined as new evidence becomes available.

Recommendations for Future Research

There is significant potential for additional studies of the cultural materials from both 14SN106 and 41WK21. Additional research into how site formation processes have impacted the cultural materials at 14SN106 will help further elucidate the hideworking that took place there. Expansion of the Main Block and more exploration at the site may help identify other activity areas that surely accompany hideworking; however, the impact of the channelization of Middle Beaver Creek may mean those areas are already lost. Placing 14SN106 in the context of the Kanorado Locality by completing the analysis of materials recovered from 14SN101 and 14SN105 will provide a larger context for how that area was used during the Paleoindian period. The Kanorado Locality appears to have been repeatedly occupied by mobile hunter-gatherers, and lithic materials from southwestern Wyoming to central Texas were identified in the fairly small assemblage. How can this site inform us about mobility? Additional excavation at the 14SN106 Main Block is recommended to explore farther to the south of the concentration and a potential concentration in the northern portion of the Main Block, which was identified through this study.

At 41WK21, excavation might provide additional information about the vertical distribution of artifacts, as well as provide another controlled sample of cultural materials. The area between Blowout Areas 2 and 7, where an artifact concentration has been identified, would be a good place for such investigation. Currently there is an area of approximately 1,000 m^2 in this area; however, as the winds blow, the amount of intact sediment decreases.

Additional spatial analysis at 41WK21 may help to further define hideworking activity areas, recognize other activity areas, and explore the possibility of gendered spaces. Specifically, spatial questions from the site may be addressed through a close examination of the hearth and associated artifact distributions; in-depth study of refits from the site; mapping of Folsom points, Midland points, and variations of these projectile points (e.g. unfluted Folsom points); and illustrating where other artifact types are concentrated. At Cattle Guard, Jodry (1999:324) identified anvil stones as perhaps the best proxy for identifying individual households. Additional analysis of the ground stone artifacts recovered from 41WK21 may be another way of identifying household or hearth areas. Finally, the interpretation of both 14SN106 and 41WK21 endscrapers and other expected hideworking artifacts would benefit from use-wear analysis.

Sites 14SN106 and 41WK21 are both Folsom/Midland archaeological components that contain lithic and spatial evidence of hideworking; however, the evidence is not identical at the two sites. A comparative analogical model like the one presented in this study allows researchers to consider the range of activities that may have been undertaken in the past and the archaeological content they leave behind. A model for potential hideworking activity areas may be applied more widely using archaeological assemblages that date from both Paleoindian and other time periods. For example, it will be interesting to consider hideworking activity areas at Late Prehistoric archaeological sites on the Great Plains.

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Appendices

Appendix A. Historic Images Data Tables

Appendix B. Site 14SN106 Chipped Stone Tools Data

Appendix C. Site 41WK21 Mapped items and Endscraper Data

Table A-1. Images of hideworking among Great Plains/Rocky Mountain peoples who hunted bison. Only images used in the analysis are included here.

Tracking Number	Hideworking Task	Tribe/ Group	What activity (my words)	What activity (description on caption/website)	Focus or Incidental?	Agent (Person)	Other people?	Location	Material Culture used in hide working	Time of year	Type of hide	Type of influences	Tipi visible/ material
2	Scraping and Tanning	Cheyenne	People (some of which are women, others it is uncertain) involved in hideworking - four different activities depicted in four sketches on one page.	Charles Murphy drawing of women engaged in various stages of hide processing, ca. 1904-1906.	Focus (four images; different activities)	Woman	None	Indeterminate	Stick, frame, pounder (?), rock to rub hide (?); scraper; clothing	Unknown	Large mammal		No
3	Drying	Arapaho	People posing for a photo in front of their homes, a hide is staked on the ground near the home.	"Scene in the Arapaho Camp/near Camp Supply, I.T." Big Mouth Hawk (holding shield) - Arapaho - 1869	Incidental	None	Children, men, and women	Near structure	Wooden stakes, other material culture unrelated to hide processing	Winter	Large mammal	Some western dress a western hat	Yes/both canvas and hide?
4	Fleshing	Crow	Woman scraping a staked hide	hide scraping apsaroke 1908	Focus	Woman	None	Near structure	Wooden stakes; scraper	Winter	Large mammal	Possible western dress	Yes/canvas?
5	Staking	Crow	Woman stretching a hide	hide stretching apsaroke 1908	Focus	Woman	None	Near structure	Wooden stakes	Winter	Large mammal	Possible western dress	Yes/canvas?
6	Scraping or Softening	Sioux	Woman scraping a hide on a frame	Woman Scraping Hide Stretched in Frame; Brush Arbor Nearby n.d.	Focus	Woman	None	Indeterminate	Wooden frame and rope to stretch hide; scraping tool	Unknown	Large mammal	Western dress	No

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7	Scraping and Softening	Cheyenne	Four women are present near tipis, they all appear to be participating in the hideworking process. The two in front are rubbing the hid on a wooden pole (part of a meat drying pole) and scraping a hide (not staked).	"Cheyenne women dressing skins" "Cheyenne squaws dressing buffalo hides and softening buckskin" (written on back of image). "Cheyenne women working buffalo hides, 1870s""This is a very rare photograph of women tanning buffalo hides. The individual on the left is softening a hairless hide on a thin rope, while the women on the right and in the background are thinning down hides with their scrapers. It is interesting to note that the tipis are already are [sic] made from canvas and not buffalo skins, as can be judged from the placement of the seams." (Klek 2008) "A very rare shot of Cheyenne women tanning buffalo hides (1870's). The woman to the left of the photo is softening a hairless buffalo hide on a rope, while the woman to the right is thinning a buffalo skin with a scraper. It is interesting to note that the tipis in the back are already made of canvas not skins. The seams can be clearly seen on the original print."	Focus	Woman	None	Near structure	Rope, hand tool, scraper, wooden frame	Unknown	Buffalo	Canvas tipi, metal hoe, western dress	Yes/canv as
8	Scraping	Mandan, Hidatsa, Arikara	Woman scraping an unstaked hide near a tipi.	Mrs. Birds Bill (Plain House) bends over t o scrape a hide stretched out on the ground. A boy watches from inside a ti pi.	Focus	Woman	Child	Near structure	Scraper? Can't really see it	Unknown	Medium to large mammal	Chair, quilt, western dress	Yes/canv as?
9	Fleshing	Blackfoot	Woman using a flesher to thin a hide.	Website: Native Americans used animal hides for many things including clothing and shelter. This image depicts a man performing one step in the preparation of a hide. Curtis: The implement for removing flesh and fat from hides is a long bone with a beveled scraping edge. The thong attached to the upper end and passing about the woman’s wrist is for the purpose of giving additional leverage.	Focus	Ambiguo us (One website says man, Curtis notes say woman)	None	Indetermina te	Flesher	Unknown	Medium to large mammal	Western dress	No
11	Drying and Indeterminate	Sioux	Two staked buffalo hides visible some distance from tipis, six women sit around one of the hides processing it.	Women curing buffalo hides: "Squaws curing buffalo hides, Yellowstone River" Number 172 in the series Photographic Gems of the Great Northwest	Focus	Woman	None	Intermediat e distance from structure	Wooden stakes	Unknown	Buffalo	Western dress and blanket	Yes/hide ?

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12	Scraping	Arikara	Drawing of a native woman scraping a hide near a tipi. The tipi is decorated and meat is drying behind it. Children are playing nearby. There are stakes in the tipi and the meat drying rack, but not the hide (why?). Red and blue may have just been the only colors available.	"Anonymous Arikara drawing of woman tanning hide next to painted tipi, with meat drying rack in background and playing children in foreground, ca. 1875"	Focus	Woman	Children	Near structure	Scraper	Unknown	Large mammal	Hard to tell since it is a drawing, but the colors suggest western cloth.	Yes/drawing
13	Scraping	Cheyenne	Woman stands next to a stretched hide with a scraper.	"A Southern Cheyenne woman with an elk-horn scraper, about 1900" p 63	Focus	Woman	None	Near structure	Wooden stakes, elk-horn scraper according to description	Unknown	Medium to large mammal	possible western dress	Yes/just the edge
14	Fleshing and Softening	Sioux	Village scene with tipis, meat drying, children playing, and women participating in hide processing	"A Camp of Horse-Using Indians in the Southern Plains" "Village of the North American Sioux Tribe"	Incidental, but important	Woman	Children, men, and women	Near structure	Stakes and frame for hide processing, scraper and/or flesher for use in hide processing, other material culture unrelated to hide processing	Unknown	Large mammal		Yes/drawing
15	Fleshing or Scraping	Pawnee	Women, children, and a dog outside of a tipi and other structure. One woman appears to be holding a scraper and bending over a large hide on the ground. The hide was formerly staked but is not currently. The women are all looking at the camera and the dog stands on the hide. The hide appears to still have its hair.	"Pawnee camp scene in Indian Territory. The woman is using a flesher to scrape excess flesh from the hide…" p 193	Focus	Woman	Children and women	Near structure	Flesher or scraper	Unknown	Large mammal	Western dress and blanket, metal hoe, canvas tipi	Yes/canvas
16	Fleshing	Crow	Three women are working with meat and hides of large animals, maybe bison, two are actively fleshing (probably, difficult to confirm) the hides, which are staked to the ground. The other is sitting next to them. There is a small dog visible as well.	"Crow women at work drying meat and tanning hides. Occasionally they would join the hunt and help butcher the meat and carry it back to camp."	Focus	Woman	None	In field	Wooden stakes, scraper	Unknown	Large mammal	Western dress, blanket on the ground	No

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18	Drying	Sioux	A group of men and women stand near tipis, wagons, and other camp stuff. A hide is drying on the ground and meat is drying from the wagon. A large frame building is in the background.	"Sioux group in front of tipis, wagons, and a boy's boarding school, 1890. Fort Bennett, South Dakota"	Incidental	None	Men and women	Near structure	None visible	Unknown	Medium to large mammal	Western dress, wagons, boy's school	Yes/canvas
19	Scraping or Softening	Cheyenne	Two women are working hides while a third observes. A man/boy is in the background. The women appear to be holding the hides up in one hand while they work it in the other or with a tool in the other. Perhaps they are tanning or graining? They are not staked.	"Cheyenne women scraping hide in preparation for tanning."	Focus	Woman	Child and woman	In field	possible scraping tool	Spring to fall	Large mammal	Western dress	No
20	Staking	Sioux	A woman pounds a stake into the ground before working a hide. A hide (?) bag and other tools are on the hide to be worked and the stakes are partially in the ground. The woman sits to pound with a metal axe. In a pasture.	"Jenny Leading Cloud stretching and staking out a hide for tanning. Blackpipe Creek is in background. Rosebud Reservation, 1916"	Focus	Woman - Jenny Leading Cloud	None	In field	Wooden stakes, parfleche, metal(?) hammer	Unknown	Large mammal	Western dress, metal tool	No
21	Decorating	Crow	A woman (possibly a man, but the cloths look like a woman's) sits next to a hide painting a design for a parfleche on it. It is staked off the ground. Another hide is in the background, already painted and no longer staked.	"Crow Woman Decorating Staked and Stretched Buffalo hides, Montana"	Focus	Woman	None	In field	Wooden stakes, paintbrush of some sort	Unknown	Large mammal	Western dress?	No
22	Fleshing	Cheyenne	A woman uses a flesher to clean a hide that is staked just off the ground. She kneels next to the hide.	"Turkey Legs' wife preparing a cowhide to be used for moccasin soles. She is scraping off the inside of the hide. It's quite a job to prepare a hide properly." - John Woodenlegs	Focus	Woman - Turkey Legs' Wife	None	In field	Wooden stakes, knife (?)	Spring to fall	Cow	Western dress, metal tool (?), leather holster (?)	No
23	Drying	Sioux	Tipis in winter with several buffalo hides, one is on an upright (leaning) rack, others are leaning against tipis.	"View of a Native American (Sioux) camp shows te pees, buffalo hides and debris in a clearing of bare trees and snow."	Incidental	None	None	Near structure	Wooden poles for frame, material for tying the hide to the frame.	Winter	Buffalo	Canvas tipi	Yes/canvas

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25	Fleshing, Scraping, or Softening	Cheyenne	Normal camp activities that are clustered around a tipi. Activities include children playing, cooking, smoking, hide processing, and horse riding. Agents include men, women, children, and dogs. The woman doing the hide processing has the hide stretched on a frame. I do not know what is up with the guy on the left!	"Tichkematse drawing of camp scene with women cooking and tanning hide outside tipi, with man smoking in entrance and children and dogs nearby, 1879""Inscription reads 'Tichkematse Cheyenne.' Shield, lance, and headdress displayed behind tipi."	Incidental, but important	Woman	Children, men, and women	Near structure	Frame, unknown tanning tool	Unknown	Medium to large mammal	Clothing, horse, possible metal pot and pitcher	Yes/drawing
26	Fleshing and Softening	Comanche	Tipi village with hide processing, several meat drying racks, smoke exiting the tipis, dogs and people. Three women (it looks like women) are doing the hide processing of two skins. One is working on a frame stretched hide, the other two are working on one on staked on the ground. Both hide appear to still have tails attached. Other people do a variety of activities	"Comanche Village, Woman Dressing Robes and Drying Meat" "…the women are drying meat, and 'graining' buffalo robes" (Catlin, Letters and Notes, vol. 2 no. 42, 1841; reprint 1973).	Incidental, but important	Woman	Ambiguous, children, and men	Intermediate distance from structure	Wooden stakes, frame, tools in hand	Spring to fall	Large mammal	Horse, hard to see anything else because it is a painting	Yes/drawing
27	Fleshing and Softening	Sioux	Small group of tipis with several meat drawing racks, a train of people and horses arriving, hide working both on the ground and on a frame depicted, but not much detail.	"Sioux Encamped on the Upper Missouri, Dressing Buffalo Meat and Robes"	Incidental, but important	Ambiguous	Ambiguous	Intermediate distance from structure	Wooden stakes, frame, tools in hand	Spring to fall	Large mammal	Horse, hard to see anything else because it is a painting	Yes/drawing
29	Fleshing or Scraping	Crow	Painting of a tipi with dog in front along with a man doing something; half hidden by the tipi is a woman hideworking. The man may be messing with a saddle that appears to be staked down(?). His shield is also prominently placed next to the tipi. The hide is large and on a frame.	"Crow Lodge of Twenty-five Buffalo Skins"	Incidental	Woman	Man	Near structure	Frame, unknown tanning tool	Unknown	Large mammal	Guns on tipi, hard to see anything else as it is a drawing	Yes/drawing
30	Fleshing and Softening	Comanche /Kiowa	Painting of a small group of tipis with people sitting outside and looking in the distance, a dog is present. Also, two examples of hide working, one on the ground staked out and the other on a frame are depicted. The hide on the ground appears to be being scraped, the other being attached to the frame.	"Indian Encampment, Comanche (or Kiowa) Dressing Skins, Red River"	Focus	Ambiguous	Ambiguous	Near structure	Wooden stakes, frame, tools in hand	Unknown	Large mammal	None identifiable	Yes/drawing

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31	Drying	Crow	Painting of a family group next to their tipi. The group includes a man, woman, children, and dogs; it appears there is a buffalo in the background, but it is more likely a horse. There is a shield and meat drying racks visible in addition to a hide staked out on the ground (tail still on the hide).	"A Crow Chief at His Toilette"	Incidental	None	Children, man, and woman	Near structure	Wooden stakes	Spring to fall	Large mammal	None identifiable	Yes/drawing
32	Drying	Kansa	Drawing of six tipis with different designs along with three large hides nearby. They appear to be buffalo hides with the tails intact.	"Camp scene showing painted tepees and skins stretched to dry on the ground."	Incidental	None	Women	Near structure	None visible	Unknown	Large mammal	None identifiable	Yes/drawing
33	Decorating	Crow	A woman working on a hide near a tipi, meat is drying on a rack in the background. The woman may be painting the hide. The hide is staked and stretched on the ground. The stakes appear to have decoration or the bark left on…making a place for something.	"Glass plate negative of a Native American woman preparing a hide at camp"	Focus	Woman	None	Near structure	Wooden stakes	Unknown	Large mammal	Western dress, metal hoe	Yes/canvas
34	Fleshing	Crow or Northern Cheyenne	A group of women who are some distance from a tipi village are working on processing a hide. Two women appear to be just hanging out. One woman is using a scraper; the fourth has her back to the photographer and you can't see what she is doing. The hide is staked to the ground near some bushes in some medium length grass.	"Women preparing a hide"	Focus	Woman	Women	Intermediate distance from structure	Wooden stakes, flesher	Spring to fall	Large mammal	Western dress	Yes/canvas
36	Decorating	Crow or Northern Cheyenne	Two women under a shade who are painting a staked hide. They are leaning over the hide painting. They appear to be painting parfleches. Meat drying in back right; a wagon with wood on it in back left; a tipi village is in the background.	"Women preparing a hide"	Focus	Woman	None	Intermediate distance from structure	Wooden stakes	Unknown	Medium to large mammal	Western dress, horse, bucket (unknown material)	Yes/too far to see
37	Fleshing and Drying	Northern Cheyenne	Two women are processing a hide that is staked to the ground, at least one of them is scraping the hide. There are many other hides staked on the ground nearby. Meat drying racks and tipis are visible in the background.	"Northern Cheyenne women tanning buffalo hides, mouth of the Yellowstone River, circa 1878" (Scheiber 2005:Figure 4.1).	Focus	Woman	None	Near structure	Wooden stakes, scraper	Unknown	Buffalo	Western dress	Yes/canvas

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38	Fleshing	Blackfoot	A woman scraping a staked hide next to a tipi with wagons in the area.	"Tanning hides adjacent to the Otter tepee, ca. 1915"	Focus	Woman	None	Near structure	Wooden stakes, scraper (hard to tell, but it looks like the tool has a thong around her wrist connected to the tool)	Unknown	Large mammal	Western dress and wagon	Yes/canv as
39	Scraping or Softening	Apache	A woman is working with a hide in the left foreground; in the right foreground another hide is visible. The background shows a wickiup and household items along with a brush barrier.	"Apache woman tanning hides"	Focus	Woman	None	Near structure	Image not clear	Unknown	Medium mammal	Western dress and metal pot	No
40	Drying	Arapaho	A hide is staked on the ground near a meat drying rack and a hide tipi. Another tipi is visible in the background. A family is posing near the tipi, it appears to be a man, some women, and a child stands in the door of the tipi.	"Four Native American (Arapahoe) women site by a large tepee in Fort Sill, Indian Territory (Oklahoma). They wear dresses with blankets over their shoulders and branches are scattered around their feet. A child stands at the tepee entrance next to a fur blanket covering. The camp shows a dried hide on a suspended pole, a covered garden plot, and other tepees"	Incidental	None	Child, man, and women	Near structure	Wooden stakes	Spring to fall	Medium to large mammal	Western dress and blanket	Yes/hide
41	Drying	Apache	Hide staked near a shelter while a woman makes baskets. Some of the stakes are through a hide under the hide being processed; the hide being processed appears to be partially dehaired.	"Woman in Native Dress, Making Basket; Pitch-Covered Basket Jugs and Other Baskets Nearby; Hide Pegged for Processing in Foreground 1907"	Incidental	None	Woman	Near structure	Wooden stakes; other stuff not related to hide processing	Spring to fall	Medium mammal	Western dress, metal pan	No
42	Drying and Decorating	Sioux	Woman paints designs for parfleches on a hide that is staked on the ground. Another hide is on the ground behind it and a log house and possible brush structure and possible meat drying rack are also visible.	"Teton woman painting geometric designs on rawhide for parfleches. The skin is fixed to the ground with wooden stakes while another skin, not yet staked, is lying on the ground a short distance away."	Focus	Woman	None	Near structure	Wooden stakes	Winter	Large mammal	Western dress, log house	No

