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**WOMEN'S TOOLKITS:
ENGENDERING PALEOINDIAN TECHNOLOGICAL
ORGANIZATION**

by

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DISSERTATION

**Submitted in Partial Fulfillment of the
Requirements for the Degree of
Doctor of Philosophy
Anthropology**

**The University of New Mexico
Albuquerque, New Mexico**

July 13, 2013

DEDICATION

For Will and David

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**WOMEN'S TOOLKITS:
ENGENDERING PALEOINDIAN TECHNOLOGICAL ORGANIZATION**

by

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ABSTRACT

Archaeologists have long studied hunting strategies and weapons technology of the Paleoindian period of North America, dating to the close of the Pleistocene more than 10,000 years ago. Less well understood are women's activities, the toolkits they used, and how gendered activities can be recognized in the archaeological record. I use a number of lines of inquiry, including ethnographic review, cross-cultural analysis, and archaeological investigation, to address these questions.

Because the Paleoindian record consists largely of flaked stone, investigating gendered activities is challenging, particularly if women did not use stone tools to any great extent. Examination of the historic and ethnographic literature reveals women's participation in all aspects of technological organization, including quarrying, transport, manufacture, use, and maintenance. Especially prominent among women's toolkits are stone hide-working tools. Similar tools, called endscrapers, occur in the Paleoindian record, suggesting that these may have been used by women.

To further examine the possibility of women's contributions to the Paleoindian record, I conducted cross-cultural analyses, which indicate that high reliance on hunting

and increasing latitude results in a division of labor in which women do the vast majority of the hide processing. Employing embodied capital theory (Kaplan et al. 2000), I argue that tasks requiring both in-depth knowledge and complex perceptual motor skills, such as hide-working, take many years to master and are often divided along gender lines beginning in early childhood.

Finally, I use the Rio Rancho Folsom site in the Central Rio Grande Valley of New Mexico as a case study to investigate Paleoindian gendered activities. Spatial distribution of Folsom-age endscrapers and weaponry from the Rio Rancho Folsom site indicate that endscrapers and weapons debris were distributed differently, though they also overlapped to a degree. The spatial distributions of weapons and endscrapers suggest that most endscrapers were not associated with weapons production. Raw material allocation for weapons and endscrapers differs to some degree, but there are overall similarities in the makeup of these assemblages in terms of local and non-local materials. The allocation of raw material to endscrapers does not appear to have been expedient, but rather planned for in anticipation of use at the site. Further, the production of endscrapers does not appear to have been a byproduct of weapons production, but rather a separate strategy to produce a particular form. Overall, multiple lines of evidence are suggestive of women's hide-working in the Paleoindian record, and point to the possibility of endscrapers as a component of women's hide-working toolkits.

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CHAPTER 1

Introduction

The women all showed their hands, every one blistered and cut from the wielding of the heavy stone axes. But all laughed at their pains.

—J.R.B. Love (1942)

Since the discovery of the Folsom site in northeastern New Mexico more than 70 years ago, archaeologists have worked toward an increasingly complete understanding of Paleoindian hunting strategies, weapons manufacture, and butchery. Despite their research potential and prevalence at Paleoindian campsites, endscrapers have received less archaeological attention than the impressive projectile points of the period (Bamforth 2002:93; Chilton 2004:164). This bias may be due in part to the lack of temporal sensitivity of endscrapers (Meltzer 1981) or perhaps to the extraordinary craftsmanship of projectile points. Others suggest that Paleoindian research focuses mainly on activities that are typically carried out by males, especially hunting and weapons manufacture (Adovasio and Page 2002:286; Chilton 1994, 2004; Gero 1991; Hudecek 1998; Waguespack 2003:138, 140-141). Whether due to aesthetics, practicality, or gender bias, the analytical concentration on projectile points and hunting has resulted in an incomplete examination of the full spectrum of Paleoindian activities and a partial and potentially misleading understanding of Paleoindian technological organization.

Research Questions

This research focuses on four related questions: (1) In what capacities do women participate in stone tool technologies? (2) What factors influence whether activities and toolkits are gendered or not? (3) Were Paleoindian women doing the majority of the hide-

working? and (4) How can women's activities be recognized in the Paleoindian archaeological record and distinguished from men's activities?