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44	Scraping	Crow	Two women outside a wooden house, one is using a scraper on a hide. The hide is not staked but has holes that evidence it was prior to this photo. The hide is curling up on the sides and is laying on another piece of fabric. Another woman holds a child and is looking away from the camera. A car, wooden farm implement, and houses indicate a more modern time.	"Mrs. Peter Lefthand, Crow, using an elkhorn scraper to reduce the skin to uniform thickness."	Focus	Woman - Mrs. Peter Lefthand	Child and woman	Near structure	Scraper	Unknown	Medium to large mammal	Western dress, vehicle, houses, farm implement, more!	No
45	Softening	Cheyenne	A woman uses a metal item to soften a medium sized hide, she is wearing western dress and there is a blanket on the ground. The metal idem is attached to an upright stick stuck in the ground. A tipi is on the left with logs weighting down the edge.	"Tanning a deer hide by her lodge, this Cheyenne woman has a steel scythe blade tied to an upright pole to help her soften the hide and remove all its hair"	Focus	Woman	None	Near structure	Metal scythe	Unknown	Medium mammal	Western dress, blanket on the ground, metal scythe	Yes/just the edge
46	Fleshing	Cheyenne	A woman using a flesher or scraper is processing a staked hide in a pasture. A dog is nearby.	"A Cheyenne woman is fleshing the cowhide she has staked hair side down in a tipi camp on the prairie, circa 1895"	Focus	Woman	None	In field	Wooden Stakes; flesher	Spring to fall	Cow	Western dress	No
48	Drying	Blackfoot	A man and a woman are outside of their painted tipi. A staked hide is behind the tipi.	"The zigzag lines on the Thunder tipi of Cream Antelope…in a Blackfeet camp represent lightning"	Incidental	None	Man and woman	Near structure	Wooden stakes	Unknown	Large mammal		Yes/canvas
50	Drying	Crow	Two hides are staked to the ground, they are completed and have been painted as parfleches.	"Crow stretched rawhides painted for constructing prarfleches. Photographed about 1900."	Focus	None	None	In field	Wooden stakes	Unknown	Large mammal		No
51	Scraping	Kiowa	Tipi camp with painted tipis and camp activities. Men, women, children and dogs are visible. People appear to be gathering something, riding horses, and processing hides. There is a bison skull, shield, etc. outside one of the tipis. There is a hide being scraped on the ground, it appears to be staked and still has a tail. There is also a hide stretched on a wooden frame behind the tipi.	"Camp showing 7 tepees. According to the artist's journal the Kiowa camp 'in sight of a small river shaded by cottonwood trees and shrubs…was of eighteen large tents' (Mollhausen 1858, 1:212). A war bonnet, lance, and shield are on a rack in front of the painted tepee. A woman on the left is scraping a hide, and behind the tepee is another hide being stretched."	Incidental	Woman	Children, men, and women	Near structure	Wooden frame	Unknown	Large mammal		Yes/drawing
52	Softening	Ktunaxa (Kutenai)	A woman kneels before four skins of medium sized mammals (deer?) she is tanning or graining the hides (rubbing them on the pole?). They are hung up on a pole. They are near a tipi and the camp is near a lake. There is a buggy in the background and a child looks on.	"Dressing skins - Kutenai"	Focus	Woman	Child	Near structure	Wooden poles	Spring to fall	Medium mammal	Western dress, metal pots, buggy	Yes/canvas

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54	Tanning	Blackfoot	A woman is near a camp and she is processing a hide.	"Processing rawhide into buckskin" "Blackfeet woman rubbing fat into a hide"…the surface rubbed over with an oily compound composed of brains and fat often mixed with liver. This is usually rubbed on with the hands (Plate III)" Wissler 1910:64.	Focus	Woman	None	In field	None visible	Spring to fall	Medium mammal	Western dress, metal pan and dishes(?)	No
55	Softening	Blackfoot	A woman kneels while softening a hide against a rope tied on a lodge pole that is in the ground at an angle. Another woman is carrying containers.	"Blackfeet women pulling a hide across a twisted loop of sinew tied to a tepee pole. A metal strap was also used for this purpose…" "Drying the Hide" "The skin is further dried and whitened by sawing back and forth through a loop of twisted sinew or thong tied to the under side of an inclined lodge pole (Plate V)" page 64	Focus	Woman	Woman	In field	Sinew and wooden pole	Spring to fall	Medium mammal	Western dress, metal can	No
56	Tanning	Cree	A woman wringing out a hide during the tanning process. The pole in use appears to be a meat drying rack. A metal hide softening loop is also visible.	"Plains Cree woman (married to an Assiniboine) wringing out a deerskin after soaking."	Focus	Woman	None	In field	Wooden post and metal scythe thing	Spring to fall	Deer	Western dress, metal scythe	No
57	Smoking	Crow	A woman sits on the ground smoking a hide with the hair on. It is suspended from a pole over a smoking pit.	"Crow woman smoking skin."	Focus	Woman	Ambiguous	In field	Wooden pole, smoking pit	Spring to fall	Medium mammal	Western dress	No
58	Tanning	Hidatsa	A woman scraping a hide that is on a frame up against a wooden building.	"Jeanette Little Crow works to scrape a hide stretched on a frame leaning up against a wooden building"	Focus	Woman - Jeanette Little Crow aka Weasel Woman aka Uta Wiad	None	Near structure	Wooden frame, metal scraping tool	Summer	Calf	Western dress, wooden house, metal tool	No
59	Scraping	Hidatsa	Woman scraping a calf hide that is laying on the ground. A wooden house is in the background and an observer is on the right (this may be Wesley Hiller or another observer; he may be taking another photograph).	"Jeanette Little Crow, also known as Weasel Woman, works to scrape hair from a hide on the ground. She holds a tool in her hand, and a knife is visible next to her. A man is partially visible, taking a photograph of the procedure."	Focus	Woman - Jeanette Little Crow aka Weasel Woman aka Uta Wiad	None	Near structure	Scraper with metal edge	Summer	Calf	Western dress, wooden house, metal tools, metal bowl	No

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62	Softening	Hidatsa	Woman softens a hide on a rope tied on a wooden post.	"Jeanette Little Crow, also known as Weasel Woman, works to stretch a hide over a rope tied to a log."	Focus	Woman - Jeanette Little Crow aka Weasel Woman aka Uta Wiad	None	Near structure	rope	Summer	Calf	Western dress, wooden house, metal tool	No
63	Softening	Hidatsa	Woman uses a tool (bone/stone?) to grain a hide on a frame leaning against a wooden building.	"Jeanette Little Crow, also known as Weasel Woman, works to grain a hide stretched on a frame."	Focus	Woman - Jeanette Little Crow aka Weasel Woman aka Uta Wiad	None	Near structure	tool - wood/bone?, wooden frame	Summer	Calf	Western dress, wooden house, cut wooden frame	No
64	Fleshing	Sioux	Close-up of a kneeling woman uses a tool (flesher?) to process a small hide that is staked to the ground some distance from a village.	"A woman uses an implement attached to her wrist to flesh a hide she has staked to the ground. Tents, flags, horses, and carts are visible in the background."	Focus	Woman	None	Intermediate distance from structure	Wooden stakes, flesher?	Spring to fall	Medium mammal	Western dress, horse, tents	Yes/too far to see
66	Staking	Sioux	A woman kneels to pound stakes that hold a hide into the ground. She uses a metal axe as a hammer. In the distance is a village,	"A Sioux Indian woman works to flesh a hide that is stretched on the ground. She uses an axe to pound stakes into the ground to stretch a hide. Tents and horses are visible in the background."	Focus	Woman	None	Intermediate distance from structure	Wooden stakes, metal axe	Spring to fall	Medium mammal	Western dress, metal axe	Yes/too far to see
67	Staking	Sioux	A kneeling woman removes stakes which have been holding a small hide. The back end of a buggy is on the right and a village is visible in the background.	"A woman removes stakes that has [sic] been holding a hide to the ground while she was fleshing it. People watch from a carriage in the background."	Focus	Woman	Euro-American(?) man and woman	Intermediate distance from structure	Wooden stakes	Spring to fall	Medium mammal	Western dress, buggy	Yes/too far to see
70	Softening	Mandan, Hidatsa, Arikara	Close-up of a woman softening a hide on a metal implement attached to an arbor near the entrance to an earth lodge.	"A woman scrapes a hide against what appears to be a curved piece of metal tied to an upright wooden post. Another hide is stretched and hanging in the air from two poles beside her."	Focus	Woman	None	Near structure	Metal scythe, wooden post	Unknown	Medium mammal	Western dress, metal scythe	No
71	Tanning	Mandan, Hidatsa, Arikara	A woman scraping a small hide that is hanging from a stick hung horizontally.	"A woman stretches and scrapes a hide hanging on a wooden bar on the Fort Berthold Indian Reservation. A dog sits on the ground in the background."	Focus	Woman	None	Near structure	Metal tool?, wooden post	Unknown	Medium mammal	Western dress, metal tool?	No

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72	Scraping	Mandan/Hidatsa	Woman standing on a hide is using a scraper. The hide is not staked and there is an axe nearby.	"Crow Heart's mother or wife removing hair from hide" "A woman identified as Crow Heart's mother or wife uses a tool to remove hair from a hide on the ground." Another Webpage describes it as: "A Mandan/Hidatsa woman cleaning hair from a bison hide with an elk-horn scraper." (http://www.studioroma.com/forpeabody/05_elements.html)	Focus	Woman	None	In field	Metal scraper?	Spring to fall	Large mammal	Western dress, metal axe, wooden houses in distance	No
73	Moving	Mandan/Hidatsa	A woman stands with a large hide that she is picking up. She is in a pasture.	"A woman identified as Crow Heart's wife or mother flips over a hide that she has been working to remove the hair from. A river is visible in the distance"	Focus	Woman	None	In field	None visible	Spring to fall	Large mammal	Western dress	No
74	Drying	Sioux	Buffalo hides with the fur on are laying outside near an arbor and tipi. A woman is sitting outside the tipi, another person stands beside her and three children stand at photo left. A man is laying down under an arbor covered with western clothes and buffalo hides.	"Yanktonite (Sioux) tepees, Fort Rice, D. T." "Three children are to the left in the photograph, skins are in the foreground and a man sleeps under a covered structure"	Incidental	None	Children, men, and women	Near structure	None visible	Unknown	Buffalo	Western dress	Yes/hide ?
75	Drying	Gros Ventre (Atsina)	Several tipis with a saddle and a staked hide laying on the ground in front of the nearest one.	"Atsina Camp, 1908" "Photograph of Atsina tepees"	Incidental	None	None	Near structure	Wooden stakes	Unknown	Medium to Large mammal	Saddle	Yes/canvas
76	Beaming	Sioux	Painting of a camp scene at a Sioux camp. Four tipis are visible, in front of one of them a woman is beaming a hide (deer?) against an inclined post with a tool she holds with two hands. Dogs and a man are also in the area; another person appears to be reclining nearby and there are some other pieces of site furniture visible.	"Watercolor on paper by Karl Bodmer from his travels to the U.S. 1832-1834"	Incidental	Woman	Man	Near structure	Beaming took, wooden post	Unknown	Medium mammal	Horse in distance	Yes/hide
77	Scraping	Cheyenne	A woman on the plains bent over at the waist is using a scraper on a hide. The hide is not staked down, the woman wears western dress and there is a metal bucket behind her. There is something else on the ground, I am not sure what it is.	"Women/Hides&Skins/Tanning/Native Americans" "Woman using tools to tan a hide"	Focus	Woman	None	In field	Scraper	Unknown	Medium to Large mammal	Western dress, metal bucket	No

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78	Scraping	Sioux	A woman standing on a large mammal hide with the hair on. She is looking at the cameral and holding a scraper as if to use it. There is something else on the hide, perhaps a stone used in processing. She is among some spotty trees and the hide is laying on something (cardboard) on the ground. In the background there appears to be an outdoor kitchen with metal pots set up, other material cultural is also visible. On the left of the photo another hide is hanging from a post upheld by other wooden posts. there is some material rolled up and tied as well.	"Woman rolling out animal skin"	Focus	Woman	None	In stand of trees	Scraper, possible other tools	Spring to summer	Large mammal	Western dress, possible cardboard, metal pots	No
79	Fleshing	Cheyenne	Image of several women working on hair on buffalo hides. The one woman whose work is visible appears to be fleshing the hide. They are near a large tipi with what appears to be a pile of wood next to it. Meat is also observed drying at photo right. At least six hides are staked to the ground in this area. There appears to be some clothing laying on the ground in the foreground of the photo.	"Pressing buffalo hides, Cheyenne camp - Photographic views of the great north-west, number 18"	Focus	Woman	None	Near structure	Wooden pegs, flesher	Fall to spring	Buffalo	Western dress	Yes/canvas
80	Drying	Sioux	Image shows a somewhat squat tipi with a wagon in front of it. Meat is hanging from the wagon drying (wagon essentially replaces the location of a meat drying rack). Two people, a man sitting and a woman standing are visible. In the foreground several hair on bison skins are drying and one is staked to the ground.	"The old chief's camp" "Number 203" and "Goose"	Incidental	None	Man and woman	Near structure	Wooden pegs	Spring to fall	Large mammal	Western dress, wagon	Yes/canvas?
81	Fleshing	Crow	Two women sit next to a staked hide in the foreground. Tipis and a wagon are visible in the background. One woman does not appear to be participating in the processing, the other may be using a flesher, but it is difficult to determine given the quality of the image.	"Crow women tanning hides."	Focus	Woman	None	Near structure	Wooden pegs, flesher	Unknown	Large mammal	Western dress, wagon	Yes/canvas?

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83	Scraping	Blackfoot	A woman sitting on a hill slope is using an implement to strike a hide. The hide is not staked and the woman wears western cloths.	"Using a Stone Scraper" "In 1906, the writer observed a woman removing the hair from a rawhide with a rounded waterworn pebble (Plate I)." page 66	Focus	Woman	None	In field	Stone	Unknown	Medium to large mammal	Western dress	No
84	Scraping	Blackfoot	A woman stands leaning over at the waist scraping a the hide of a medium mammal with an elkhorn handled scraper. She wears western clothing and moccasins. The activity is taking place near camp based on the sticks in the upper right of the photo.	"Scraping the Hide" "Standing on the hide, the woman leans over and with a sidewise movement removes the surface in chips or shavings, the action of the tool resembling that of a hand plane (Plate III)." page 64	Focus	Woman	None	Near structure	Scraper	Unknown	Medium mammal	Western dress	No
86	Softening	Blackfoot	A woman stands in front of a tipi stretching a skin.	"Stretching the Hide" "This is accomplished by pulling with the hands and feet, two persons being required to handle a large skin (Plate IV)" page 64	Focus	Woman	None	Near structure	None visible	Unknown	Medium mammal	Western dress	Yes/canvas?
87	Softening	Blackfoot	A woman bends over at the waist to grain a hide with a tool. She is in front of a tipi.	"Graining the Surface" "The surface is vigorously rubbed with a rough edged stone until it presents a clean grained appearance (Plate V)" page 64	Focus	Woman	None	Near structure	Graining tool	Unknown	Medium mammal	Western dress	Yes/canvas?
88	Softening	Blackfoot	A woman softens a hide on a rope that is attached to a wooden pole that is part of a tent. She is kneeling to preform this act and a wagon/red river cart is in the background.	"Old Woman tanning hide"	Focus	Woman	None	Near structure	Rope and wooden post	Unknown	Medium to large mammal	Western dress, wagon, tent	No
90	Fleshing	Blackfoot	Two women are processing a hide that is staked to the ground in the foreground and in the background tipis, a tent, wagons, and other camp accoutrement are visible. One of the women is sitting next to the hide while the other works it.	"Two Blackfeet women tanning a deer skin. 56"	Focus	Woman	Women	Far distance from structure	Wooden pegs, flesher	Fall to spring	Deer	Western dress, wagons, tents	Yes/canvas?
91	Fleshing	Blackfoot	Woman in a pasture with a dog. She is fleshing a large hide that is staked to the ground.	"Old Woman tanning"	Focus	Woman	None	In field	Wooden pegs, flesher	Unknown	Large mammal	Western dress	No

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2	Charles Murphy	1 drawing : graphite, colored pencil, and ink	1904-1906	United States Oklahoma Territory Cantonment. United States Oklahoma Canton.	http://siris-archives.si.edu/ipac20/ipac.jsp?&profile=all&source=~!siarchives&uri=full=3100001~!78927~!0#focus	4/5/2016	Manuscript 2531, Volume 10, National Anthropological Archives, Smithsonian Institution, Museum Support Center, Suitland, Maryland. This image was used in Moore (1999) *The Cheyenne* . From Mooney Sketch Book No. 2, Anthropological Archives, Smithsonian	National Anthropological Archives	NAA INV 8901700; NAA MS 2531, Volume 10	--
3	Unknown	Photograph	1869	Camp Supply, Indian Territory	https://www.facebook.com/photo.php?fbid=10150141353015578&set=a.10150141329955578.400581.10150102703945578&type=	4/5/2016	--	Downloaded from Native American Indian - Old Photos on Facebook	--	--
4	Edward S. Curtis	Photograph	1908	--	http://curtis.library.northwestern.edu/curtis/viewPage.cgi?showp=1&id=nai.04.book.00000021.p&volume	4/5/2016	--	--	--	4, 5
5	Edward S. Curtis	Photograph	1908	--	https://www.1000museums.com/art_works/edward-sheriff-curtis-hide-stretching-apsaroke-the-north-american-indian-v-iv-cambridge-ma-the-	4/5/2016	--	--	--	4, 5
6	Unknown	Black and white gelatin glass negative	Unknown	--	http://siris-archives.si.edu/ipac20/ipac.jsp?&profile=all&source=~!siarchives&uri=full=3100001~!14730~!0#focus	4/5/2016	In Collection: Glass Negatives of Indians (Collected by the Bureau of American Ethnology) 1850s-1930s; Cite as: BAE GN 03700 06605800, National Anthropological Archives, Smithsonian Institution	National Anthropological Archives, Smithsonian Museum Support Center, Suitland,	NAA INV 6605800; OPPS NEG 3700	--
7	Stanley J. Morrow	Stereograph	1870s	--	http://siris-archives.si.edu/ipac20/ipac.jsp?&profile=all&source=~!siarchives&uri=full=3100001~!88398~!0; Klek 2008	4/5/2016; NA	Photo Lot 90-1, number 304	Smithsonian Institution, National Anthropological Archives, George V. Allen Photographic Collection 1860s-1930s; page 127	NAA INCV 09851300; OPPS NEG 0-17238	--

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8	Unknown	Photographic prints	1910-1915	Fort Berthold Indian Reservation, ND	http://digitalhorizonsonline.org/cdm4/item_viewer.php?CISOROOT=/uw-ndshs&CISOPTR=5752&CISOBOX=1&REC=8	4/5/2016	--	State Historical Society of North Dakota	Item number: 00270-071; Digital ID: sb00279071	--
9	Edward S. Curtis	Photograph	1896-1926	--	http://www.old-picture.com/indians/Indian-Working.htm	4/5/2016	--	--	Image ID# D411E03D	--
11	Stanley J. Morrow	Stereograph	ca. 1870	Yellowstone River	http://siris-archives.si.edu/ipac20/ipac.jsp?session=13T7C486728N2.2651&profile=all&source=~!siarchives&view=subscriptionsummary&uri=full=3100001~!88409~!0&ri=3&aspect=subtab157&menu=search&ipp=20&spp=20&staffonly=&term=hides&index=.TW&uindex=&aspect=subtab157&menu=search&ri=3	4/5/2016	Photo Lot 90-1, number 315, National Anthropological Archives, Smithsonian Institution	National Anthropological Archives, Smithsonian Museum Support Center, Suitland, Maryland	NAA INV 09852400; OPPS NEG 90-17235	--
12	Unknown, Arikara Person	1 drawing: graphite and colored pencil, mounted on paper	ca. 1875	United States Dakota Territory, Fort Buford	http://siris-archives.si.edu/ipac20/ipac.jsp?session=13436M59K054L.5185&menu=search&aspect=subtab157&npp=50&ipp=20&spp=20&profile=all&ri=&term=NAA+INV+08510607&index=.GW&x=0&y=0&aspect=subtab157&term=&index=.AW&term=&index=.SW&term=&index=.TW&term=	4/5/2016	Contained in a Book of Arikara drawings by anonymous artist, ca. 1875. Smithsonian Institution (manuscript 154064B)	National Anthropological Archives	NAA INV 08510607	--
13	George Bird Grinnell/Elizabeth C. Grinnell/Julia E. Tuell	Photograph	ca. 1900	--	Moore 1999 *The Cheyenne*	NA	--	Grinnell Collection, Museum of the American Indian	--	--
14	George Catlin	Painting	1833	--	Wissler 1944 *Indians of the United States*	NA	p 220	Private Collection: Bridgeman Art Library / Private Collection / Peter Newark Western Americana	--	--

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15	William S. Prettyman	Photograph	1889	north of Pawnee, Indian Territory	Blaine 1990 *Pawnee Passage: 1870-1875;* DeMallie 2001 Plains	NA	Demallie page 525 Figure 6	Archives and Manuscripts Division of the Oklahoma Historical Society, Oklahoma City	5057	--
16	Unknown	Photograph	ca. 1900	--	Sommer 1998 *North American Indian Women*	NA	--	p. 44	--	16, 49
18	Unknown	Photograph	1890	Fort Bennett, South Dakota	Johnson 1998 *Spirit Capture: Photographs from the National Museum of the American Indian*	NA	Joseph Hurst Collection (he was a military guy, probably not the photographer, but I am not sure)	p. 63	N41461	--
19	Julia E. Tuell	Photograph	ca. 1906-1930	--	Aadland 2000 *Women and Warriors of the Plains: The Pioneer Photography of Julia E. Tuell*	NA	--	p. 98	--	--
20	Julia E. Tuell	Photograph	1916	Rosebud Reservation	Aadland 2000 *Women and Warriors of the Plains: The Pioneer Photography of Julia E. Tuell*	NA	--	p. 98	--	--
21	Charles Rau Collection	Photograph	Unknown	Montana	Robotham 1994 *Native Americans in Early Photographs*	NA	National Museum of the American Indian, Smithsonian Institution	p. 52	--	--
22	Thomas B. Marquis	Photograph	ca. 1922-1935	--	Liberty ed. 2007 *A Northern Cheyenne Album*	NA	--	P. 158	--	--
23	Laton Alton Huffman	1 copy negative and one photo print	1878	Yellowstone	http://cdm16079.contentdm.oclc.org/cdm/singleitem/collection/p15330coll22/id/27219	4/5/2016	Additional information from stereograph: "Yellowstone Scenery and Indian Views."; At head of title: "#53."; Formerly F44817.;Photoprint represents one half of a stereograph; photonegative represents stereograph.; Title hand-written on front of original.; R7100317026 (Copyright restrictions applying to use or reproduction of this image available from the Western History/Genealogy Dept., Denver Public Library.)	Denver Public Library - Digital Collections	X-31702 or F44817 DPLW or 10031702.TIF	--

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25	Tichematse	1 drawing: watercolor and ink	1879	--	http://siris-archives.si.edu/ipac20/ipac.jsp?&profile=all&source=~!siarchives&uri=full=3100001~!75853~!0#focus	4/5/2016	Contained in Tichkematse drawings of Cheyenne life, 1879, Smithsonian Museum Support Center, Suitland MD (manuscript 290844)	National Anthropological Archives	NAA INV 08601600	--
26	George Catlin	Painting (oil on canvas)	1834	--	americanart.si.edu/collections/search/artwork/?id=4011	4/5/2016	--	Smithsonian American Art Museum	1985.66.356	--
27	George Catlin	Painting (oil on canvas)	1832	Upper Missouri	americanart.si.edu/collections/search/artwork/?id=4367	4/5/2016	--	Smithsonian American Art Museum	1985.66.377	27, 28
29	George Catlin	Painting (oil on canvas)	1832-1833	--	americanart.si.edu/collections/search/artwork/?id=4019	4/5/2016	--	Smithsonian American Art Museum	1985.66.491	--
30	George Catlin	Painting (oil on canvas)	1847	Red River	http://americanart.si.edu/collections/search/artwork/?id=4117	4/5/2016	Catlin painted this image while in Paris, France	Smithsonian American Art Museum	1985.66.597	--
31	George Catlin	Painting	1860s	--	www.nga.gov/fcgi-bin/timage_f?object=50330&image=11203&c=	4/5/2016	Paul Mellon Collection	National Gallery of Art, Washington, D.C.	1965.16.22	--
32	Stephen Stubbs	Drawing in pencil and watercolor	ca. 1882	--	DeMallie 2001 *Plains*	NA	Volume 13, part 1 of 2. Handbook of North American Indians. William C. Sturtevant, General Editor. Smithsonian Institution, Washington DC	p. 468 Figure 6 (source: Smithsonian, NAA)	92-2478	--
33	Richard Throssel	Glass plate negative	1902-1911	--	http://cdm15330.contentdm.oclc.org/cdm/ref/collection/p15330coll22/id/20714	4/5/2016	Richard Throssel Papers, Accession Number 02394, Box 12, TP78, Throssel #188.	University of Wyoming, American Heritage Center	ah008380	--
34	Richard Throssel	Glass plate negative	1902-1933	--	http://digital.uwyo.edu/thumbs.cfm?collection=Throssel&img=ah008677.jpg	6/26/2012	Richard Throssel Papers, Accession Number 02394, Box 41, TP694, Throssel #65.	University of Wyoming, American Heritage Center	ah008677	--
36	Richard Throssel	Glass plate negative	1902-1933	--	http://www.indiani.cz/clanky/index.php?a=docasne-pristresky-seltry-a-stinitka-na-velkych-planich	4/5/2016	Richard Throssel Papers, Accession Number 02394, Box 12, TP81, Throssel #191.	University of Wyoming, American Heritage Center	ah008381	35, 36
37	Stanley J. Morrow	Stereograph	ca. 1878	Yellowstone River	http://www.cowanauctions.com/auctions/item.aspx?ItemId=54322; Scheiber 2005:Figure 4.1, page 61 (in Gender and Hide Production)	4/5/2016	--	National Anthropological Archives	NAA neg #3701	--

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38	H. F. Robinson	Photograph	ca. 1915	on a Blackfoot reservation	Farr 1984 *The Reservation Blackfeet, 1882-1945: A Photographic History of Cultural Survival*	NA	Museum of New Mexico	page 145	--	--
39	Unknown	Photograph	Unknown	--	Haley 1997	NA	--	Arizona Historical Society/ Tucson	#25650	--
40	William S. Soule	Negative, photo print, cabinet card	1869-1874	Fort Sill, Indian Territory	http://cdm16079.contentdm.oclc.org/cdm/ref/collection/p15330coll22/id/32132	4/5/2016	--	Denver Public Library - Digital Collections	X-32133 or F33355 DPLW or 10032133.TIF	--
41	Walter J. Lubken	Photo print, black and white on cardboard mount	1907	Near Arizona Salt River	http://siris-archives.si.edu/ipac20/ipac.jsp?uri=full=3100001~!34024!0	4/5/2016	SPC Sw Apache NM 183804 02070900, National Anthropological Archives, Smithsonian Institution	National Anthropological Archives, Smithsonian Museum Support Center, Suitland,	NAA INV 02070900	10, 41
42	John A. Anderson	Photograph	1897	--	DeMallie 2001 Plains	NA	Nebraska State Historical Society, Lincoln	page 1048 Figure 6	RG 2969:2-226	--
44	Fred Voget	Photograph	1940	Lodge Grass, Montana	DeMallie 2001 Plains	NA	--	page 8 Figure 3, center left	--	--
45	George Bird Grinnell/Elizabeth C. Grinnell/Julia E. Tuell	Photograph	ca. 1900-1930	--	Hungrywolf 2006 *The Tipi: Traditional Native American Shelter*	NA	--	page 35	--	--
46	George Bird Grinnell/Elizabeth C. Grinnell/Julia E. Tuell	Photograph	ca. 1895	--	Hungrywolf 2006 *The Tipi: Traditional Native American Shelter*	NA	--	page 37	--	1, 17, 46, 47
48	Unknown	Photograph	Unknown	--	Nabokov and Easton 1989 *Native American Architecture*	NA	--	page 161	--	--
50	Unknown	Photograph	ca. 1900	--	DeMallie 2001 Plains	NA	Eastern Washington State Historical Society	page 8 Figure 3, bottom left	--	--
51	Baldwin Mollhausen	Drawing	1853	--	DeMallie 2001 Plains	NA	Museum fur Volkerkunde, Berlin	page 908 Figure 2	--	--
52	Edward S. Curtis	Photogravure	ca. 1910	--	http://www.artsmia.org/viewer/detail.php?id=2172&i=151&v=3&dept=7	4/5/2016	--	Minneapolis Institute of Arts	75.15.9	--
54	Clark Wissler	Photograph	1904	Near Browning Montana	DeMallie 2001 Plains	NA	American Museum of Natural History, New York	page 10-11 Figure 4, top left	23418	54-55, 84-87

Appendix A-2. Additional information about the images of hideworking among Great Plains/Rocky Mountain peoples who hunted bison. Only images used in the analysis are included here.

Tracking Number	Photographer / Artist	Format / Object	Year taken / completed	Where taken or illustrated	Location where found	Website - date accessed	Additional Information (Cite as/Repository/Collection History/Provenance):	Where is the image from	Catalog Number	Similar images (by tracking number)
55	Clark Wissler	Photograph	1904	Near Browning Montana	DeMallie 2001 Plains and Wissler 1910 *Material Culture of the Blackfoot Indians (Plates I-VIII)*	NA	American Museum of Natural History, New York	page 10-11 Figure 4, top right; Wisslerr Plate V	24396	54-55, 84-87
56	Robert H. Lowie	Photograph	1908	Fort Belknap, Montana	DeMallie 2001 Plains	NA	American Museum of Natural History, New York	page 10-11 Figure 4, center right	284064	53, 56
57	Robert H. Lowie	Photograph	1910-1916	Crow Indian Reservation, Montana	DeMallie 2001 Plains	NA	American Museum of Natural History, New York	page 10-11 Figure 4, bottom right	118957	--
58	Monroe P. Kelly	Photograph	1942	Elbowoods, North Dakota	http://digitalhorizonsonline.org/u?/uw-ndshs,6581	4/5/2016	See Hiller (1948) for more information and a drawing of this photo.	State Historical Society of North Dakota	sh000390054	58-63
59	Monroe P. Kelly	Photograph	1942	Elbowoods, North Dakota	http://digitalhorizonsonline.org/u?/uw-ndshs,6575	4/5/2016	See Hiller (1948) for more information and a drawing of this photo.	State Historical Society of North Dakota	sh000390055	58-63
62	Monroe P. Kelly	Photograph	1942	Elbowoods, North Dakota	http://digitalhorizonsonline.org/u?/uw-ndshs,6570	4/5/2016	See Hiller (1948) for more information and a drawing of this photo.	State Historical Society of North Dakota	sh000390053	58-63
63	Monroe P. Kelly	Photograph	1942	Elbowoods, North Dakota	http://digitalhorizonsonline.org/u?/uw-ndshs,6562	4/5/2016	See Hiller (1948) for more information and a drawing of this photo.	State Historical Society of North Dakota	sh000390052	58-63
64	Unknown	Photograph	1910-1915	Probably Near Fort Berthold	http://digitalhorizonsonline.org/u?/uw-ndshs,5814	4/5/2016	--	State Historical Society of North Dakota	sh00270110	64-68
66	Unknown	Photograph	1910-1915	Probably Near Fort Berthold	http://digitalhorizonsonline.org/u?/uw-ndshs,5799	4/5/2016	--	State Historical Society of North Dakota	sh00270107	64-68
67	Unknown	Photograph	1910-1915	Probably Near Fort Berthold	http://digitalhorizonsonline.org/u?/uw-ndshs,5782	4/5/2016	--	State Historical Society of North Dakota	sh00270111	64-68
70	Unknown	Photograph	1910-1915	Fort Berthold Indian Reservation, ND	http://digitalhorizonsonline.org/u?/uw-ndshs,5758	4/5/2016	--	State Historical Society of North Dakota	sh00270142	69-71
71	Unknown	Photograph	1910-1915	Fort Berthold Indian Reservation, ND	http://digitalhorizonsonline.org/u?/uw-ndshs,5743	4/5/2016	--	State Historical Society of North Dakota	sh00270141	69-71
72	Unknown	Photograph	1910-1915	Fort Berthold Indian Reservation, ND	http://digitalhorizonsonline.org/u?/uw-ndshs,5798	4/5/2016	--	State Historical Society of North Dakota	sh00270139	72-73
73	Unknown	Photograph	1910-1915	Fort Berthold Indian Reservation, ND	http://digitalhorizonsonline.org/u?/uw-ndshs,5755	4/5/2016	--	State Historical Society of North Dakota	sh00270140	72-73

Appendix A-2. Additional information about the images of hideworking among Great Plains/Rocky Mountain peoples who hunted bison. Only images used in the analysis are included here.

Tracking Number	Photographer / Artist	Format / Object	Year taken / completed	Where taken or illustrated	Location where found	Website - date accessed	Additional Information (Cite as/Repository/Collection History/Provenance):	Where is the image from	Catalog Number	Similar images (by tracking number)
74	Stanley J. Morrow	Stereograph	ca. 1868-1878	Fort Rice, Dakota Territory	http://sirismm.si.edu/naa/90-1/09852200.jpg	4/5/2016	Photo Lot 90-1, number 313, National Anthropological Archives, Smithsonian Institution	National Anthropological Archives, Smithsonian Museum Support Center, Suitland,	NAA INV 09852200	--
75	Edward S. Curtis	Photogravure	1908	--	http://www.mccord-museum.qc.ca/en/collection/artifacts/M21417.175/	4/5/2016	--	McCord Museum	M21417.175	--
76	Karl Bodmer	Painting: watercolor on paper	1833	--	http://commons.wikimedia.org/wiki/File:Tipi01.jpg	4/5/2016	--	--	--	--
77	Unknown, Department of the Interior, Bureau of Indian Affairs, Aberdeen Area Office	Photograph	ca. 1935	Cheyenne River Agency	http://research.archives.gov/description/285266	4/5/2016	From Series: Cheyenne River Agency: Photographs, compiled 1900-1960. Record Group 75: Records of the Bureau of Indian Affairs, 1793-1999.	National Archives	National Archives Identifier 285266; NARA ID 75-CR(PHO)-	--
78	Unknown, Department of the Interior, Bureau of Indian Affairs, Rosebud Agency	Photographic print	ca. 1936	Rosebud Reservation	https://commons.wikimedia.org/wiki/File:Woman_rolling_out_animal_skin_-_NARA_-_285648.jpg	4/5/2016	Record Group 75: Records of the Bureau of Indian Affairs, 1793 - 1999; Rosebud Agency Series: Photographs, compiled 1900-1960	National Archives Records Administration Central Plains Region	NAIL Control Number: NRE-75-RBD(PHO)-514; ARC Identifier	--
79	Stanley J. Morrow	Stereograph	ca. 1870-1880	Dakota Territory	http://digitalgallery.nypl.org/nypldigital/id?g90f387_013zf	4/5/2016	Robert N. Dennis collection of stereoscopic views in Stephen A. Schwarzman Building, Photography Collection, Miriam and Ira D. Wallach Division of Art, Prints, and Photographs	New York Public Library	Catalog Call Number: MFY Dennis Coll 90-F387; Digital ID: g90f387_013zf; Record ID: 659525	--

Appendix A-2. Additional information about the images of hideworking among Great Plains/Rocky Mountain peoples who hunted bison. Only images used in the analysis are included here.

Tracking Number	Photographer / Artist	Format / Object	Year taken / completed	Where taken or illustrated	Location where found	Website - date accessed	Additional Information (Cite as/Repository/Collection History/Provenance):	Where is the image from	Catalog Number	Similar images (by tracking number)
80	Truman Ward Ingersoll (probably), printed by Webster and Albee's	Stereograph	ca. 1890s	Dakota Territory	http://digitalgallery.nypl.org/nypldigital/id?g92f138_030f	4/5/2016	Robert N. Dennis collection of stereoscopic views in Stephen A. Schwarzman Building, Photography Collection, Miriam and Ira D. Wallach Division of Art, Prints, and Photographs	New York Public Library	Catalog Call Number: MFY Dennis Coll 92-F138; Digital ID: g92f138_030f; Record ID: 665642	--
81	J. H. Sharp	Photograph	1904	Crow Indian Reservation, Montana	Riebeth 1985 *J.H. Sharp among the Crow Indians 1902-1910*	NA	Photo is from the collection of Tim Milburn, Grass Range, Montana	page 110	--	--
83	Clark Wissler or Walter McClintock	Photograph	1900-1909	Northwestern Plains	Wissler 1910 *Material Culture of the Blackfoot Indians (Plates I-VIII)*	NA	--	Plate I	--	--
84	Clark Wissler or Walter McClintock	Photograph	1900-1909	Northwestern Plains	Wissler 1910 *Material Culture of the Blackfoot Indians (Plates I-VIII)*	NA	--	Plate III	--	54-55, 84-87
86	Clark Wissler or Walter McClintock	Photograph	1900-1909	Northwestern Plains	Wissler 1910 *Material Culture of the Blackfoot Indians (Plates I-VIII)*	NA	--	Plate IV	--	54-55, 84-87
87	Clark Wissler or Walter McClintock	Photograph	1900-1909	Northwestern Plains	Wissler 1910 *Material Culture of the Blackfoot Indians (Plates I-VIII)*	NA	--	Plate V	--	54-55, 84-87
88	Walter McClintock	Photographic negative, b&w, nitrate negative	1904	Montana	http://beinecke.library.yale.edu/dl_crosscollex/brbldl_getrec.asp?fld=img&id=1089832	4/5/2016	--	Walter McClintock Collection, Yale Collection of Western Americana, Beinecke Rare Book and Manuscript Library	Call Number WA MSS S-1175, Bibliographic Record Number 10451692, Image ID Number	88, 94

Appendix A-2. Additional information about the images of hideworking among Great Plains/Rocky Mountain peoples who hunted bison. Only images used in the analysis are included here.