The first part of this research investigates whether Paleoindian women might have been involved in stone tool technologies, and whether endscrapers might have been a component of Paleoindian women's toolkits, with toolkit being defined "a set of tools used in the execution of a task" (Binford 1980:147). This question is significant because the vast majority of artifactual remains on Paleoindian sites consist of stone debris. If women did not participate in stone tool technologies to any great extent, recognizing women's activities through the archaeological record is largely fruitless. To address this question, I review the ethnographic and historic literature on women's participation in flaked-stone technologies, finding evidence for women's involvement in all aspects of technological organization, including quarrying, stone selection, transport, manufacture, use, and maintenance. The ethnographic and historic literature also hints that women and men tended to use different reduction techniques as well as produce different flaked-stone tool forms. Women's tool production tends to be relatively simple, and few complex forms, such as bifaces are produced. The apparent differences in reduction and form may provide a means of investigating gendered tool production. While the examples of woman's stone tool manufacture found in the literature are not skill-intensive according to the criteria outlined by Bamforth and Finlay (2008), it is clear that women are and have been skilled knappers in the sense that they are knowledgeable about the reduction techniques they use, and produce and use stone tools rapidly and with few errors.

Review of the literature revealed that one tool type in particular, the stone hide scraper, is often made and used by women. Similar tools, or their metal counterparts, were

used by women on the Great Plains, Alaska, Canada, northern Scandinavia, Siberia, and South America to process animal hides. To examine the conditions in which hide-working is a highly gendered activity, I turned to the *Revised Ethnographic Atlas*, a worldwide database of cultural and environmental variables compiled by George Murdock beginning in the 1960s. The cross-cultural data show that hide-working is rarely performed equally by men and women. Further, in societies reliant on terrestrially hunted foods or in extreme latitudes, women do the hide-working in virtually all of the ethnographic cases. In addition, women tend to perform the bulk of the hide-work at extreme latitudes, regardless of reliance on hunted foods. If this pattern holds true prehistorically, and Folsom Paleoindians were reliant on hunted foods for even half of their diet, then the results suggest that women were likely performing the bulk of the hide-work during this time.

I then investigate the factors that condition toolkit “gendering”—the use of tools by mainly one gender. Drawing on experience-based embodied capital theory (Kaplan et al. 2000), I argue that long-learning trajectories associated with complex tool use present costs that preclude mastery of other skills, particularly in situations where multiple complex skills are critical to survival, notably in higher latitudes and in areas of low primary productivity and high animal biomass, where hunting skill becomes vital to survival. Simply put, complex skills cannot be achieved at the level of proficiency necessary if all individuals are educated in all complex skill sets. As others have observed, training in complex skill sets and tool use are often divided according to gender, though not in a strict, inflexible sense. Kaplan et al. (2000) argue that hunting is the most skill-intensive activity, requiring years of education beginning in childhood. If skilled aspects of hunting were the primary responsibility of Folsom boys and men, then other time and skill-intensive activities, such as hide-working

and the making of hide products, would be precluded. I argue that girls and women were primarily responsible for working hides, likely obtaining training and acquiring complex motor skills associated with the task beginning in childhood. In short, there is not enough time or energy for a single individual to learn all complex tasks. Waguespack (2003) presents a similar argument for Clovis adaptation in which she argues women were involved more in technical production rather than in subsistence. Division by gender allows for greater productivity and ensures skilled labor. Gendered activities, I argue, also result in highly gendered toolkits, with specialized perceptual motor skills inhibiting the use of tools by the untrained. While simple borrowing of tools likely occurred, ethnographic sources hint that when gendered tools are borrowed by another gender, they are applied to a different task or used ineptly.

If Folsom women were the main hide processors, then how can these activities be recognized in the archaeological record and distinguished from men's activities? Historically, women around the world have used hafted stone scrapers to process animal hides and continue to do so today. On the Great Plains, considerable evidence exists for an association between stone endscrapers and dry scraping of bison hides and other large-bodied animals. Archaeologists have also observed a correlation between bison procurement and the prevalence of endscrapers in the archaeological record (Boszhardt and McCarthy 1999; Creel 1991). Use-wear studies have shown that at least some endscrapers retain wear of hide-working. If Paleoindians regularly targeted bison, which the archaeological record suggests, then it is likely that at least some endscrapers were used to thin bison hides for use as clothing, tools, and shelter.