Tracking Number	Photographer / Artist	Format / Object	Year taken / completed	Where taken or illustrated	Location where found	Website - date accessed	Additional Information (Cite as/Repository/Collection History/Provenance):	Where is the image from	Catalog Number	Similar images (by tracking number)
90	Walter McClintock	Hand-colored, transparent, 3 x 5 inch glass lantern slides	1904	Northwestern Montana	http://beinecke.library.yale.edu/dl_crosscollex/brbldl_getrec.asp?fld=img&id=1044574	4/5/2016	Printer Charles R. Pancoast	Walter McClintock Collection, Yale Collection of Western Americana, Beinecke Rare Book and Manuscript Library	Call Number WA MSS S-1175, Bibliographic Record Number 2008444, Image ID Number	43, 82, 90, 92-93
91	Walter McClintock	Photographic negative, b&w, glass negative	1909	Montana	http://beinecke.library.yale.edu/dl_crosscollex/brbldl_getrec.asp?fld=img&id=1090513	4/5/2016	--	Walter McClintock Collection, Yale Collection of Western Americana, Beinecke Rare Book and Manuscript Library	Call Number WA MSS S-1175, Bibliographic Record Number 10451210, Image ID Number	89, 91

Table B-1. Attribute data for 14SN106 chipped stone tools recovered from excavations prior to 2015.

Area (all from Main Block)	Catalog Number or Block-Unit Specimen number	Thermal Alteration?	Cortex?	Portion	Weight (g)	Length (mm)	Width (mm)	Thickness (mm)	Lithic Material	Flake Type/Debitage Sub-Type	Tool Type	Tool Sub-Type	Level
South	106-04-012	No	No	Complete	13.3	52	32	10	Hartville	Amorphous core flake	Scraper	Endscraper	Eroded out of place
North	30O-13-01	Yes	No	Complete	4.4	32.2	23.5	5.8	Fossilized Wood	Indeterminate	Scraper	Distolateral	100.410-100.252
South	30O-23-05	No	No	Fragment	0.7	17.6	9.6	5.3	Hartville	Indeterminate	Unimarginal flake tool	Scraper	100.100-100.050
South	106-05-113	No	No	Complete	2.4	25.1	21.4	4.9	Fossilized Wood	Amorphous core flake	Scraper	Endscraper	Eroded out of place
North	106-05-119	No	No	Fragment	1.2	20.4	13.1	5.7	Fossilized Wood	Indeterminate	Reamer	Reamer	In buried soil, level not recorded.
South	29O-03-62-09	No	No	Complete	NA	NA	NA	NA	Alibates	Indeterminate	Unimarginal flake tool	Scraper	100.050-100.000
South	29O-02-28	No	No	Medial	1	17.6	14.1	3.2	Tecovas	Biface Reduction	Projectile point/knife	Repurposed dart point	100.100-100.050
South	30O-19-79-01	No	No	Complete	0.3	14.2	7	4.2	Alibates	Indeterminate	Unimarginal flake tool	Scraper	100.000-099.950
South	29O-02-08-1	No	No	Tip	0.2	10.9	10	3	Alibates	Biface Reduction	Preform	Stage 3 or 4	100.150-100.100
South	30O-22-33	Yes	No	Complete	12.1	48.1	36.5	7.2	Hartville	Amorphous core flake	Scraper	Distolateral	100.100-100.050
South	30O-22-39	No	No	Fragment	0.1	19.2	5.5	2	Hartville	Indeterminate	Unimarginal flake tool	Knife	100.100-100.050
South	29O-03-58	No	No	Complete	4.9	25.9	22.1	9.5	Alibates	Amorphous core flake	Scraper	Endscraper	100.100-100.050
North	31P-12-39	No	Yes	Complete	6.3	42.1	17.7	9.7	Fossilized Wood	Indeterminate	Utilized flake tool	Knife	100.100-100.050
South	29O-01-70	No	No	Complete	8.8	46.3	25.5	8.4	Fossilized Wood	Amorphous core flake	Utilized flake tool	Knife	100.100-100.050
South	29O-08-08	No	No	Distal	3.2	27.4+	23.4+	3.5+	Hartville	Indeterminate	Scraper	Endscraper	100.450-100.400
South	29O-07-20	No	No	Complete	5.8	27	24.3	6.9	Hartville	Biface Reduction	Scraper	Distolateral	100.100-100.050
South	29O-08-36	No	No	Fragment	3.3	25.2	19.6	8	Alibates	Indeterminate	Preform	NA	100.100-100.050

Table B-1. Attribute data for 14SN106 chipped stone tools recovered from excavations prior to 2015.

Area (all from Main Block)	Catalog Number or Block-Unit Specimen number	Thermal Alteration?	Cortex?	Portion	Weight (g)	Length (mm)	Width (mm)	Thickness (mm)	Lithic Material	Flake Type/Debitage Sub-Type	Tool Type	Tool Sub-Type	Level
South	29O-09-23	No	No	Fragment	2.4	32.5	16.5	6.4	Fossilized Wood	Amorphous core flake	Utilized flake tool	Knife	100.250-100.200
South	29O-08-56	No	No	Complete	7.6	30.8	24.5	7.6	Hartville	Amorphous core flake	Scraper	Distolateral	100.050-100.000
North	31P-13-02	No	No	Medial	0.2	16.2	7.2	2	Alibates	Indeterminate	Utilized flake tool	Knife	100.250-100.200
North	31P-13-03	Yes	No	Fragment	1.1	21.4+	9+	5.9+	Alibates	Indeterminate	Scraper	Indeterminate	100.200-100.150
South	30O-23-04	No	No	Complete	10.8	38.9	28.1	9.5	Hartville	Amorphous core flake	Scraper	Indterminate	100.150-100.100
North	106-05-118	No	No	Fragment	6.1	40.4	21	6.5	Fossilized Wood	Indeterminate	Reamer	Reamer	100.200-100.150
North	31P-17-04	No	No	Proximal	2.2	19.6+	12.7+	8.6+	Edwards	Indeterminate	Scraper	Indeterminate	100.000-099.950
South	29O-04-09	No	No	Complete	16.3	58.2	25.5	11.9	Edwards	Blade	Scraper	Distolateral	100.100-100.050

Table C-1. Artifacts from 41WK21 that were mapped in the field. NR = not recorded.

Catalog Number	Blowout Area	Class	Tool Type	Year Collected	Month Collected	Day Collected
20	2	Chipped Stone	Endscraper	1981	6	NR
21	2	Chipped Stone	Point	1981	6	NR
22	2	Chipped Stone	Endscraper	1981	6	NR
23	2	Chipped Stone	Endscraper	1982	NR	NR
24	2	Chipped Stone	Unifacial combination tool	1982	NR	NR
25	2	Chipped Stone	Flake	1982	NR	NR
26	2	Chipped Stone	Endscraper	1982	NR	NR
27	2	Chipped Stone	Endscraper	1982	NR	NR
28	2	Chipped Stone	Endscraper	1982	NR	NR
29	2	Chipped Stone	Biface	1982	NR	NR
31	3	Chipped Stone	Point	1981	6	NR
32	3	Chipped Stone	Point	1981	NR	NR
33	3	Chipped Stone	Point	1981	NR	NR
34	3	Chipped Stone	Point	1981	NR	NR
35	3	Chipped Stone	Point	1981	NR	NR
36	3	Chipped Stone	Point	1981	NR	NR
37	3	Chipped Stone	Point	1981	NR	NR
38	3	Chipped Stone	Key-shaped perforator	1981	NR	NR
39	3	Chipped Stone	Endscraper	1981	NR	NR
51	5	Chipped Stone	Graver	1981-1985	NR	NR
52	5	Chipped Stone	Endscraper	1981-1985	NR	NR
53	5	Chipped Stone	Endscraper	1981-1985	NR	NR
54	5	Chipped Stone	Endscraper	1981-1985	NR	NR
55	5	Chipped Stone	Endscraper	1981-1985	NR	NR
56	5	Chipped Stone	Endscraper	1981-1985	NR	NR
57	5	Chipped Stone	Endscraper	1981-1985	NR	NR
58	5	Chipped Stone	Endscraper	1981-1985	NR	NR
59	5	Chipped Stone	Unifacial knife	1981-1985	NR	NR
61	6	Chipped Stone	Endscraper	1981-1985	NR	NR
62	6	Chipped Stone	Point	1981-1985	NR	NR
63	6	Chipped Stone	Point	1981-1985	NR	NR
64	6	Chipped Stone	Point	1981-1985	NR	NR
65	6	Chipped Stone	Side scraper	1981-1985	NR	NR
66	6	Chipped Stone	Point	1981-1985	NR	NR
67	6	Chipped Stone	Blade	1981-1985	NR	NR
68	6	Chipped Stone	Endscraper	1985	6	NR
69	6	Chipped Stone	Ultrathin	1986	3	10
210	2	Chipped Stone	Preform	1982	NR	NR
211	2	Chipped Stone	Uniface	1982	NR	NR
212	2	Chipped Stone	Side scraper	1982	NR	NR
213	2	Chipped Stone	Point	1982	NR	NR
214	2	Chipped Stone	Uniface	1982	NR	NR
215	2	Chipped Stone	Uniface	1982	NR	NR
216	2	Chipped Stone	Endscraper	1982	NR	NR
217	2	Chipped Stone	Graver	1985	NR	NR
218	2	Chipped Stone	Point	1981	NR	NR
219	2	Chipped Stone	Point	1985	NR	NR

Table C-1. Artifacts from 41WK21 that were mapped in the field. NR = not recorded.

Catalog Number	Blowout Area	Class	Tool Type	Year Collected	Month Collected	Day Collected
220	2	Chipped Stone	Graver	1985	NR	NR
221	2	Chipped Stone	Graver	1985	NR	NR
222	2	Chipped Stone	Channel	1983	NR	NR
223	2	Chipped Stone	Uniface	1983	NR	NR
224	2	Chipped Stone	Flake	1983	NR	NR
225	2	Chipped Stone	Point RT	1983	NR	NR
226	2	Faunal	Tooth, human	1981-1985	NR	NR
227	2	Chipped Stone	Point	1985	NR	NR
228	2	Chipped Stone	Preform	1985	NR	NR
229	2	Chipped Stone	Channel	1985	NR	NR
231	2	Faunal	Bone	1985	11	27
232	2	Chipped Stone	Uniface	1986	1	26
233	2	Chipped Stone	Channel	1986	1	26
234	2	Chipped Stone	Point	1986	1	26
235	2	Chipped Stone	Channel	1986	2	1
236	2	Chipped Stone	Utilized flake	1986	2	1
237	2	Chipped Stone	Graver	1986	2	22
238	2	Chipped Stone	Flake	1986	3	10
239	2	Chipped Stone	Endscraper	1986	4	4
240	2	Chipped Stone	Channel	1986	4	20
241	2	Chipped Stone	Flake	1986	4	20
242	2	Chipped Stone	Point	1986	5	5
243	2	Chipped Stone	Flake	1986	5	15
244	2	Chipped Stone	Graver	1986	5	15
245	2	Chipped Stone	Point	1986	8	10
246	2	Chipped Stone	Point	1981	NR	NR
247	2	Chipped Stone	Key-shaped perforator	1981	NR	NR
248	2	Chipped Stone	Flake	1986	11	26
249	2	Chipped Stone	Biface	1986	11	26
250	2	Chipped Stone	Graver	1986	11	26
251	2	Ground Stone	Hammerstone	1986	11	26
252	2	Chipped Stone	Utilized flake	1987	2	15
253	2	Chipped Stone	Side scraper	1987	4	5
254	2	Faunal	Bone and teeth	1987	4	5
255	2	Chipped Stone	Endscraper	1987	4	5
256	2	Chipped Stone	Flake	1987	4	5
257	2	Chipped Stone	Flake	1987	4	5
258	2	Chipped Stone	Endscraper	1987	5	2
259	2	Chipped Stone	Graver	1987	5	2
260	2	Chipped Stone	Flake	1987	5	2
261	2	Chipped Stone	Preform	1987	5	22
262	2	Chipped Stone	Point	1987	7	5
263	2	Red Ocher	Red Ocher	1987	8	1
264	2	Chipped Stone	Flake	1988	2	26
265	2	Chipped Stone	Flake	1988	2	26
266	2	Faunal	Bone tool	1988	3	19
267	2	Chipped Stone	Endscraper	1988	4	2

Table C-1. Artifacts from 41WK21 that were mapped in the field. NR = not recorded.

Catalog Number	Blowout Area	Class	Tool Type	Year Collected	Month Collected	Day Collected
268	2	Chipped Stone	Endscraper	1988	4	2
269	2	Chipped Stone	Point	1988	4	23
270	2	Chipped Stone	Utilized flake scraper edge	1988	4	23
271	2	Chipped Stone	Flake	1988	4	23
272	2	Chipped Stone	Flake	1988	4	23
273	2	Chipped Stone	Radial break tool	1988	4	23
310	3	Chipped Stone	Point	1981	NR	NR
311	3	Chipped Stone	Point	1981	NR	NR
312	3	Chipped Stone	Point	1981	NR	NR
313	3	Chipped Stone	Endscraper	1981-1985	NR	NR
314	3	Chipped Stone	Point	1981	NR	NR
315	3	Chipped Stone	Point	1981	NR	NR
317	3	Chipped Stone	Point	1985	NR	NR
318	3	Chipped Stone	Point	1981-1985	NR	NR
319	3	Chipped Stone	Chopper	1983	NR	NR
320	3	Chipped Stone	Chopper	1983	NR	NR
321	3	Chipped Stone	Graver	1981-1985	NR	NR
322	3	Chipped Stone	Graver	1981-1985	NR	NR
324	3	Chipped Stone	Point	1981-1985	NR	NR
325	3	Chipped Stone	Point	1981-1985	NR	NR
326	3	Chipped Stone	Point	1985	7	1
327	3	Chipped Stone	Channel	1985	8	12
328	3	Chipped Stone	Graver	1985	9	1
329	3	Chipped Stone	Flake	1985	9	8
330	3	Chipped Stone	Point	1985	9	NR
331	3	Chipped Stone	Endscraper	1985	11	27
332	3	Chipped Stone	Point	1985	11	27
333	3	Chipped Stone	Point	1986	2	1
334	3	Chipped Stone	Point	1986	5	5
335	3	Chipped Stone	Endscraper	1986	5	5
336	3	Chipped Stone	Point	1986	2	1
337	3	Chipped Stone	Point	1981	NR	NR
338	3	Chipped Stone	Flake	1986	11	26
339	3	Chipped Stone	Uniface	1986	11	26
341	3	Chipped Stone	Flake	1987	3	21
342	3	Chipped Stone	Utilized flake scraper edge	1987	6	13
343	3	Chipped Stone	Point	1987	9	7
344	3	Chipped Stone	Point	1987	10	18
345	3	Chipped Stone	Point	1988	3	12
373	3	Chipped Stone	Point	1988	10	26
374	3	Red Ocher	Red Ocher	1988	10	26
375	3	Red Ocher	Red Ocher	1988	10	26
384	3	Chipped Stone	Point	1989	10	25
385	3	Chipped Stone	Biface	1989	4	8
386	3	Chipped Stone	Utilized flake	1989	4	8
387	3	Chipped Stone	Radial break tool	1989	4	29
388	3	Chipped Stone	Endscraper	1989	10	29

Table C-1. Artifacts from 41WK21 that were mapped in the field. NR = not recorded.

Catalog Number	Blowout Area	Class	Tool Type	Year Collected	Month Collected	Day Collected
389	3	Ground Stone	Utilized flake	1990	10	6
390	3	Faunal	Tooth	1990	10	16
391	3	Chipped Stone	Point	1990	NR	NR
392	3	Chipped Stone	Point	1990	5	4
393	3	Faunal	Tooth, antelope	1990	NR	NR
394	3	Chipped Stone	Graver	1990	6	2
395	3	Ground Stone	Hammerstone	1991	4	13
396	3	Chipped Stone	Graver	1991	5	18
397	3	Chipped Stone	Point	1991	6	15
398	3	Chipped Stone	Key-shaped perforator	1991	6	15
399	3	Chipped Stone	Endscraper	1991	6	30
437	4	Chipped Stone	Point	2000	9	12
442	4	Chipped Stone	Utilized flake	2002	5	21
443	4	Chipped Stone	Channel	2002	5	21
444	4	Chipped Stone	Channel	2002	6	19
445	4	Chipped Stone	Graver	2002	6	19
446	4	Chipped Stone	Utilized flake	2002	6	19
447	4	Chipped Stone	Utilized channel flake	2002	6	19
448	4	Chipped Stone	Endscraper	2002	6	19
449	4	Chipped Stone	Channel	2002	6	19
450	4	Chipped Stone	Point	2002	6	19
451	4	Chipped Stone	Utilized flake	2002	6	19
456	4	Chipped Stone	Channel	2002	12	18
457	4	Chipped Stone	Utilized flake	2003	1	2
459	4	Chipped Stone	Utilized flake	2003	7	6
461	4	Chipped Stone	Preform	2003	10	2
462	4	Chipped Stone	Utilized flake	2004	2	20
463	4	Chipped Stone	Point	2004	2	20
469	4	Chipped Stone	Endscraper	2005	3	30
470	4	Chipped Stone	Preform	2005	4	11
474	4	Chipped Stone	Endscraper	2007	2	21
475	4	Chipped Stone	Point	2007	2	26
476	4	Chipped Stone	Preform	2007	4	14
477	4	Chipped Stone	Utilized flake	2007	4	14
478	4	Chipped Stone	Endscraper	2007	4	22
479	4	Chipped Stone	Channel	2008	5	3
480	4	Chipped Stone	Point	2008	5	21
481	4	Chipped Stone	Preform	2009	2	11
482	4	Chipped Stone	Ultrathin	2009	2	11
483	4	Chipped Stone	Utilized flake	2009	4	5
484	4	Chipped Stone	Utilized flake side scraper	2009	4	5
485	4	Chipped Stone	Graver	2009	4	5
486	4	Chipped Stone	Point	2009	5	12
487	4	Chipped Stone	Endscraper	2009	6	18
488	4	Chipped Stone	Unifacial knife	2009	8	20
489	4	Chipped Stone	Ultrathin	2010	1	24
490	4	Chipped Stone	Endscraper	2010	5	7

Table C-1. Artifacts from 41WK21 that were mapped in the field. NR = not recorded.