Turning to the archaeological record, I examine the spatial location of endscrapers and weaponry—projectile points, preforms, and channel flakes—along with other unifacial tools, bifaces, and unretouched flakes at the Rio Rancho Folsom site in the Central Rio Grande Valley in New Mexico. Carr (1984) and Binford (1983) proposed that hide-working in general is often located away from central activity areas and also takes up more space than flint-knapping and fine wood-working. At the Rio Rancho Folsom site, Dawson and Judge (1969) observed that endscrapers were located on the periphery of areas of high lithic artifact density. Expectations for hide-working being located distant to central activity areas may be too idealized, however, especially on forager sites where many activities may have taken place outside of residences and activity areas used sequentially by different people. Based on examination of historic photographs and paintings, it is clear that hide-working may also be conducted immediately adjacent to main living areas and sometimes even inside residences. Archaeological spatial distributions that stray from the idealized pattern of endscrapers being distributed away from central activity areas cannot then be viewed as inconsistent with hide-working expectations.

Spatial analysis of endscrapers and weapons at the Rio Rancho Folsom site in the Central Rio Grande Valley of New Mexico indicates that while the distribution of endscrapers and weapons overlap, endscrapers are more likely to be located both away from artifact-dense areas and weapons in general. The distribution suggests that most endscrapers were not directly associated with Folsom point production. While endscrapers could have been used for other activities, their spatial patterning is not inconsistent with hide-working.

Drawing on Amick's (1999) work which suggests that demand for hunting weapons coupled with regional lithology can affect allocation of raw material to different tool types, I

examine similarities and differences in raw material for weapons and endscrapers at the site. When demand for weapons is high, Amick argues, high-quality non-local raw material may be preferentially allocated to weaponry, whereas endscrapers and other maintenance tools will be made using local materials. Comparing the raw material of endscrapers and weapons at the Rio Rancho Folsom site, I find that the two assemblages overlap in terms of toolstone, but are not equivalent. Both the endscraper and weapons assemblages are dominated by Zuni Spotted chert from the Zuni Mountains, with lower incidences of other local and non-local materials. The endscraper assemblage lacks obsidian and Pedernal chert, while these occur in the weapons assemblage. Though obsidian endscrapers are used by African hide-workers today, it seems possible that obsidian was deemed mostly unsuitable or less than ideal for bison hide-working. The differences in obsidian use may not stem from separate procurement strategies, but perhaps differing functions. Difference in Pedernal chert in the two assemblages could result from material cycling through the endscraper assemblage at a faster rate than the weapons assemblage, and may not be caused by preferential allocation. In all, both weapons and endscrapers were supplied using a similar strategy, and neither assemblage relied more heavily on local gravels or less suitable material. These results indicate that both weapons and endscrapers were equally important tool types, and their raw material allocation was anticipated prior to arrival at the site.

Archaeological evidence from the Rio Rancho Folsom site suggests the production of endscrapers was separate from weapons manufacture, and did not rely on the byproducts of weapons manufacture for flake blanks. Based on morphometric attributes, endscrapers appear to have been produced from unidirectional cores, using a direct percussion technique. In some cases these are similar to the Clovis wedge cores that Collins and Lohse (2004)

describe for Clovis assemblages. Consistent morphological attributes of endscrapers across all loci at the site suggest a standardized technique to produce a particular form. While it is difficult to say whether Folsom women were producing their own endscrapers given the likely off-site production of flake blanks, it is clear that endscraper production was separate and distinct from Folsom point manufacture. Folsom groups occupying the site appeared to anticipate the need for a particular endscraper form and suitable material type prior to arrival at the site. It does not appear that increased demand for weapons resulted in poorer quality material or less suitable form for endscrapers.

The results of this research imply that women are not necessarily invisible in the Paleoindian archaeological record and that endscrapers may be a possible window into their activities and toolkits. Secondly, the spatial patterning of endscrapers at the Rio Rancho Folsom site is not inconsistent with hideworking. Finally, Folsom groups likely anticipated the need for endscrapers of a particular form and raw material, and furnished them accordingly prior to arriving at the site.

Examination of non-subsistence activities and their associated toolkits has the potential to broaden our understanding of Paleoindian adaptation. These tasks, while often overlooked, clearly play key roles in foraging societies (Halperin 1980; Kelly 1995:264; Spector 1998a:156; Waguespack 2003). The results show that multiple lines of evidence can be used to cast light on gendered tasks and toolkits in the prehistoric past. Recognition that Paleoindian women could and likely did participate in many aspects of technological organization contributes to a more balanced view of Paleoindian life.

Chapter Organization

The first part of this research (Chapters 2 through 4) investigates the gendering of activities and tools, and the second part (Chapters 5 through 9) examines archaeological residues of women's activities and toolkits. In Chapter 2, I present a literature review on women's participation in stone tool technologies from around the world. The review demonstrates that women participate and have participated in all aspects of stone tool technology, including quarrying, selection, production, transport, use, and maintenance. Chapter 3 uses a cross-cultural approach to show that when reliance on terrestrial prey is high and at extreme latitudes, women do the vast majority of the hide-working. I argue that this pattern can be applied to the Folsom time period, and suggest that women were likely doing the bulk of the hide production. Chapter 4 discusses the gendering of toolkits using experience-based embodied capital theory and the long period of juvenile training necessary to become proficient at tool use in complex tasks. I argue that complex, critical tasks and their associated toolkits are more likely to be gender-specific. Chapter 5 provides a cultural, temporal, technological, and environmental overview of the Folsom time period. Chapter 6 reviews the literature on endscraper studies, and summarizes different approaches to understanding endscraper technological organization. In Chapter 7, I examine the stages of hide-working and the associated tools, showing that bison processing typically involved stone scrapers. I argue that the stage of hide-working, the number of hides processed, and the season of processing, might have affected whether hide-working was a peripheral or centrally located activity. Chapter 8 looks at the archaeological record from the Rio Rancho Folsom site in central New Mexico, and shows that endscrapers tend to occur away from high-density areas and weapons. In Chapter 9, I compare endscraper and weaponry raw material

and reduction at the Rio Rancho Folsom site, finding that weapons and endscrapers were supplied with raw material in a similar manner, yet endscraper production techniques were distinct from weapons production techniques.

CHAPTER 2

Women and Stone Tools

One day an old woman with her wood basket on her back and a stone hatchet in her hand came along the beach looking for some wood....She began to chop it, and to her great surprise the tree sprang from the earth and vanished in a flash, and then took up the shape of Coyote which stood before her.

—Lucy Thompson, Che-na-wa Weitch-ah-wah (1916:262)

This chapter discusses women's use of stone tools in the ethnographic and historic records in an effort to understand what kinds of stone tools women use, what aspects of technological organization women participate in, and whether women and men have similar toolkits and the same skill sets. The answers to these questions can be applied to understanding Paleoindian women's use of stone tools and how they might have participated in technological organization. I find that ethnographically and historically, women have been involved in all aspects of technological organization, including quarrying, raw material selection, transport, production, use, and maintenance. The examples of women's stone tool use found in the literature tend not to be highly specialized or complex in form according to criteria set out by Bamforth and Finlay (2008). At the same time, the examples make it clear that women were highly skilled in the techniques that they used to reduce stone, despite the relatively simple forms produced. The results of this review suggest that it is quite possible that Folsom women were active participants in stone tool technologies, though these roles may have differed from men's.

Gender in Archaeology

Gender studies in sociocultural anthropology flourished in the 1970s following a resurgence of interest in feminist theory and activism in the 1960s (e.g., Friedl 1975; Kessler 1976; Leacock 1978; Linton 1971; Quinn 1977; Reiter 1975; Rosaldo Zimbalist and Lamphere 1974; Sanday 1973; Tiffany 1979). Assumptions of male aggression and female passivity, glorification of hunting, devaluation of women's roles, inequalities in ethnographic data and reliance on western gender categories became issues of interest to sociocultural anthropologists (Conkey and Spector 1984; Hughes 1991; Leacock 1978; Linton 1971; Ortner and Whitehead 1981:1; Reiter 1975). A pivotal contribution which served to balance the interest in men's and women's activities was Richard Lee's (1968, 1979) study of labor among the !Kung San, which illustrated the importance of women's subsistence contributions in hunting and gathering societies.

Consideration of gender issues in archaeology developed somewhat later, in part because gender was thought to be irrelevant to large-scale processes, a prevailing theme in archaeology during the 1960s and 70s (Claassen 1992b; Conkey and Spector 1984; Wylie 1991). In a similar vein, Weedman (2010:228) argued that during the 19th century, women's continued use of stone tools only confirmed their lower status. Conkey and Spector's 1984 article, "Archaeology and the Study of Gender" stimulated interest in gender in archaeology, a subject that has since received considerable attention (e.g., Bird 1993; Bolen 1992; Claassen 1992a; Claassen and Joyce 1997; Conkey and Gero 1991; Donald and Hurcombe 2000; du Cros and Smith 1993; Ehrenberg 1989; Frink and Weedman 2005; Gibbs 1987; Hays-Gilpin and Whitley 1998; Hodder 1984; Hudecek-Cuffe 1998; Jochim 1988; Kent 1998; Kornfeld 1991a; Kornfeld and Francis 1991; Marshall 1985; Nelson 1997; Nelson and Rosen-Ayalon