Catalog Number	Blowout Area	Class	Tool Type	Year Collected	Month Collected	Day Collected
491	4	Chipped Stone	Core	2010	5	24
492	4	Chipped Stone	Point	2010	6	19
493	4	Chipped Stone	Channel	2010	10	26
494	4	Chipped Stone	Endscraper	2011	1	3
495	4	Chipped Stone	Ultrathin	2011	1	3
496	4	Chipped Stone	Channel	2011	2	28
497	4	Chipped Stone	Preform	2011	3	26
498	4	Chipped Stone	Flake	2011	3	26
499	4	Chipped Stone	Endscraper	2011	3	26
510	5	Chipped Stone	Point	1981-1985	NR	NR
510	5	Chipped Stone	Point	1981-1985	NR	NR
510	5	Chipped Stone	Point	1981-1985	NR	NR
510	5	Chipped Stone	Point	1981-1985	NR	NR
511	5	Chipped Stone	Graver	1981-1985	NR	NR
513	5	Chipped Stone	Endscraper	1985	6	NR
514	5	Chipped Stone	Endscraper	1985	6	NR
515	5	Chipped Stone	Endscraper	1985	NR	NR
516	5	Chipped Stone	Flake	1985	12	24
517	5	Chipped Stone	Channel	1986	3	10
518	5	Chipped Stone	Graver	1986	3	13
519	5	Chipped Stone	Point	1986	5	5
521	5	Chipped Stone	Uniface	1986	11	26
522	5	Chipped Stone	Utilized flake scraper edge	1987	5	22
523	5	Chipped Stone	Endscraper	1987	7	5
524	5	Chipped Stone	Endscraper	1987	8	1
525	5	Chipped Stone	Utilized flake scraper edge	1988	3	5
526	5	Chipped Stone	Endscraper	1988	4	2
527	5	Chipped Stone	Endscraper	1988	4	30
528	5	Ground Stone	Hammerstone	1988	5	30
542	5	Chipped Stone	Key-shaped perforator	1988	8	26
545	5	Chipped Stone	Biface	1988	11	5
546	5	Chipped Stone	Endscraper	1988	12	3
547	5	Chipped Stone	Utilized flake scraper edge	1988	12	3
557	5	Chipped Stone	Channel	1990	1	6
558	5	Ground Stone	Hammerstone	1990	1	6
559	5	Chipped Stone	Flake	1990	3	16
560	5	Chipped Stone	Utilized flake	1990	3	16
561	5	Chipped Stone	Point	1990	5	4
562	5	Red Ocher	Red Ocher	1990	5	4
563	5	Chipped Stone	Blade	1990	7	8
564	5	Chipped Stone	Point	1990	7	8
565	5	Chipped Stone	Preform	1990	12	1
566	5	Chipped Stone	Radial break tool	1990	12	1
567	5	Chipped Stone	Graver	1991	3	7
568	5	Chipped Stone	Graver	1991	3	29
569	5	Chipped Stone	Biface	1991	3	29
570	5	Chipped Stone	Biface	1991	3	29

Table C-1. Artifacts from 41WK21 that were mapped in the field. NR = not recorded.

Catalog Number	Blowout Area	Class	Tool Type	Year Collected	Month Collected	Day Collected
571	5	Chipped Stone	Channel	1991	3	29
572	5	Chipped Stone	Uniface	1991	4	13
573	5	Chipped Stone	Point	1991	4	13
574	5	Chipped Stone	Flake	1991	4	13
575	5	Chipped Stone	Flake	1991	4	13
576	5	Chipped Stone	Bend break tool	1991	5	18
577	5	Chipped Stone	Endscraper	1991	6	15
578	5	Chipped Stone	Endscraper	1991	6	15
579	5	Chipped Stone	Point	1991	6	15
580	5	Chipped Stone	Utilized flake scraper edge	1991	6	30
581	5	Chipped Stone	Flake	1991	6	30
582	5	Chipped Stone	Graver	1991	8	4
583	5	Chipped Stone	Uniface	1991	11	11
584	5	Chipped Stone	Endscraper	1991	11	29
585	5	Chipped Stone	Preform	1992	2	9
586	5	Chipped Stone	Utilized channel flake	1992	3	8
587	5	Chipped Stone	Utilized flake	1992	3	8
588	5	Chipped Stone	Channel	1992	7	10
589	5	Chipped Stone	Preform	1993	2	16
591	5	Chipped Stone	Core	1993	3	15
592	5	Chipped Stone	Utilized flake	1993	4	7
594	5	Chipped Stone	Utilized flake scraper edge	1993	5	3
596	5	Chipped Stone	Notch	1993	6	3
598	5	Ground Stone	Smoothed surface	1993	6	15
599	5	Chipped Stone	Graver	1993	6	27
610	6	Chipped Stone	Side scraper	1986	4	4
611	6	Chipped Stone	Point	1986	4	4
612	6	Chipped Stone	Core	1986	4	4
613	6	Ground Stone	Hammerstone	1986	4	4
614	6	Chipped Stone	Point	1986	4	14
615	6	Chipped Stone	Point	1986	4	14
616	6	Chipped Stone	Point or Channel	1986	4	20
617	6	Chipped Stone	Endscraper	1986	8	10
618	6	Chipped Stone	Side scraper	1986	10	4
619	6	Chipped Stone	Flake	1987	2	15
620	6	Chipped Stone	Point	1987	5	22
621	6	Chipped Stone	Side scraper	1988	4	23
622	6	Chipped Stone	Side scraper	1988	3	5
635	6	Chipped Stone	Endscraper	1988	8	26
636	6	Chipped Stone	Flake	1988	8	26
637	6	Chipped Stone	Side scraper	1988	12	3
645	6	Chipped Stone	Endscraper	1989	3	23
646	6	Chipped Stone	Endscraper	1989	3	23
646	6	Chipped Stone	Endscraper	1989	3	23
647	6	Chipped Stone	Channel	1989	6	3
648	6	Chipped Stone	Point	1989	9	10
650	6	Chipped Stone	Flake	1990	5	4

Table C-1. Artifacts from 41WK21 that were mapped in the field. NR = not recorded.

Catalog Number	Blowout Area	Class	Tool Type	Year Collected	Month Collected	Day Collected
651	6	Chipped Stone	Flake	1990	5	4
652	6	Chipped Stone	Flake	1990	5	4
653	6	Ground Stone	Utilized	1990	5	4
654	6	Chipped Stone	Side scraper	1990	5	20
657	6	Chipped Stone	Flake	1991	3	7
658	6	Chipped Stone	Endscraper	1991	3	29
659	6	Chipped Stone	Flake	1991	4	13
660	6	Chipped Stone	Utilized flake side scraper	1991	4	13
661	6	Chipped Stone	Flake	1991	4	28
662	6	Chipped Stone	Flake	1991	4	28
662	6	Chipped Stone	Flake	1991	4	28
663	6	Chipped Stone	Flake	1991	4	28
664	6	Chipped Stone	Flake	1991	4	28
666	6	Ground Stone	Mano and metate	1991	5	18
667	6	Chipped Stone	Flake	1991	5	18
668	6	Chipped Stone	Flake	1991	5	18
669	6	Ground Stone	Hammerstone	1991	6	15
670	6	Chipped Stone	Endscraper	1991	6	30
671	6	Chipped Stone	Side scraper	1991	6	30
672	6	Chipped Stone	Utilized flake scraper edge	1991	6	30
674	6	Chipped Stone	Graver	1993	1	24
675	6	Chipped Stone	Endscraper	1993	2	16
676	6	Chipped Stone	Utilized flake scraper edge	1993	2	21
678	6	Chipped Stone	Utilized flake side scraper	1993	5	3
679	6	Chipped Stone	Channel	1993	6	3
680	6	Chipped Stone	Point	1993	6	15
680	6	Chipped Stone	Point	1993	6	15
682	6	Chipped Stone	Endscraper	1993	7	9
683	6	Chipped Stone	Endscraper	1993	8	13
684	6	Chipped Stone	Point	1993	9	21
685	6	Chipped Stone	Utilized flake scraper edge	1994	2	19
686	6	Chipped Stone	Side scraper	1994	3	17
687	6	Chipped Stone	Utilized flake side scraper	1994	3	26
689	6	Chipped Stone	Biface	1994	4	25
691	6	Chipped Stone	Graver	1995	1	28
694	6	Chipped Stone	Utilized flake	1995	3	18
695	6	Chipped Stone	Utilized flake scraper edge	1995	3	18
697	6	Chipped Stone	Side scraper	1995	4	9
698	6	Chipped Stone	Utilized flake side scraper	1995	5	20
699	6	Chipped Stone	Utilized flake	1995	5	20
749	7	Chipped Stone	Point	2003	2	17
763	7	Chipped Stone	Endscraper	2005	7	23
764	7	Chipped Stone	Utilized flake	2007	4	14
766	7	Chipped Stone	Point	2008	3	5
767	7	Chipped Stone	Point	2008	4	11
768	7	Chipped Stone	Utilized flake scraper edge	2008	5	21
769	7	Chipped Stone	Utilized flake scraper edge	2008	5	21

Table C-1. Artifacts from 41WK21 that were mapped in the field. NR = not recorded.

Catalog Number	Blowout Area	Class	Tool Type	Year Collected	Month Collected	Day Collected
770	7	Chipped Stone	Utilized flake scraper edge	2008	5	21
771	7	Chipped Stone	Utilized flake	2008	6	14
772	7	Chipped Stone	Uniface retouch flake	2009	4	5
774	7	Chipped Stone	Point RT	2009	8	20
775	7	Chipped Stone	Utilized flake	2010	1	24
776	7	Chipped Stone	Notch	2010	3	11
777	7	Chipped Stone	Utilized flake scraper edge	2010	6	19
778	7	Chipped Stone	Endscraper	2010	6	19
779	7	Chipped Stone	Utilized flake	2010	6	19
780	7	Chipped Stone	Utilized flake	2011	2	28
781	7	Chipped Stone	Utilized flake	2011	5	12
783	7	Chipped Stone	Utilized flake scraper edge	2011	9	9
783	7	Chipped Stone	Utilized flake scraper edge	2011	9	9
784	7	Chipped Stone	Graver	2012	1	24
785	7	Chipped Stone	Point	2012	2	26
786	7	Chipped Stone	Utilized flake	2012	2	26
787	7	Chipped Stone	Biface	2012	2	26
788	7	Chipped Stone	Utilized flake	2012	2	26
789	7	Chipped Stone	Endscraper	2012	3	19
790	7	Chipped Stone	Graver	2012	3	19
791	7	Chipped Stone	Flake	2012	3	19
792	7	Chipped Stone	Channel	2012	4	3
793	7	Chipped Stone	Biface	2012	4	3
794	7	Chipped Stone	Flake	2012	4	3
795	7	Chipped Stone	Biface	2012	5	6
796	7	Chipped Stone	Point	2012	5	6
797	7	Chipped Stone	Endscraper	2012	7	22
798	7	Faunal	Tooth, bison	2012	7	22
799	7	Chipped Stone	Utilized flake	2012	11	4
2110	2	Chipped Stone	Endscraper	1988	8	26
2112	2	Chipped Stone	Unifacial combination tool	1988	8	26
2127	2	Chipped Stone	Graver	1988	10	16
2128	2	Chipped Stone	Utilized flake scraper edge	1988	10	16
2130	2	Chipped Stone	Flake	1988	12	3
2131	2	Chipped Stone	Flake	1988	12	3
2132	2	Chipped Stone	Endscraper	1988	12	3
2133	2	Chipped Stone	Endscraper	1988	12	3
2158	2	Chipped Stone	Flake	1989	3	23
2159	2	Chipped Stone	Utilized flake	1989	3	23
2160	2	Red Ocher	Red Ocher	1989	3	23
2161	2	Chipped Stone	Flake	1989	3	23
2162	2	Chipped Stone	Utilized flake	1989	3	23
2164	2	Chipped Stone	Utilized flake	1989	3	23
2166	2	Chipped Stone	Utilized flake	1989	4	8
2167	2	Chipped Stone	Graver	1989	4	8
2168	2	Chipped Stone	Gouge	1989	6	3
2169	2	Chipped Stone	Endscraper	1989	6	3

Table C-1. Artifacts from 41WK21 that were mapped in the field. NR = not recorded.

Catalog Number	Blowout Area	Class	Tool Type	Year Collected	Month Collected	Day Collected
2171	2	Chipped Stone	Flake	1990	1	6
2172	2	Chipped Stone	Flake	1990	1	6
2173	2	Chipped Stone	Utilized flake	1990	1	28
2176	2	Chipped Stone	Flake	1990	5	4
2177	2	Chipped Stone	Channel	1990	5	4
2178	2	Faunal	Bone	1990	5	4
2180	2	Chipped Stone	Point	1990	6	24
2182	2	Chipped Stone	Utilized flake	1990	8	19
2183	2	Chipped Stone	Graver	1990	9	5
2184	2	Chipped Stone	Utilized flake side scraper	1990	9	5
2185	2	Chipped Stone	Endscraper	1990	11	4
2186	2	Chipped Stone	Point	1990	11	25
2187	2	Chipped Stone	Flake	1990	12	8
2188	2	Chipped Stone	Flake	1991	3	2
2191	2	Chipped Stone	Graver	1991	5	18
2194	2	Chipped Stone	Utilized flake	1991	6	30
2195	2	Chipped Stone	Endscraper	1991	8	4
2196	2	Chipped Stone	Flake	1991	8	4
2197	2	Chipped Stone	Graver	1991	8	18
2198	2	Chipped Stone	Flake	1991	8	18
2199	2	Chipped Stone	Preform	1992	2	9
2200	2	Chipped Stone	Channel	1992	2	9
2202	2	Chipped Stone	Endscraper	1992	3	8
2203	2	Chipped Stone	Gouge	1992	3	8
2205	2	Chipped Stone	Point	1992	4	10
2206	2	Chipped Stone	Point	1992	4	10
2208	2	Chipped Stone	Point RT	1993	2	16
2209	2	Chipped Stone	Graver	1993	2	21
2210	2	Red Ocher	Red Ocher	1993	3	15
2211	2	Chipped Stone	Side scraper	1993	4	7
2212	2	Chipped Stone	Utilized flake scraper edge	1993	4	23
2213	2	Chipped Stone	Flake	1993	5	3
2214	2	Chipped Stone	Flake	1993	5	3
2215	2	Ground Stone	Hammerstone	1993	6	15
2216	2	Chipped Stone	Ultrathin	1993	6	15
2217	2	Chipped Stone	Flake	1993	6	15
2218	2	Chipped Stone	Endscraper	1993	7	9
2219	2	Chipped Stone	Flake	1993	7	9
2220	2	Chipped Stone	Utilized flake	1993	7	23
2222	2	Chipped Stone	Utilized flake	1993	10	8
2223	2	Chipped Stone	Flake	1993	10	8
2224	2	Chipped Stone	Flake	1993	11	4
2225	2	Chipped Stone	Flake	1993	12	12
2226	2	Chipped Stone	Point	1993	12	12
2227	2	Chipped Stone	Uniface	1994	3	17
2228	2	Chipped Stone	Flake	1994	3	17
2229	2	Chipped Stone	Utilized flake	1994	3	26

Table C-1. Artifacts from 41WK21 that were mapped in the field. NR = not recorded.

Catalog Number	Blowout Area	Class	Tool Type	Year Collected	Month Collected	Day Collected
2231	2	Chipped Stone	Point	1994	5	9
2232	2	Faunal	Bone, bison	1994	6	6
2233	2	Chipped Stone	Endscraper	1994	8	19
2234	2	Chipped Stone	Point	1995	4	30
2235	2	Chipped Stone	Preform	1995	4	30
2236	2	Chipped Stone	Utilized flake	1995	6	10
2237	2	Chipped Stone	Utilized flake	1995	7	8
2238	2	Chipped Stone	Spokeshave	1995	8	10
2239	2	Chipped Stone	Flake	1995	8	10
2241	2	Chipped Stone	Utilized flake	1995	9	2
2242	2	Chipped Stone	Endscraper	1995	10	22
2243	2	Chipped Stone	Utilized flake scraper edge	1995	10	22
2245	2	Chipped Stone	Point	1995	11	11
2246	2	Chipped Stone	Flake	1995	11	11
2247	2	Chipped Stone	Flake	1995	11	11
2248	2	Chipped Stone	Utilized flake	1996	3	30
2249	2	Chipped Stone	Graver	1996	3	30
2250	2	Chipped Stone	Utilized flake scraper edge	1996	3	30
2250	2	Chipped Stone	Utilized flake scraper edge	1996	3	30
2251	2	Chipped Stone	Graver	1996	5	26
2253	2	Chipped Stone	Unifacial combination tool	1996	5	26
2256	2	Chipped Stone	Endscraper	1997	2	15
2260	2	Chipped Stone	Endscraper	1997	3	29
2261	2	Chipped Stone	Flake	1997	3	29
2262	2	Chipped Stone	Point	1997	4	12
2263	2	Chipped Stone	Point	1997	4	12
2266	2	Chipped Stone	Point	1997	9	7
2268	2	Chipped Stone	Point	1997	11	1
2269	2	Chipped Stone	Ultrathin	1997	11	1
2270	2	Chipped Stone	Uniface	1998	1	10
2271	2	Chipped Stone	Point	1998	1	10
2272	2	Chipped Stone	Endscraper	1998	1	10
2273	2	Chipped Stone	Biface	1998	2	21
2274	2	Chipped Stone	Point	1998	4	19
2277	2	Chipped Stone	Graver	1998	5	25
2283	2	Chipped Stone	Point	1999	3	6
2284	2	Chipped Stone	Endscraper	1999	3	14
2286	2	Chipped Stone	Utilized flake scraper edge	2000	3	4
2288	2	Chipped Stone	Utilized flake	2000	3	9
2292	2	Chipped Stone	Endscraper	2000	4	23
2293	2	Chipped Stone	Endscraper	2000	5	12
2295	2	Chipped Stone	Side scraper	2000	8	12
2296	2	Chipped Stone	Preform	2001	1	14
2297	2	Chipped Stone	Preform	2001	2	25
2298	2	Chipped Stone	Utilized flake	2001	2	25
2299	2	Chipped Stone	Endscraper	2001	4	14
2303	2	Chipped Stone	Uniface	2001	9	1

Table C-1. Artifacts from 41WK21 that were mapped in the field. NR = not recorded.