2002; Peterson 2002; Spector 1998a, b; Sweely 1999; Walde and Willows 1991; Whelan 1995; Wright 1996). In her article “Genderlithics,” Gero (1991) asserted that not only was it likely that women used chipped-stone tools in prehistory, but also that discovery of gendered use of stone tools in the archaeological record was possible. Building on this foundation, several scholars have since argued that the gender of the tool user can affect the spatial patterning of artifacts and features (Bird 1993:27; Blackmar 2000; Conkey and Spector 1984; Gero 1991; Jodry 1998; Judge 1973), patterns in raw material use and tool form (Amick 1999; Binford and Binford 1969; Hildebrandt and McGuire 2002; Waguespack 2003), and artifact visibility (Elston and Zeanah 2002; Gero 1991; Sassaman 1998). Gero’s objections to the lack of study of women’s use of stone tools have been echoed by other researchers. Sassaman (1998:160) commented that “nearly all recent attempts at modeling hunter-gatherer lithic technology have treated groups as if they were composed of undifferentiated members.” In her article on women’s use of stone tools, Bird (1993:22) wrote that “the possible role of gender in the organization of lithic technology has not been considered as it is commonly assumed that prehistoric stone tool makers and users were predominantly male.” Great Plains archaeology, with its remarkable kill sites and hunting weapons, has been singled-out as being especially male-biased (Whelan 1995:45). “The prehistoric world and particularly the Plains region,” explains Kornfeld (1991b:2), “seemed to be full of hunters, generally seen as male, with a small sprinkling of women gatherers.” More specific to the Paleoindian period, Jarvenpa and Brumbach (2009:62) declared that, “While Paleoindian hunting of big game, especially the Pleistocene megafauna, occupies a privileged niche in professional journals and academic discourse, it would seem that the role of women in such hunting economies has been marginalized.”

While gender bias might account for some of the inattention to women's activities and possible stone tool use, others claim that women's activities are simply more difficult to recognize in the archaeological record because (1) women made and used fewer retouched tools than men (Thomas 1983:439), and (2) women made and used organic tools, such as basketry, which tend not to survive in the archaeological record (Hayden 1977; Isaac 1978; White and O'Connell 1982). Adovasio et al. (2007) and Jarvenpa and Brumbach (2009) argued that the problem is not archaeological invisibility, but rather that archaeologists have failed to recognize the material traces associated with women's activities. Despite objections to inequalities in archaeological research, women's stone tool use in the ethnographic and ethnohistoric literature has not been fully evaluated and can potentially supply insight into women's prehistoric stone technologies.

Women and Stone Tools: Manufacture and Use

In their discussion of the sex of hominin tool users, McBrearty and Moniz (1991:76) have pointed out that female chimpanzees manufacture and use probes when foraging for termites and use hammer stones to crack open hard fruits. Tai Forest chimps, especially females, have been known to transport hammer stones as much as 500 yards (Adovasio et al. 2007:81; McBrearty and Monitz 1991:76). Female chimpanzees more often consume social insects than male chimpanzees, and therefore female chimpanzees, generally do more tool making and using than their male counterparts (Fedigan 1986:42). In addition, more complex nut-cracking techniques are practiced by female chimpanzees, and female chimpanzees tend to be more efficient tool users (McBrearty and Moniz 1991:76). These examples suggest that female human ancestors might have used stone tools extensively as a means of extracting resources to support themselves and their offspring, and perhaps even initiated stone tool use.

Unlike chimpanzees, human social organization relies heavily on cooperation between the sexes as well as male provisioning (Kaplan et al. 2000). A need for cooperation might have great relevance for the activities that women and men performed in the past, and the types of tools that men and women used. Ethnographic and historic accounts of women's activities and tool use can provide a more detailed picture of women's role in technological organization. The following sections document women's stone technologies from around the world in the ethnographic and historic records.