Catalog Number	Blowout Area	Class	Tool Type	Year Collected	Month Collected	Day Collected
2304	2	Chipped Stone	Point	2001	9	1
2305	2	Chipped Stone	Preform	2001	10	13
2306	2	Chipped Stone	Utilized flake	2001	11	24
2307	2	Chipped Stone	Bend break tool	2001	11	24
2308	2	Chipped Stone	Utilized flake	2001	11	24
2309	2	Chipped Stone	Preform	2002	3	3
2310	2	Chipped Stone	Point	2002	3	3
2312	2	Chipped Stone	Channel	2002	3	3
2315	2	Chipped Stone	Flake	2002	3	3
2316	2	Ground Stone	Utilized	2002	3	3
2317	2	Chipped Stone	Endscraper	2002	3	15
2318	2	Chipped Stone	Flake	2002	3	15
2319	2	Chipped Stone	Flake	2002	4	3
2320	2	Chipped Stone	Utilized flake side scraper	2002	4	3
2321	2	Chipped Stone	Utilized flake scraper edge	2002	5	11
2322	2	Chipped Stone	Endscraper	2002	5	11
2323	2	Chipped Stone	Utilized flake	2002	5	11
2324	2	Chipped Stone	Channel	2002	5	21
2325	2	Chipped Stone	Biface	2002	5	21
2326	2	Chipped Stone	Biface	2002	5	21
2349	2	Chipped Stone	Point	2002	7	29
2350	2	Chipped Stone	Flake	2002	7	29
2351	2	Ground Stone	Utilized	2002	10	3
2371	2	Chipped Stone	Biface	2003	3	22
2372	2	Chipped Stone	Endscraper	2003	4	4
2373	2	Ground Stone	Hammerstone	2003	4	16
2374	2	Chipped Stone	Point	2003	4	24
2375	2	Chipped Stone	Point	2003	6	5
2376	2	Chipped Stone	Biface	2003	6	5
2377	2	Chipped Stone	Point	2003	7	6
2378	2	Chipped Stone	Bifacial knife	2003	7	6
2379	2	Chipped Stone	Point	2003	9	10
2380	2	Chipped Stone	Channel	2003	10	2
2381	2	Chipped Stone	Point	2003	11	3
2383	2	Chipped Stone	Channel	2004	2	20
2384	2	Chipped Stone	Preform	2004	2	20
2386	2	Chipped Stone	Channel	2004	2	20
2394	2	Chipped Stone	Preform	2004	3	18
2395	2	Chipped Stone	Channel	2004	3	18
2396	2	Chipped Stone	Flake	2004	3	18
2398	2	Chipped Stone	Flake	2004	5	4
2399	2	Chipped Stone	Utilized flake scraper edge	2004	5	4
2400	2	Chipped Stone	Side scraper	2004	5	4
2402	2	Chipped Stone	Point	2004	6	3
2404	2	Chipped Stone	Biface	2004	6	24
2405	2	Chipped Stone	Channel	2004	6	24
2406	2	Chipped Stone	Point	2004	10	29

Table C-1. Artifacts from 41WK21 that were mapped in the field. NR = not recorded.

Catalog Number	Blowout Area	Class	Tool Type	Year Collected	Month Collected	Day Collected
2407	2	Chipped Stone	Biface	2004	10	29
2408	2	Chipped Stone	Flake	2004	10	29
2409	2	Chipped Stone	Point	2005	1	13
2410	2	Chipped Stone	Point	2005	1	13
2411	2	Chipped Stone	Channel	2005	1	13
2412	2	Chipped Stone	Preform	2005	1	13
2413	2	Chipped Stone	Channel	2005	1	13
2414	2	Chipped Stone	Preform	2005	3	25
2415	2	Chipped Stone	Point	2005	3	25
2416	2	Chipped Stone	Point RT	2005	3	30
2417	2	Chipped Stone	Utilized flake	2005	3	30
2418	2	Chipped Stone	Channel	2005	4	11
2419	2	Chipped Stone	Point RT	2005	6	11
2419	2	Chipped Stone	Point RT	2005	6	11
2420	2	Chipped Stone	Channel	2005	9	10
2421	2	Chipped Stone	Channel	2005	9	10
2423	2	Chipped Stone	Preform	2006	1	7
2424	2	Chipped Stone	Channel	2006	1	7
2425	2	Chipped Stone	Channel	2006	1	7
2426	2	Chipped Stone	Point	2006	1	7
2431	2	Chipped Stone	Endscraper	2006	4	7
2432	2	Chipped Stone	Endscraper	2006	4	7
2433	2	Chipped Stone	Preform	2006	4	18
2434	2	Chipped Stone	Point	2007	4	22
2435	2	Chipped Stone	Point	2007	8	25
2436	2	Chipped Stone	Endscraper	2008	2	1
2440	2	Chipped Stone	Utilized flake side scraper	2009	6	18
2443	2	Chipped Stone	Point	2010	3	21
2444	2	Chipped Stone	Point	2010	5	7
2445	2	Chipped Stone	Utilized flake	2010	5	7
2446	2	Chipped Stone	Channel	2010	5	24
2447	2	Chipped Stone	Utilized flake scraper edge	2011	6	21
2448	2	Chipped Stone	Point	2011	10	12
2449	2	Chipped Stone	Flake	2012	1	24
2451	2	Chipped Stone	Channel	2012	5	6
2452	2	Chipped Stone	Point	2012	11	4
2453	2	Chipped Stone	Utilized flake	2013	1	13
2454	2	Chipped Stone	Spokeshave	2013	2	23
2455	2	Chipped Stone	Bend break tool	2013	4	9
2456	2	Chipped Stone	Point	2013	6	22
2458	2	Ground Stone	Abrader	2013	9	29
2459	2	Chipped Stone	Point	2013	11	21
2460	2	Chipped Stone	Point	2014	1	29
2461	2	Chipped Stone	Utilized flake	2014	3	13
2462	2	Chipped Stone	Endscraper	2014	3	13
2463	2	Chipped Stone	Point	2014	4	28
2464	2	Chipped Stone	Point or Channel	2014	5	14

Table C-1. Artifacts from 41WK21 that were mapped in the field. NR = not recorded.

Catalog Number	Blowout Area	Class	Tool Type	Year Collected	Month Collected	Day Collected
2465	2	Chipped Stone	Bend break tool	2014	6	17
2466	2	Chipped Stone	Biface	2014	7	9
2467	2	Chipped Stone	Endscraper	2014	11	2
2468	2	Chipped Stone	Point	2015	4	4
3100	3	Chipped Stone	Graver	1991	6	30
3101	3	Chipped Stone	Biface	1991	6	30
3102	3	Chipped Stone	Flake	1991	6	30
3104	3	Chipped Stone	Channel	1992	2	9
3105	3	Chipped Stone	Graver	1992	2	9
3106	3	Chipped Stone	Channel	1992	3	8
3107	3	Chipped Stone	Preform	1992	3	8
3108	3	Chipped Stone	Hammerstone	1992	3	22
3109	3	Chipped Stone	Flake	1992	3	22
3110	3	Chipped Stone	Endscraper	1992	3	22
3112	3	Chipped Stone	Point	1992	9	12
3113	3	Faunal	Bone	1993	4	7
3114	3	Chipped Stone	Utilized flake	1993	4	23
3115	3	Chipped Stone	Flake	1993	5	3
3116	3	Faunal	Bone	1993	5	3
3117	3	Chipped Stone	Point	1993	7	9
3119	3	Chipped Stone	Channel	1993	7	9
3120	3	Chipped Stone	Flake	1993	7	23
3121	3	Faunal	Tooth	1993	7	23
3122	3	Chipped Stone	Core	1993	9	21
3123	3	Chipped Stone	Utilized flake scraper edge	1993	10	8
3127	3	Chipped Stone	Point	1994	6	6
3128	3	Chipped Stone	Point	1994	8	19
3129	3	Chipped Stone	Side scraper	1994	10	6
3130	3	Chipped Stone	Point	1995	1	28
3131	3	Chipped Stone	Graver	1995	3	18
3132	3	Chipped Stone	Endscraper	1995	4	9
3133	3	Chipped Stone	Point	1995	4	9
3135	3	Chipped Stone	Utilized flake	1995	4	30
3136	3	Chipped Stone	Utilized flake	1995	5	20
3137	3	Chipped Stone	Utilized flake scraper edge	1995	9	2
3138	3	Chipped Stone	Knife	1996	3	30
3139	3	Chipped Stone	Endscraper	1996	4	3
3140	3	Chipped Stone	Endscraper	1996	4	3
3141	3	Chipped Stone	Point	1996	4	3
3142	3	Chipped Stone	Utilized flake	1996	5	26
3143	3	Chipped Stone	Flake	1996	5	26
3144	3	Chipped Stone	Utilized flake	1996	7	7
3146	3	Chipped Stone	Utilized flake	1996	7	7
3148	3	Chipped Stone	Endscraper	1997	3	29
3149	3	Chipped Stone	Flake	1997	3	29
3150	3	Chipped Stone	Flake	1997	4	12
3152	3	Chipped Stone	Endscraper	1997	5	18

Table C-1. Artifacts from 41WK21 that were mapped in the field. NR = not recorded.

Catalog Number	Blowout Area	Class	Tool Type	Year Collected	Month Collected	Day Collected
3153	3	Chipped Stone	Utilized flake	1997	9	7
3154	3	Chipped Stone	Endscraper	1997	9	7
3155	3	Chipped Stone	Side scraper	1998	1	10
3156	3	Chipped Stone	Point	1998	1	10
3157	3	Chipped Stone	Point	1998	4	4
3158	3	Chipped Stone	Point	1998	4	4
3160	3	Chipped Stone	Ultrathin	1998	6	27
3161	3	Chipped Stone	Point	1998	6	27
3162	3	Chipped Stone	Endscraper	1998	6	27
3163	3	Chipped Stone	Endscraper	1998	9	5
3164	3	Chipped Stone	Utilized flake scraper edge	1998	9	5
3167	3	Chipped Stone	Biface	1998	9	5
3168	3	Chipped Stone	Utilized flake	1998	9	5
3169	3	Chipped Stone	Side scraper	1998	9	18
3170	3	Chipped Stone	Burin	1998	9	19
3174	3	Chipped Stone	Point	1998	9	19
3176	3	Chipped Stone	Flake	1998	10	16
3177	3	Chipped Stone	Graver	1998	11	1
3178	3	Chipped Stone	Flake	1998	11	1
3179	3	Chipped Stone	Flake	1998	11	1
3180	3	Chipped Stone	Utilized flake scraper edge	1998	11	11
3185	3	Chipped Stone	Utilized flake	1998	12	8
3186	3	Chipped Stone	Graver	1999	2	7
3187	3	Chipped Stone	Graver	1999	3	6
3188	3	Chipped Stone	Channel	1999	3	6
3189	3	Chipped Stone	Channel	1999	3	6
3190	3	Chipped Stone	Utilized flake	1999	3	6
3191	3	Chipped Stone	Endscraper	1999	3	14
3192	3	Chipped Stone	Utilized flake	1999	4	3
3193	3	Chipped Stone	Endscraper	1999	4	8
3194	3	Chipped Stone	Point	1999	4	8
3195	3	Chipped Stone	Endscraper	1999	4	15
3196	3	Chipped Stone	Uniface	1999	4	15
3197	3	Chipped Stone	Flake	1999	5	5
3198	3	Chipped Stone	Graver	1999	5	5
3199	3	Chipped Stone	Endscraper	1999	7	5
3200	3	Chipped Stone	Flake	1999	7	5
3201	3	Chipped Stone	Point	1999	7	5
3202	3	Chipped Stone	Point	1999	7	5
3203	3	Chipped Stone	Channel	1999	7	5
3204	3	Chipped Stone	Utilized flake scraper edge	1999	7	5
3205	3	Chipped Stone	Bifacial combination tool	1999	7	20
3206	3	Chipped Stone	Uniface	2000	2	23
3207	3	Chipped Stone	Endscraper	2000	3	4
3208	3	Chipped Stone	Endscraper	2000	3	4
3209	3	Chipped Stone	Endscraper	2000	3	9
3210	3	Chipped Stone	Utilized flake side scraper	2000	3	9

Table C-1. Artifacts from 41WK21 that were mapped in the field. NR = not recorded.

Catalog Number	Blowout Area	Class	Tool Type	Year Collected	Month Collected	Day Collected
3211	3	Chipped Stone	Side scraper	2000	3	24
3212	3	Chipped Stone	Endscraper	2000	5	18
3213	3	Chipped Stone	Endscraper	2000	5	18
3215	3	Chipped Stone	Point	2000	5	18
3216	3	Chipped Stone	Utilized flake scraper edge	2000	9	25
3217	3	Chipped Stone	Endscraper	2001	2	25
3218	3	Chipped Stone	Endscraper	2001	2	25
3219	3	Chipped Stone	Endscraper	2001	2	25
3220	3	Chipped Stone	Flake	2001	7	1
3221	3	Chipped Stone	Utilized flake scraper edge	2001	7	1
3222	3	Chipped Stone	Preform	2001	11	24
3224	3	Chipped Stone	Utilized flake	2002	5	21
3225	3	Chipped Stone	Graver	2002	5	21
3226	3	Chipped Stone	Flake	2002	6	19
3248	3	Chipped Stone	Uniface	2002	9	4
3254	3	Chipped Stone	Flake	2003	3	22
3258	3	Chipped Stone	Channel	2003	9	10
3259	3	Chipped Stone	Channel	2003	11	3
3265	3	Chipped Stone	Flake	2004	6	24
3266	3	Chipped Stone	Graver	2004	6	24
3267	3	Chipped Stone	Flake	2004	6	24
3268	3	Chipped Stone	Endscraper	2004	7	19
3269	3	Chipped Stone	Utilized flake	2004	7	19
3270	3	Chipped Stone	Utilized flake	2005	3	25
3271	3	Chipped Stone	Flake	2005	3	30
3273	3	Chipped Stone	Endscraper	2005	4	11
3274	3	Chipped Stone	Channel	2005	9	10
3275	3	Chipped Stone	Endscraper	2006	1	7
3276	3	Chipped Stone	Biface	2006	3	10
3277	3	Chipped Stone	Utilized flake	2006	4	18
3278	3	Chipped Stone	Utilized flake side scraper	2006	5	27
3279	3	Chipped Stone	Point	2008	4	11
3280	3	Chipped Stone	Endscraper	2008	6	14
3281	3	Chipped Stone	Endscraper	2009	2	11
3282	3	Chipped Stone	Utilized flake	2009	2	11
3284	3	Chipped Stone	Utilized flake side scraper	2009	6	18
3284	3	Chipped Stone	Utilized flake side scraper	2009	6	18
3287	3	Chipped Stone	Utilized flake	2011	3	26
3288	3	Chipped Stone	Point	2011	5	25
3289	3	Chipped Stone	Utilized flake	2012	2	26
3290	3	Chipped Stone	Utilized flake	2012	3	19
3291	3	Chipped Stone	Utilized flake	2012	4	3
3292	3	Chipped Stone	Utilized flake	2012	9	23
3293	3	Chipped Stone	Utilized flake	2013	2	23
3294	3	Chipped Stone	Endscraper	2013	3	5
3295	3	Chipped Stone	Utilized flake	2013	4	9
3296	3	Chipped Stone	Biface	2013	5	31

Table C-1. Artifacts from 41WK21 that were mapped in the field. NR = not recorded.

Catalog Number	Blowout Area	Class	Tool Type	Year Collected	Month Collected	Day Collected
3297	3	Chipped Stone	Utilized flake	2013	6	22
3298	3	Chipped Stone	Graver	2014	1	29
3299	3	Chipped Stone	Endscraper	2014	1	29
3300	3	Chipped Stone	Endscraper	2014	1	29
3301	3	Chipped Stone	Endscraper	2014	3	13
3302	3	Chipped Stone	Flake	2014	3	13
3303	3	Chipped Stone	Channel	2014	5	14
3304	3	Chipped Stone	Point	2014	6	17
3305	3	Chipped Stone	Channel	2014	6	17
3306	3	Chipped Stone	Flake	2015	2	13
3307	3	Chipped Stone	Graver	2015	4	4
3323	3	Chipped Stone	Utilized flake scraper edge	2001	11	24
4100	4	Chipped Stone	Graver	2011	5	12
4101	4	Chipped Stone	Utilized flake scraper edge	2011	6	21
4102	4	Chipped Stone	Preform	2011	7	25
4103	4	Chipped Stone	Utilized flake	2011	9	9
4104	4	Chipped Stone	Graver and notch	2011	9	9
4105	4	Chipped Stone	Graver	2011	9	9
4106	4	Chipped Stone	Channel	2012	3	19
4107	4	Chipped Stone	Point	2012	3	19
4108	4	Chipped Stone	Channel	2012	4	3
4109	4	Chipped Stone	Graver	2012	5	6
4110	4	Chipped Stone	Channel	2012	5	6
4111	4	Chipped Stone	Graver	2013	4	9
4112	4	Chipped Stone	Endscraper	2013	5	31
4113	4	Chipped Stone	Channel	2013	6	22
4114	4	Chipped Stone	Graver	2013	6	22
4115	4	Chipped Stone	Endscraper	2013	6	22
4116	4	Chipped Stone	Flake	2013	10	24
4117	4	Chipped Stone	Channel	2014	2	24
4118	4	Chipped Stone	Endscraper	2014	3	13
4119	4	Ground Stone	Abrader	2014	4	15
4120	4	Chipped Stone	Endscraper	2014	6	17
4121	4	Chipped Stone	Graver	2014	6	17
4122	4	Chipped Stone	Preform	2014	6	17
4123	4	Chipped Stone	Flake	2014	7	9
5103	5	Chipped Stone	Point	1993	11	4
5104	5	Chipped Stone	Point	1994	6	6
5105	5	Chipped Stone	Channel	1994	11	6
5106	5	Chipped Stone	Point	1995	3	18
5107	5	Chipped Stone	Core	1995	4	30
5110	5	Chipped Stone	Utilized flake scraper edge	1996	3	30
5111	5	Chipped Stone	Channel	1996	3	30
5112	5	Chipped Stone	Utilized flake side scraper	1996	5	26
5112	5	Chipped Stone	Utilized flake side scraper	1996	5	26
5113	5	Chipped Stone	Endscraper	1997	4	12
5114	5	Chipped Stone	Point	1997	4	12

Table C-1. Artifacts from 41WK21 that were mapped in the field. NR = not recorded.

Catalog Number	Blowout Area	Class	Tool Type	Year Collected	Month Collected	Day Collected
5125	5	Chipped Stone	Key-shaped perforator	1998	11	1
5127	5	Chipped Stone	Point	1998	12	8
5129	5	Chipped Stone	Endscraper	1999	7	5
5130	5	Chipped Stone	Preform	1999	7	5
5131	5	Chipped Stone	Endscraper	2000	3	4
5133	5	Chipped Stone	Endscraper	2000	3	24
5134	5	Chipped Stone	Preform	2000	3	24
5136	5	Chipped Stone	Channel	2000	4	20
5138	5	Chipped Stone	Utilized flake	2000	6	15
5139	5	Chipped Stone	Utilized flake	2001	2	25
5140	5	Chipped Stone	Endscraper	2001	2	25
5141	5	Chipped Stone	Endscraper	2001	4	22
5142	5	Chipped Stone	Biface	2001	5	23
5143	5	Chipped Stone	Biface	2001	7	1
5144	5	Chipped Stone	Utilized flake	2002	1	29
5145	5	Chipped Stone	Bifacial knife	2002	3	3
5146	5	Chipped Stone	Utilized flake	2002	4	28
5147	5	Chipped Stone	Endscraper	2002	4	28
5151	5	Chipped Stone	Flake	2002	10	3
5152	5	Chipped Stone	Channel	2002	11	10
5153	5	Chipped Stone	Channel	2002	12	18
5154	5	Chipped Stone	Utilized flake	2002	12	18
5163	5	Chipped Stone	Endscraper	2003	4	4
5165	5	Chipped Stone	Channel	2003	11	3
5170	5	Chipped Stone	Endscraper	2006	4	7
5172	5	Chipped Stone	Endscraper	2007	2	26
5173	5	Chipped Stone	Chopper	2008	2	1
5174	5	Chipped Stone	Channel	2008	6	14
5176	5	Chipped Stone	Channel	2008	9	27
5177	5	Chipped Stone	Utilized flake	2008	9	27
5178	5	Chipped Stone	Flake	2009	2	11
5179	5	Chipped Stone	Endscraper	2009	3	28
5180	5	Chipped Stone	Bifacial combination tool	2009	5	12
5181	5	Chipped Stone	Utilized flake	2009	5	12
5182	5	Chipped Stone	Graver	2010	5	7
5183	5	Chipped Stone	Utilized flake scraper edge	2011	5	12
5184	5	Ground Stone	Hammerstone	2012	5	6
5185	5	Chipped Stone	Point	2013	1	31
5186	5	Chipped Stone	Preform	2013	1	31
5187	5	Chipped Stone	Channel	2013	5	21
5189	5	Chipped Stone	Biface	2014	8	28
5190	5	Chipped Stone	Biface	2015	3	24
6106	6	Chipped Stone	Utilized flake scraper edge	1996	3	30
6107	6	Chipped Stone	Point	1996	3	30
6109	6	Chipped Stone	Endscraper	1996	3	30
6110	6	Chipped Stone	Utilized flake	1996	5	26
6111	6	Chipped Stone	Utilized flake	1996	5	26

Table C-1. Artifacts from 41WK21 that were mapped in the field. NR = not recorded.

Catalog Number	Blowout Area	Class	Tool Type	Year Collected	Month Collected	Day Collected
6112	6	Chipped Stone	Utilized flake scraper edge	1996	5	26
6113	6	Chipped Stone	Graver	1996	5	26
6120	6	Chipped Stone	Flake	1996	7	7
6121	6	Chipped Stone	Ultrathin	1996	7	7
6122	6	Chipped Stone	Graver	1996	7	7
6123	6	Chipped Stone	Endscraper	1997	7	6
6124	6	Ground Stone	Hammerstone	1998	4	19
6125	6	Chipped Stone	Graver	1998	5	25
6126	6	Chipped Stone	Utilized flake	1998	6	27
6128	6	Chipped Stone	Utilized flake	1998	7	18
6129	6	Chipped Stone	Flake	1998	7	28
6135	6	Chipped Stone	Point	2000	4	23
6136	6	Chipped Stone	Biface	2001	4	14
6137	6	Chipped Stone	Utilized flake	2001	10	13
6139	6	Chipped Stone	Core	2001	11	24
6154	6	Chipped Stone	Endscraper	2003	11	3
6155	6	Chipped Stone	Endscraper	2004	1	28
6156	6	Chipped Stone	Flake	2004	1	28
6162	6	Chipped Stone	Flake	2004	3	18
6166	6	Chipped Stone	Utilized flake scraper edge	2010	3	21
6167	6	Chipped Stone	Point	2012	2	26
6168	6	Chipped Stone	Utilized flake	2012	3	19
6169	6	Chipped Stone	Utilized flake	2013	1	13
6170	6	Chipped Stone	Core	2013	3	5
6171	6	Chipped Stone	Channel	2014	8	28
7100	7	Chipped Stone	Utilized flake scraper edge	2013	1	13
7101	7	Chipped Stone	Graver	2013	1	13
7102	7	Chipped Stone	Graver	2013	1	13
7103	7	Chipped Stone	Endscraper	2013	1	31
7104	7	Chipped Stone	Utilized flake	2013	3	5
7105	7	Chipped Stone	Flake	2013	3	24
7106	7	Faunal	Bone	2013	3	24
7107	7	Chipped Stone	Flake	2013	4	28
7108	7	Chipped Stone	Graver	2013	4	28
7109	7	Chipped Stone	Endscraper	2013	4	28
7110	7	Chipped Stone	Utilized flake scraper edge	2013	5	21
7111	7	Chipped Stone	Utilized flake	2013	5	21
7112	7	Chipped Stone	Flake	2013	5	21
7113	7	Chipped Stone	Point	2013	5	21
7114	7	Chipped Stone	Endscraper	2013	5	21
7115	7	Chipped Stone	Flake	2013	5	21
7116	7	Chipped Stone	Point	2013	5	13
7117	7	Chipped Stone	Utilized flake	2013	5	31
7118	7	Chipped Stone	Endscraper	2013	5	31
7119	7	Chipped Stone	Endscraper	2013	6	22
7120	7	Chipped Stone	Endscraper	2013	6	22
7121	7	Chipped Stone	Utilized flake scraper edge	2013	6	22

Table C-1. Artifacts from 41WK21 that were mapped in the field. NR = not recorded.

Catalog Number	Blowout Area	Class	Tool Type	Year Collected	Month Collected	Day Collected
7122	7	Chipped Stone	Utilized flake scraper edge	2013	6	22
7123	7	Chipped Stone	Utilized flake	2013	9	29
7124	7	Chipped Stone	Endscraper	2013	10	24
7125	7	Chipped Stone	Utilized flake	2013	10	24
7126	7	Chipped Stone	Utilized flake scraper edge	2014	1	29
7127	7	Chipped Stone	Channel	2014	1	29
7128	7	Chipped Stone	Endscraper	2014	3	13
7129	7	Chipped Stone	Endscraper	2014	3	22
7130	7	Chipped Stone	Endscraper	2014	3	22
7131	7	Chipped Stone	Utilized flake	2014	3	22
7132	7	Ground Stone	Utilized	2014	3	22
7133	7	Chipped Stone	Utilized flake	2014	4	15
7134	7	Chipped Stone	Utilized flake	2014	4	15
7135	7	Chipped Stone	Utilized flake	2014	4	15
7136	7	Chipped Stone	Radial break tool	2014	4	15
7137	7	Chipped Stone	Utilized flake	2014	4	15
7138	7	Chipped Stone	Utilized flake	2014	4	15
7139	7	Chipped Stone	Utilized flake	2014	4	15
7140	7	Chipped Stone	Bifacial combination tool	2014	4	28
7141	7	Chipped Stone	Endscraper	2014	4	28
7142	7	Chipped Stone	Utilized flake scraper edge	2014	4	28
7143	7	Chipped Stone	Endscraper	2014	6	17
7144	7	Chipped Stone	Endscraper	2014	8	28
7145	7	Chipped Stone	Endscraper	2014	8	28
7146	7	Ground Stone	Utilized	2015	1	26
2181a	2	Chipped Stone	Biface	1990	7	8
2181b	2	Chipped Stone	Biface	1990	7	8
230a	2	Faunal	Bone	1985	7	27
230b	2	Faunal	Bone	1985	12	1
2385a	2	Chipped Stone	Core	2004	2	20
2385b	2	Chipped Stone	Flake	2004	2	20
2385c	2	Chipped Stone	Flake	2004	2	20
2385d	2	Chipped Stone	Flake	2004	2	20
2385e	2	Chipped Stone	Flake	2004	2	20
2385f	2	Chipped Stone	Flake	2004	2	20
2SRR1	2	Faunal	Tooth, mammoth	1985	7	27
2SRR2	2	Faunal	Tooth, mammoth	1990	5	4
2SRR3	2	Faunal	Tooth, mammoth	1990	5	20
316a	3	Chipped Stone	Point	1985	NR	NR
316b	3	Chipped Stone	Point	1985	NR	NR
3A01	3A	Chipped Stone	Point	1981	6	NR
3A02	3A	Chipped Stone	Point	1981	6	NR
3A03	3A	Chipped Stone	Point	1981	NR	NR
3A04	3A	Chipped Stone	Preform	1981	NR	NR
3A05	3A	Chipped Stone	Uniface	1982	NR	NR
3A06	3A	Chipped Stone	Point	1985	NR	NR
3A07	3A	Chipped Stone	Point	1985	6	NR

Table C-1. Artifacts from 41WK21 that were mapped in the field. NR = not recorded.

Catalog Number	Blowout Area	Class	Tool Type	Year Collected	Month Collected	Day Collected
3A08	3A	Chipped Stone	Point	1985	NR	NR
3A09	3A	Chipped Stone	Point	1986	2	1
3A10	3A	Chipped Stone	Point	1986	5	5
3A11	3A	Chipped Stone	Point	1986	10	4
3A12	3A	Chipped Stone	Point	1987	11	23
3A13	3A	Chipped Stone	Point	1988	3	19
3A15	3A	Chipped Stone	Point	1988	11	5
3A17	3A	Chipped Stone	Point	1990	6	2
3A18	3A	Chipped Stone	Burin, unifacial	1990	7	8
3A20	3A	Chipped Stone	Endscraper	1991	3	29
3A21	3A	Chipped Stone	Point	1991	6	30
3A22	3A	Chipped Stone	Channel	1991	6	30
3A23	3A	Chipped Stone	Biface	1991	11	11
3A24	3A	Chipped Stone	Point	1991	11	29
3A25	3A	Chipped Stone	Point	1991	11	29
3A26	3A	Chipped Stone	Radial break tool	1992	7	10
3A28	3A	Chipped Stone	Point	1999	7	20
3A29	3A	Chipped Stone	Point	1999	7	20
3A30	3A	Ground Stone	Red Ocher	2000	3	24
3A31	3A	Chipped Stone	Utilized flake	2001	1	14
3A32	3A	Chipped Stone	Channel	2001	4	22
3A36	3A	Chipped Stone	Point	2004	6	24
3A37	3A	Chipped Stone	Radial break tool	2005	3	30
3A38	3A	Chipped Stone	Point	2005	4	7
3A39	3A	Chipped Stone	Graver	2005	7	23
3A40	3A	Chipped Stone	Endscraper	2006	1	7
3A41	3A	Chipped Stone	Point	2006	3	10
3A42	3A	Chipped Stone	Utilized flake side scraper	2006	4	18
3A43	3A	Chipped Stone	Endscraper	2006	5	27
3A44	3A	Chipped Stone	Utilized flake	2006	5	27
3A45	3A	Chipped Stone	Point	2006	9	6
3A46	3A	Chipped Stone	Point	2007	2	26
3A48	3A	Chipped Stone	Point	2008	2	1
3A49	3A	Chipped Stone	Point	2008	4	11
3A50	3A	Chipped Stone	Point	2008	6	14
3A51	3A	Chipped Stone	Point	2008	6	14
3A52	3A	Chipped Stone	Point	2008	6	14
3A53	3A	Chipped Stone	Point	2008	6	14
3A56	3A	Chipped Stone	Point	2008	8	10
3A57	3A	Chipped Stone	Endscraper	2009	4	5
3A58	3A	Chipped Stone	Point	2009	6	18
3A59	3A	Chipped Stone	Point	2010	1	24
3A60	3A	Chipped Stone	Point	2010	1	24
3A62	3A	Chipped Stone	Point	2010	6	19
3A63	3A	Chipped Stone	Channel	2010	6	19
3A64	3A	Chipped Stone	Endscraper	2010	10	26
3A65	3A	Chipped Stone	Point	2010	10	26

Table C-1. Artifacts from 41WK21 that were mapped in the field. NR = not recorded.

Catalog Number	Blowout Area	Class	Tool Type	Year Collected	Month Collected	Day Collected
3A66	3A	Chipped Stone	Utilized flake	2011	5	12
3A67	3A	Chipped Stone	Utilized flake scraper edge	2011	6	21
3A68	3A	Chipped Stone	Point	2011	6	21
3A69	3A	Chipped Stone	Point	2012	1	24
3A70	3A	Chipped Stone	Point	2013	2	23
3A71	3A	Chipped Stone	Endscraper	2013	3	24
3A72	3A	Chipped Stone	Point	2013	4	28
3A73	3A	Chipped Stone	Preform	2013	6	22
3A74	3A	Chipped Stone	Point	2014	6	17
3B77	3B	Chipped Stone	Side scraper	1996	7	7
3B96	3B	Chipped Stone	Side scraper	2008	6	14
3B97	3B	Chipped Stone	Utilized flake side scraper	2010	5	24
3B98	3B	Chipped Stone	Endscraper	2013	1	31
3SRR1	3	Chipped Stone	Flake	2000	2	23
3SRR2	3	Faunal	Tooth, bison	2000	3	9
512a	5	Chipped Stone	Point	1985	6	NR
512b	5	Chipped Stone	Point	1985	NR	NR
5SRR1	5	Faunal	Bone, accetabuleum	1990	5	4

Table C-2. Attribute data for 41WK21 endscrapers collected prior to April 2015. Not all of these tools were mapped in the field and as a result not all of them are depicted on maps in this study.

Blowout Area	Catalog Number	Patina	Thermal Alteration?	Cortex?	Portion	Spurs (n=#)	Weight (g)	Length (mm)	Width (mm)	Thickness (mm)	Lithic Material	Blank Type
2	20	0	No	No	Complete	0	7.4	32.81	27.69	6.77	Edwards	Indeterminate flake
2	22	0	No	Yes	Complete	1	7.5	39.76	31.65	5.97	Edwards	Indeterminate flake
2	23	0	No	Only on platform	Complete	2	4.1	28.18	25	6.54	Edwards	Amorphous core flake
2	26	0	No	No	Complete	0	9.6	47.56	35.84	5.27	Edwards	Indeterminate flake
2	27	0	No	No	Complete	0	37.6	67.19	38.05	11.47	Edwards	Amorphous core flake
2	28	0	No	No	Complete	0	21	50.02	35.89	9.92	Edwards	Indeterminate
2	216	0	No	No	Complete	1	9.7	34.93	29.27	9.81	Edwards	Amorphous core flake
2	239	0	No	No	Complete	2	10.3	40.67	33.5	9.83	Edwards	Amorphous core flake
2	255	0	Yes	Yes	Complete	0	7.6	39.84	23.91	7.35	Edwards	Amorphous core flake
2	267	0	No	No	Complete	0	5.3	27.88	24.94	6.57	Edwards	Indeterminate
2	268	0	No	No	Complete	2	6.2	29.29	30.09	8.68	Edwards	Amorphous core flake
2	291	0	No	No	Complete	1	3.6	30.79	24.03	4.24	Edwards	Indeterminate flake
2	293	0	No	No	Proximal	NA	4.7	NA	NA	NA	Edwards	Biface reduction flake
2	2110	0	No	No	Proximal	NA	4.8	NA	NA	NA	Edwards	Indeterminate flake
2	2132	0	No	No	Complete	2	3.3	35.37	19.88	3.71	Edwards	Blade
2	2133	0	No	No	Complete	1	14.4	40.01	36.65	9.94	Edwards	Amorphous core flake
2	2165	0	No	Yes	Complete	1	9.3	25.23	26.5	10.1	Edwards	Amorphous core flake
2	2169	0	No	No	Complete	1	11.7	40.61	29.13	7.56	Edwards	Amorphous core flake

Table C-2. Attribute data for 41WK21 endscrapers collected prior to April 2015. Not all of these tools were mapped in the field and as a result not all of them are depicted on maps in this study.

Blowout Area	Catalog Number	Patina	Thermal Alteration?	Cortex?	Portion	Spurs (n=#)	Weight (g)	Length (mm)	Width (mm)	Thickness (mm)	Lithic Material	Blank Type
2	2185	0	No	No	Complete	2	5.4	26.27	30.83	6.48	Edwards	Indeterminate flake
2	2202	0	No	No	Complete	1	3.4	24.81	26.08	5.2	Edwards	Amorphous core flake
2	2218	0	No	No	Complete	1	5.5	30.77	24.5	8.31	Edwards	Indeterminate
2	2233	0	No	No	Complete	1	6.9	31.14	23.78	9.04	Edwards	Amorphous core flake
2	2242	0	No	Yes	Proximal	--	2.3	NA	NA	NA	Edwards	Amorphous core flake
2	2252	0	No	No	Proximal	--	1.5	NA	NA	NA	Edwards	Indeterminate flake
2	2256	0	No	Yes	Complete	0	14.7	41.84	32.76	10.42	Chalcedony	Amorphous core flake
2	2260	0	No	Yes	Complete	0	34.4	85.3	50.63	7.41	Edwards	Biface reduction flake
2	2272	1	No	Yes	Complete	1	20.5	37.73	32.08	16.21	Chalcedony	Biface reduction flake
2	2284	0	No	No	Complete	3	4.8	28.05	26.72	6.02	Edwards	Indeterminate flake
2	2285	1	No	No	Complete	0	31.9	49.24	38.33	15.03	Chalcedony	Amorphous core flake
2	2293	0	No	No	Complete	2	6.2	32.28	32.92	6.91	Edwards	Indeterminate
2	2294	0	No	No	Complete	2	5.4	35	29.75	5.23	Edwards	Indeterminate flake
2	2299	0	No	No	Complete	2	7.5	32.68	30.66	7.6	Edwards	Amorphous core flake
2	2317	0	No	No	Complete	0	26.3	49.79	41.01	15.8	Quartzite	Amorphous core flake
2	2322	1	No	No	Complete	1	8.1	33.86	24.87	9.97	Edwards	Indeterminate
2	2364	0	No	Yes	Proximal	--	4.9	NA	NA	NA	Edwards	Indeterminate flake
2	2372	0	No	Yes	Complete	0	5.4	34.68	27.04	7.09	Edwards	Indeterminate flake

Table C-2. Attribute data for 41WK21 endscrapers collected prior to April 2015. Not all of these tools were mapped in the field and as a result not all of them are depicted on maps in this study.

Blowout Area	Catalog Number	Patina	Thermal Alteration?	Cortex?	Portion	Spurs (n=#)	Weight (g)	Length (mm)	Width (mm)	Thickness (mm)	Lithic Material	Blank Type
2	2431	0	No	No	Complete	2	7.5	31.39	28.05	9.12	Edwards	Indeterminate flake
2	2432	0	No	No	Complete	0	5.6	25.4	26.54	5.86	Edwards	Indeterminate flake
2	2436	0	No	No	Distal	1	15.8	34.99	31.14	13.53	Edwards	Amorphous core flake
2	2450	0	No	No	Complete	1	5	29.67	31.86	4.13	Edwards	Indeterminate
2	2462	0	No	Yes	Proximal	--	4.4	NA	NA	NA	Edwards	Amorphous core flake
2	2467	0	No	Yes	Complete	1	19.2	37.44	37.81	13.59	Chalcedony	Amorphous core flake
2	258/2292	0	No	No	Complete	0	12	64.45	38.63	4.79	Edwards	Biface reduction flake
2	294/294	0	No	No	Medial/Proximal	0	4.6	41.42	26.15	3.94	Edwards	Biface reduction flake
3	39	0	No	Yes	Complete	2	10.1	29.36	30.19	9.75	Edwards	Amorphous core flake
3	331	0	No	No	Complete	0	11.5	35.92	31.58	9.68	Edwards	Biface reduction flake
3	335	1	No	Only on platform	Proximal	--	4.4	19.5+	29.3	9.4	Edwards	Amorphous core flake
3	351	0	No	No	Complete	2	7.1	28.54	34.03	6.43	Edwards	Biface reduction flake
3	388	0	No	No	Proximal	--	2.5	21.3+	22.7	5.3	Edwards	Indeterminate flake
3	399	1	No	No	Proximal	--	0.7	NA	NA	NA	Edwards	Indeterminate flake
3	3110	0	No	No	Complete	2	6.2	33.5	26.45	7.69	Edwards	Indeterminate
3	3132	0	No	No	Complete	1	5.3	26.37	29.56	7.47	Edwards	Amorphous core flake
3	3139	1	No	No	Complete	1	5.5	35.99	23.66	5.76	Edwards	Blade
3	3140	1	No	No	Complete	0	15.7	40.43	34.85	9.76	Edwards	Indeterminate flake

Table C-2. Attribute data for 41WK21 endscrapers collected prior to April 2015. Not all of these tools were mapped in the field and as a result not all of them are depicted on maps in this study.