Australia and New Guinea. Australia has produced numerous accounts of women using chipped-stone tools (Bird 1993). The woman's knife or *yilugwa* from Central Australia is often mentioned, though its use is not entirely clear. Spencer and Gillen (1927:545), and later O'Connell (1974:193), described this tool as a coarsely flaked quartzite blade hafted onto a mass of porcupine-grass resin. An analogous tool, the Australian woman's knife from the Warramunga and Kaitish groups, is a quartzite flake with a round working edge and set in spinifex gum, similar in form to the Upper Paleolithic *grattoir* or endscraper (Noone 1949:146, Figure 1). Allchin (1957:125, Figure 1) also discussed the Australian woman's knife, which she suggested was used for general purposes, though Spencer and Gillen (1927:545) and O'Connell (1977:277) noted that women's knives are better suited for scraping than for cutting.

In addition to the *yilugwa*, Australian women also made extensive use of expedient flake knives. These implements were used in recent times by aboriginal women to butcher game and to finish carving wooden bowls (Gould 1977:131–132; 1980:124). Domestic tasks were performed with flake knives used equally by both women and men (Gould 1977:166; 1980:131). An account of a woman's use of a flake is described by Gould et al. (1971:163):

Once Mrs. Gould went out to collect honey-ants with some Ngatatjara women from the Laverton Reserve. While they were out, one of the women's dogs killed a kangaroo (under reserve conditions, women have started using dogs for hunting). One woman picked up a natural flake of rough quartzite from the ground nearby and used it to slit the animal's belly and cut the intestines.

In recent and historic times, aboriginal women used flakes for a variety of other purposes. In the southwest of Western Australia, sharp stone flakes were used in the manufacture of kangaroo garments and bags, which was predominantly a women's activity (Bates 1985:245; Bird 1993). In Tasmania, sharp flakes were used by women for cutting hair (Ling 1899:124) and cicatrization (Ling 1899:124, 126; Lyon 1979[1833]:164). Central Australian women used sharp stones for severing umbilical cords (Mountford and Harvey 1941:158; Roheim 1933:252; Spencer and Gillen 1927:487), and in Queensland women used flakes for bloodletting (Moore 1979:107).

In aboriginal women's woodworking, hatchets or blocks of stone were used, especially in the manufacture of digging sticks (Bell 1983:95, 199-200; Dickson 1981:3; Hamilton 1980:5; Love 1936:67-68, 70; Tindale 1972:245-246). In more modern times, these stone tools have been replaced by metal ones (Figures 2.1, 2.2). While working among the Tiwi in the 1950s, Goodale (1971:154-156, 167-170) observed women using stone hatchets in plant and animal procurement. One Tiwi informant remarked that he remembered his aunt manufacturing stone axes in addition to using them. In the 1800s, Tasmanian women used stone chopping implements for hunting small game and for climbing (Roth 1924 [1899]:148-149). Tylor (1894:142) related, "I learnt that Tasmanian women carry a quoit-like stone, 4 to 6 inches across, chipped about two-thirds round the edge, for notch-climbing trees; women would carry good ones." More recently, Hayden (1979b:29-34, 39-41, 110-120) described Australian women of the southern Victoria Desert using and retouching chopping

implements to manufacture wooden tools upon his request. Australian women are also known to have used, modified and transported digging stones. A reduction technique used historically by Tasmanian women is as follows:

These stones are selected for their toughness and flat surface, and with those they bruise their red earth for pomatum. In their wild state the women carry two each. They are one and a half inches. The women break off the round edge and give it a square edge. Their method of working stone to this shape appeared to me ingenious. The women I saw made a wet mark with their finger with a little spittle in the direction they wanted it broken, i.e., the edges taken off like a hexagon. They then put the edge of the stone in a small fire of charcoal, and when sufficiently warm tapped it with a small stone and it broke in the direction required (Plomley 1966:897).

An account of Australian women's stone tool use was written by Love (1942), a missionary in the first half of the twentieth century at Ernabella in the Musgrave Ranges. Six women, led by a 50-year-old woman, cooperated in the making of the bowl from a felled tree (Figure 2.3). The women collected large and small stones to act as axes in the initial shaping of the wood, but it is unclear whether or how these were modified. In the process of chopping, some of the smaller implements broke and the women subsequently discarded or reshaped them. Impressively, one of the women worked at chopping the wood with an infant under her arm. In the later stages of shaping, a more formally worked axe was borrowed from an old man, who also offered his advice on woodworking.



Figure 2.1. Aboriginal woman shaping a ritual pole (*kurduru*) with the assistance of two young girls (Bell 1983:200).



Figure 2.2. An aboriginal woman shaping a *mardu*, a traditional water carrier, with an old car spring (Bell 1983:99).



Figure 2.3. Australian women working wood with stone tools (from Love 1942:217, Plate VI).

Among the Bimin-Kuskusmin of highland Papua New Guinea, Poole (1981:122) reported that adult women use small stone axes for hunting, though this occurs infrequently. Pétrequin and Pétrequin (1993:362) wrote that, “In the case of the Danis of Baliem, only women use the true axe (rare in each village) for splitting firewood. In the Mek territory women use the little stone adze for this purpose.” Prior to the 1980s, on the Arawe Islands off the coast of New Britain, men and women flaked stone, with women using bipolar flaking techniques to produce thin sharp blades for bloodletting and tattooing (Bird 1993:26; Gosden and Knowles 2001:173). Stone tools were also used by women to process sago in the Papuan Gulf (Rhoads 1980:27).

Africa. Among the Konso and Wolyata of Ethiopia, women procure raw materials and manufacture their own stone scrapers for processing the skins of goats, sheep and cattle (Brandt and Weedman 2002; Weedman 2002, 2005). Scrapers are used on small animals in a pushing motion to remove fat and hair and to thin the hides from smaller animals. Larger animal skins are tacked to a post and scraped at an angle with a pulling motion (Weedman 2005:192-193). Konso hide-workers use scrapers made of stone, glass and iron secured to a

shaft with tree resin. In the villages of Teshmelle and Gellabo, stone is heated to improve its workability (Weedman 2005:192). Scrapers are manufactured using direct and bipolar reduction techniques (Weedman 2005:192). Both Konso men and women scrape hides, but they scrape different types of hides and manufacture different products (Weedman 2005:188). Some Ethiopian hide-workers use recycled archaeological scrapers (Weedman 2005:192).

Women make hide-working tools in southern Africa as well, though the hide-working tools (*//khom* in the Nama language) are used for removal of fat from skins in an abrading fashion (Webley 1990). Webley (1990:30) described a Nama-speaking Khoi (Khoekhoe in the Nama orthography) woman of southern Africa quarrying sandstone to be used in hide processing using an iron digging stick (Figure 2.4). The stones are trimmed with a hammerstone to remove sharp edges so they fit into the hand. In some cases, these stone scrapers were passed down from generation to generation (Webley 1990:30). A similar sandstone scraper with fat and hair adhering to one side was discovered in an archaeological context at Spoegrivier Cave (ca. 3300 B.P.) in Namaqualand, South Africa (Webley 2005:168). Wooden pegs and awls, possibly used for staking and sewing hides, were also found at the site. Other accounts of women's stone tool use are known from Africa as well. In the early 1950s, San !Kung women used a chopping stone to sharpen their digging sticks (Marshall 1976). In an early account of tool use and manufacture in native South Africa, Van Rippen (1918:90) described the *uintjes* bag, a bulb-carrying bag made of reed grass, which women made by cutting reeds with stone implements.



Figure 2.4. Khoi woman of South Africa using an iron digging stick to quarry for sandstone from bedrock to make a *//khom*—an abrasive hide-working tool (Webley 1990:30, Figure 5).

South America. Historically, stone scrapers were used to prepare skins in Patagonia (Chapman 1982:28; Furlong 1917:442) as well as in south-central Chile and southwestern Argentina (Hilger 1957:373). Mapuche women of south-central Chile and southwestern Argentina also used volcanic rubbing stones (*kura ñaṅkü*) to soften guanaco, horse and cattle hides (Hilger 1957:373). Patagonian women used scrapers of chert or obsidian to clean guanaco skins (Musters 1872:198). These stone scrapers were one of the last stone tools in use in the region, and Fox (1874:315) reports that old women used them to process skins. Lothrop (1928:112) described the scrapers of Tierra del Fuego, also called duck-billed scrapers, as oblong plano-convex chips with a retouched worked edge. The scrapers were sometimes hafted into a branch bent to form a handle or fitted transversely into a block of wood and secured by resin (Figure 2.5–2.7). The scrapers were used in a pushing motion. Patagonian women also used sharp knives to cut the skins in order to create robes (Lothrop 1929:11). Tents, or *kau*, were made from approximately 50 adult guanaco skins, which were

processed by Patagonian women (Musters 1872:197). Clothing and bedding were made from the hides of young guanacos from November to February. Hatcher (1903) wrote of the southern Patagonian practice:

When the young guanaco is killed the hide is very carefully removed, even the legs, neck and head being carefully skinned out. While still green they are partially fleshed and dressed. After this they are staked out and thoroughly dried. When dry, they are taken in hand by the old women and thoroughly dressed by sharp curved, stone or glass scrapers fastened in a bit of wood or horn.