Blowout Area	Catalog Number	Patina	Thermal Alteration?	Cortex?	Portion	Spurs (n=#)	Weight (g)	Length (mm)	Width (mm)	Thickness (mm)	Lithic Material	Blank Type
3	3148	0	No	No	Complete	0	6.5	30.53	28.12	9.05	Edwards	Indeterminate
3	3152	1	No	No	Complete	1	8.1	34.68	34	5.86	Edwards	Indeterminate flake
3	3154	1	No	Yes	Complete	2	10.5	34.55	35.67	8.62	Edwards	Amorphous core flake
3	3162	0	No	No	Complete	2	10.6	37.26	33.03	8.32	Edwards	Biface reduction flake
3	3163	2	No	No	Complete	0	17.5	47.67	29.16	9.78	Edwards	Indeterminate flake
3	3191	1	No	No	Complete	2	9	35.06	36.39	7.08	Edwards	Biface reduction flake
3	3193	0	No	No	Complete	2	6.8	28.02	31.11	7.18	Edwards	Indeterminate flake
3	3199	0	No	No	Complete	1	28	58.78	47.47	8.18	Edwards	Biface reduction flake
3	3207	0	No	No	Complete	1	10.2	36.26	32.99	8.5	Edwards	Amorphous core flake
3	3208	2	No	No	Complete	1	11.3	34.93	34.61	7.83	Edwards	Biface reduction flake
3	3209	1	No	No	Complete	1	9.7	32.59	27.62	9.37	Edwards	Indeterminate
3	3213	2	No	No	Complete	2	11.6	32.91	35.13	9.31	Edwards	Indeterminate flake
3	3218	1	No	No	Complete	1	8.2	26.93	28.34	10.83	Edwards	Indeterminate flake
3	3219	0	No	No	Complete	1	10.5	34.12	32.9	8.84	Edwards	Indeterminate flake
3	3250	0	No	Only on platform	Complete	0	3.8	26.88	18.22	8.22	Edwards	Indeterminate
3	3263	0	No	No	Complete	0	53.4	62.9	41.76	21.05	Quartzite with chert band	Amorphous core flake
3	3268	2	No	No	Complete	1	17.2	42.96	37.48	11.39	Edwards	Amorphous core flake

Table C-2. Attribute data for 41WK21 endscrapers collected prior to April 2015. Not all of these tools were mapped in the field and as a result not all of them are depicted on maps in this study.

Blowout Area	Catalog Number	Patina	Thermal Alteration?	Cortex?	Portion	Spurs (n=#)	Weight (g)	Length (mm)	Width (mm)	Thickness (mm)	Lithic Material	Blank Type
3	3273	0	No	Only on platform	Complete	2	11.6	35.59	38.82	9.05	Edwards	Indeterminate
3	3275	1	No	No	Complete	1	4.4	29.06	27.75	5.29	Edwards	Biface reduction flake
3	3280	1	No	No	Complete	2	5.5	28.59	32.13	5.69	Edwards	Amorphous core flake
3	3281	0	Yes	Only on platform	Proximal	--	5.5	NA	NA	NA	Edwards	Amorphous core flake
3	3294*	--	--	--	Proximal	--	--	--	--	--	Edwards	Unknown
3	3299	1	No	No	Distal	2	4.4	30.08	25.4	5.07	Edwards	Amorphous core flake
3	3300	0	No	Yes	Complete	1	13.4	43.3	35.08	9.13	Edwards	Amorphous core flake
3	3301*	--	--	--	Proximal	--	--	--	--	--	Edwards	Unknown
3	3195/3195	1	No	Yes	Complete	0	22.5	68.4	46.92	7.28	Edwards	Biface reduction flake
3	3217/3212 /3175	0	No	No	Complete	0	9.5	37.62	30.52	6.33	Edwards	Indeterminate flake
4	47	2	No	Yes	Complete	0	12.9	39.02	39.34	7.84	Edwards	Amorphous core flake
4	431*	1	No	No	Proximal	0	Not recorded	20	27.6	4.7	Edwards	Unknown
4	435	0	No	No	Proximal	--	5.1	NA	NA	NA	Edwards	Biface reduction flake
4	448	1	No	Yes	Distal	0	5.1	NA	NA	NA	Edwards	Indeterminate
4	467	1	No	No	Complete	2	5.8	29.22	28.82	6.62	Edwards	Amorphous core flake
4	469	1	Yes	No	Distal	1	8.3	25.48	28.86	10.09	Edwards	Indeterminate
4	474	0	No	No	Complete	2	5.1	26.64	25.35	8.21	Edwards	Indeterminate
7	478*	--	--	--	Proximal	--	--	--	--	--	Edwards	Unknown
4	487	0	No	Yes	Distal	0	17.6	36.67	38.18	10.14	Edwards	Amorphous core flake

Table C-2. Attribute data for 41WK21 endscrapers collected prior to April 2015. Not all of these tools were mapped in the field and as a result not all of them are depicted on maps in this study.

Blowout Area	Catalog Number	Patina	Thermal Alteration?	Cortex?	Portion	Spurs (n=#)	Weight (g)	Length (mm)	Width (mm)	Thickness (mm)	Lithic Material	Blank Type
4	490	1	No	Yes	Complete	2	10	37.75	36.55	7.58	Edwards	Amorphous core flake
4	494	1	No	No	Complete	1	6.7	39.18	30.79	6.44	Edwards	Biface reduction flake
4	499	1	No	No	Complete	1	6.8	27.13	26.93	7.84	Edwards	Indeterminate flake
4	4112	1	No	No	Complete	0	7.5	33.9	26.7	8.52	Edwards	Amorphous core flake
4	4115	2	No	No	Complete	1	16	50.74	38.73	9.29	Edwards	Indeterminate
4	4118	0	No	No	Complete	1	14	34.57	39.41	9.77	Chalcedony	Amorphous core flake
4	4120	1	No	No	Complete	1	5.2	30.44	36.01	4.69	Edwards	Biface reduction flake
5	52	1	No	Yes	Complete	2	6.2	34.78	26.1	6.73	Edwards	Indeterminate flake
5	53	2	No	No	Complete	1	6.3	31.93	26.4	7.53	Edwards	Indeterminate flake
5	54	1	No	No	Complete	1	13.5	46.03	25.82	9.91	Edwards	Biface reduction flake
5	55	1	No	Yes	Complete	1	17.4	37.69	41.98	9.06	Edwards	Amorphous core flake
5	56	1	No	No	Complete	1	8.7	36.32	32.08	7.24	Edwards	Biface reduction flake
5	57	2	No	No	Complete	0	8.4	32.49	34.76	7.01	Edwards	Indeterminate flake
5	58	1	No	No	Complete	2	5.3	32.24	26.51	3.87	Edwards	Blade
5	513	2	No	Yes	Complete	0	16.8	39.63	33.03	10.03	Edwards	Indeterminate
5	514	1	No	No	Complete	2	6.6	32.07	27.17	7.98	Edwards	Blade
5	515	1	No	Yes	Complete	1	7.4	32.87	25.14	8.19	Edwards	Amorphous core flake
5	523	1	No	No	Complete	2	16	41	36.82	11.18	Edwards	Amorphous core flake

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Blowout Area	Catalog Number	Patina	Thermal Alteration?	Cortex?	Portion	Spurs (n=#)	Weight (g)	Length (mm)	Width (mm)	Thickness (mm)	Lithic Material	Blank Type
5	524	2	No	No	Complete	1	14.5	28.1	34.56	11.82	Edwards	Amorphous core flake
5	526	1	No	No	Complete	0	35.9	74.9	40.79	13.88	Edwards	Indeterminate
5	527	0	No	No	Complete	2	4	21.91	26.28	6.46	Edwards	Indeterminate
5	536	1	Yes	No	Proximal	--	6.2	NA	NA	NA	Edwards	Biface reduction flake
5	546	1	No	No	Complete	1	13.8	48.2	35.24	9.12	Edwards	Indeterminate flake
5	577	P1	--	--	Complete	1	--	35	27.9	7.8	Edwards	Indeterminate
5	578	0	No	No	Complete	1	12.7	34.67	38.85	10.81	Edwards	Amorphous core flake
5	584	2	0	No	Distal	2	3.2	14.75+	26.57	7.94	Edwards	Indeterminate
5	597	1	No	No	Complete	1	12	35.63	33.43	8.51	Edwards	Indeterminate flake
5	5113	0	No	No	Complete	1	13.8	37.23	38.76	9.57	Edwards	Biface reduction flake
5	5122	1	No	No	Complete	1	6.08	29.03	33.47	5.45	Edwards	Biface reduction flake
5	5131	0	No	No	Complete	0	7	34.51	28.58	7.24	Edwards	Indeterminate flake
5	5133	0	No	Yes	Complete	1	6.7	31.08	27.21	6.91	Edwards	Amorphous core flake
5	5140	0	No	No	Complete	0	28.5	71.57	44.88	7.57	Edwards	Biface reduction flake
5	5141	2	No	No	Complete	1	7	33.09	28.21	7.6	Edwards	Indeterminate
5	5142	1	No	Yes	Proximal	--	4	NA	NA	NA	Edwards	Amorphous core flake
5	5147	0	No	No	Complete	2	6.2	28.99	30.46	6.62	Edwards	Indeterminate
5	5163	0	No	Only on platform	Complete	0	2.9	23.94	25.67	5.42	Edwards	Biface reduction flake
5	5170	1	No	No	Complete	0	9.5	47.44	29.46	6.19	Edwards	Blade
5	5172	0	No	No	Complete	0	9.5	46.03	26.82	7.11	Edwards	Amorphous core flake

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Blowout Area	Catalog Number	Patina	Thermal Alteration?	Cortex?	Portion	Spurs (n=#)	Weight (g)	Length (mm)	Width (mm)	Thickness (mm)	Lithic Material	Blank Type
5	5129 (REFITS TO FLAKE 5178)	1	No	Yes	Complete	0	54	74.84	41.24	18.88	Edwards	Amorphous core flake
6	61	0	No	No	Complete	0	36.1	41.88	53.63	12.04	Edwards	Biface reduction flake
6	68	1	No	Yes	Complete	0	21.4	48.81	38.83	11.6	Edwards	Amorphous core flake
6	617	1	No	No	Complete	0	7	35.07	31.85	5.9	Edwards	Biface reduction flake
6	645	1	No	No	Complete	2	5.4	30.24	28.54	6.22	Edwards	Biface reduction flake
6	646	1	No	No	Complete	2	6.2	31.76	33.05	6.91	Edwards	Biface reduction flake
6	654	1	No	No	Complete	0	40.8	88.94	37.25	12.05	Edwards	Blade
6	658	1	No	Yes	Complete	0	13.6	40.06	35.73	9.53	Edwards	Indeterminate flake
6	670	1	No	No	Complete	0	17.4	36.13	42.54	8.65	Edwards	Indeterminate
6	675	1	No	No	Complete	1	8.7	33.34	35.26	7.78	Edwards	Biface reduction flake
6	682	1	No	No	Complete	1	8.3	39.38	33	7.28	Edwards	Biface reduction flake
6	683	1	No	No	Complete	1	7.6	29.5	27.37	9.07	Edwards	Indeterminate
6	6109	0	No	Yes	Complete	1	7.8	30.22	35.49	6.75	Edwards	Biface reduction flake
6	6123	0	No	No	Complete	0	22.7	37.68	36.45	17	Chalcedony	Amorphous core flake
6	6155	1	No	No	Complete	2	11.5	32.12	36.61	8.49	Edwards	Amorphous core flake
6	6158	1	No	No	Complete	1	12.2	27.92	26.81	14.6	Edwards	Indeterminate
6	6163	0	No	No	Proximal	--	1	NA	NA	NA	Edwards	Indeterminate flake

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Blowout Area	Catalog Number	Patina	Thermal Alteration?	Cortex?	Portion	Spurs (n=#)	Weight (g)	Length (mm)	Width (mm)	Thickness (mm)	Lithic Material	Blank Type
6	NA AREA 6	0	No	No	Proximal	--	2.3	NA	NA	NA	Edwards	Indeterminate flake
7	715	0	No	No	Complete	1	5	26.86	26.53	7.58	Edwards	Amorphous core flake
7	721	1	No	No	Complete	2	8.5	27.85	30.79	9.76	Edwards	Amorphous core flake
7	726	2	No	No	Complete	1	5.5	30.03	30.39	6.19	Edwards	Biface reduction flake
7	730	0	No	Yes	Complete	1	8.2	35.05	29.94	8.89	Edwards	Amorphous core flake
7	737	0	No	No	Complete	1	3.4	22.1	24.44	6.43	Edwards	Indeterminate
7	738	0	No	Yes	Distal	1	2.8	16.54+	27.30+	6.8	Edwards	Indeterminate
7	763	0	No	No	Complete	2	13.2	34.35	38	9.45	Edwards	Biface reduction flake
7	773	IND	Yes	No	Distal	1	3.5	24.59+	22.97+	6.44	Edwards	Indeterminate
7	778	0	Yes	No	Distal	0	2.3	13.28+	23.5	7.05	Edwards	Indeterminate
7	789	0	No	No	Complete	2	11.1	32.26	37.36	8.99	Edwards	Indeterminate flake
7	797*	--	--	--	Distal	--	--	--	--	--	Edwards	Unknown
7	7103*	0	No	Yes	Complete	0	--	34	36	--	Edwards	Unknown
7	7108	0	No	Yes	Complete	1	8.7	35.23	36.56	6.62	Edwards	Biface reduction flake
7	7109	0	No	Yes	Complete	0	7.1	45.82	27.84	7.18	Edwards	Amorphous core flake
7	7114*	--	--	--	Complete	--	--	--	--	--	Edwards	Unknown
7	7118	0	No	No	Complete	2	5.4	27.24	28.53	6.57	Edwards	Indeterminate flake
7	7119	0	No	No	Distal	0	1.6	10.86+	28.52+	4.62	Edwards	Indeterminate
7	7120	0	No	No	Complete	2	5.5	30.76	30.99	4.85	Edwards	Biface reduction flake
7	7124	0	No	No	Distal	1	2.7	24.31+	26.56	4.35	Edwards	Indeterminate flake

Table C-2. Attribute data for 41WK21 endscrapers collected prior to April 2015. Not all of these tools were mapped in the field and as a result not all of them are depicted on maps in this study.

Blowout Area	Catalog Number	Patina	Thermal Alteration?	Cortex?	Portion	Spurs (n=#)	Weight (g)	Length (mm)	Width (mm)	Thickness (mm)	Lithic Material	Blank Type
7	7128	0	No	Yes	Complete	1	3.8	26.13	26.18	4.59	Edwards	Indeterminate flake
7	7129	0	No	No	Complete	2	11.5	41.34	40.05	7.18	Edwards	Indeterminate flake
7	7130	0	No	No	Complete	1	7	32.23	36.38	6.16	Edwards	Amorphous core flake
7	7141	0	No	No	Proximal	0	4.1	26.22+	27.15	5.56	Edwards	Biface reduction flake
7	7143	0	No	No	Complete	1	6.6	32.02	38.91	4.69	Edwards	Indeterminate flake
7	7144	0	No	No	Complete	1	10.3	39.93	35.72	6.83	Edwards	Indeterminate flake
7	7145	0	No	Yes	Complete	1	9.1	28.76	36.79	8.08	Edwards	Indeterminate flake
2/6	635/2195/ 2244	1 ON 2195 OTHER WISE NoNE	No	No	Complete	0	4.7	35.81	25.01	5.13	Edwards	Biface reduction flake
3/6	313/6154	0	No	No	Complete	0	10.1	41.25	31.68	7.86	Edwards	Indeterminate flake
NA	W216	2	No	Yes	Proximal	--	6.5	NA	NA	NA	Edwards	Biface reduction flake
3A	3A20	1	No	No	Complete	1	12	40.99	34.94	8.93	Edwards	Amorphous core flake
3A	3A40	2	No	Only on platform	Complete	0	10	44.42	34.21	7.82	Edwards	Indeterminate flake
3A	3A43	0	No	No	Complete	1	16.3	39.68	36.01	11.01	Edwards	Amorphous core flake
3A	3A57	2	No	No	Complete	0	24.4	49.04	38.93	11.01	Edwards	Amorphous core flake
3A	3A64	1	No	Yes	Complete	1	11.4	36.58	39.46	6.56	Edwards	Amorphous core flake

Table C-2. Attribute data for 41WK21 endscrapers collected prior to April 2015. Not all of these tools were mapped in the field and as a result not all of them are depicted on maps in this study.

Blowout Area	Catalog Number	Patina	Thermal Alteration?	Cortex?	Portion	Spurs (n=#)	Weight (g)	Length (mm)	Width (mm)	Thickness (mm)	Lithic Material	Blank Type
3A	3A71	1	No	No	Distal	1	6.1	30.12	28.62	5.95	Edwards	Indeterminate
3B	3B1*	0	No	No	Complete	0	11.8	36.9	31.1	9.9	Edwards	Unknown
3B	3B70	0	No	Yes	Complete	1	5	30.03	20.5	7.96	Edwards	Indeterminate
3B	3B701	0	No	Yes	Complete	1	6.5	30.14	26.28	8.7	Edwards	Indeterminate
3B	3B73*	0	No	No	Proximal	0	Not recorded	22.9	28.4	5.5	Edwards	Unknown
3B	3B74	0	No	Yes	Distal	0	4.1	23.98	19.77	8.35	Edwards	Indeterminate
3B	3B75	0	No	No	Proximal	--	3.7	NA	NA	NA	Edwards	Biface reduction flake
3B	3B83	0	No	No	Complete	1	4.2	26.52	24.92	5.24	Edwards	Indeterminate
3B	3B95	0	No	No	Complete	0	33.2	55.42	36.59	16.85	Edwards	Amorphous core flake
3B	3B98	0	No	No	Complete	1	7.7	31.84	29.13	8.92	Edwards	Indeterminate
NA	1*	1	No	No	Complete	0	30.7	75.14	41.3	10.01	Edwards	Blade
NA	43*	0	--	--	Complete	0	--	44	37.7	8	Edwards	Unknown
NA	44*	0	--	--	Complete	1	--	31.4	3.37	8.4	Edwards	Unknown
NA	45*	1	--	--	Complete	1	--	44.9	36.6	8.5	Edwards	Unknown
NA	46*	0	--	--	Complete	1	--	40.8	30.6	7.1	Edwards	Unknown
NA	47*	0	--	--	Complete	1	--	34	31.1	7.3	Edwards	Unknown
NA	48*	0	--	--	Complete	1	--	34.5	30	13.6	Edwards	Unknown
NA	49*	0	--	--	Complete	0	--	25	25.6	6.8	Edwards	Unknown
NA	50*	0	--	--	Complete	2	--	37	30.5	9.6	Edwards	Unknown
NA	51*	0	--	--	Complete	1	--	22.4	22	4.2	Edwards	Unknown
NA	52*	0	--	--	Distal	1	--	29.3	31.1	8.1	Edwards	Unknown
NA	53*	0	--	--	Complete	1	--	42.1	42.3	7.6	Edwards	Unknown
NA	None	0	No	No	Proximal	--	0.6	NA	NA	NA	Edwards	Biface reduction flake

*These artifacts were not observed during the April 2015 analysis, but are included based on Richard Rose's notes or data sheets indicating they are endscrapers.