A number of Patagonian and Tierra del Fuegan groups employed guanaco robes including the Mataco, Ashluslay, Toba, Abipon, Mbayá, Querandí, Lengua, Southern Tupinambá, Charrúa, Haush, Puelche, Minuané, Chaná-Mbeguá and Timbú (Lothrop 1929:3).

Approximately 13 of these young guanaco skins were used to create a robe. Tierra del Fuegians used three adult guanaco skins to create a robe (Lothrop 1928:31). The robes were then finished with grease and red ocher (Lothrop 1929:12). Skins of other animals such as fox, puma, wildcat, cavy, otter and skunk were also made into robes (Lothrop 1929:6).

Animal hides were also used to make windbreaks and bags (Lothrop 1928:31). Figure 2.8 shows Tehuelche (Aónikenk) women of southern Patagonia with guanaco robes and a skin scraper, and Figure 2.9 shows a Tehuelche woman painting a guanaco skin.

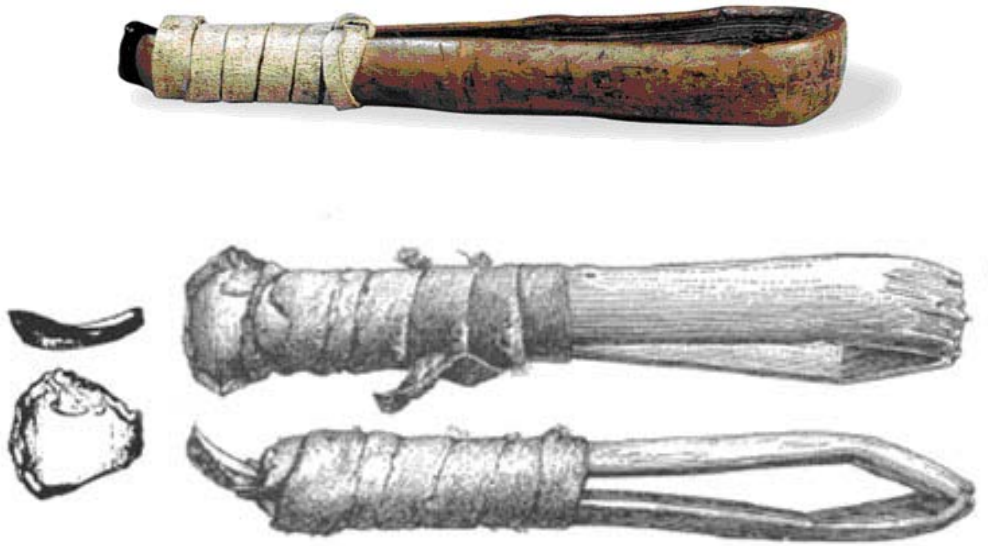


Figure 2.5. Patagonian hide scrapers. Above: Aónikenk (Tehuelche), 19th century AD, from Patagonia, tool for preparing animal skins with glass scraper (www.britishmuseum.org). Below: Hafted Aónikenk hide scraper of green bottle glass (Hrdlička 1912:140, Figure 30).

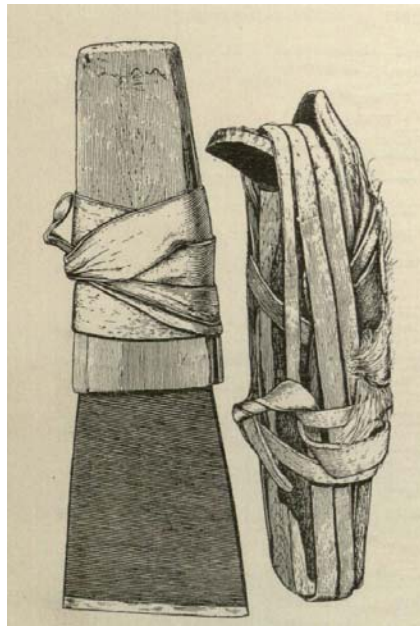


Figure 2.6. Wood scraper and hide scraper. Wood scraper (13.97 cm, 5.5 inches) on the left and hide scraper on the right (Lothrop 1929:70, Figure 25).

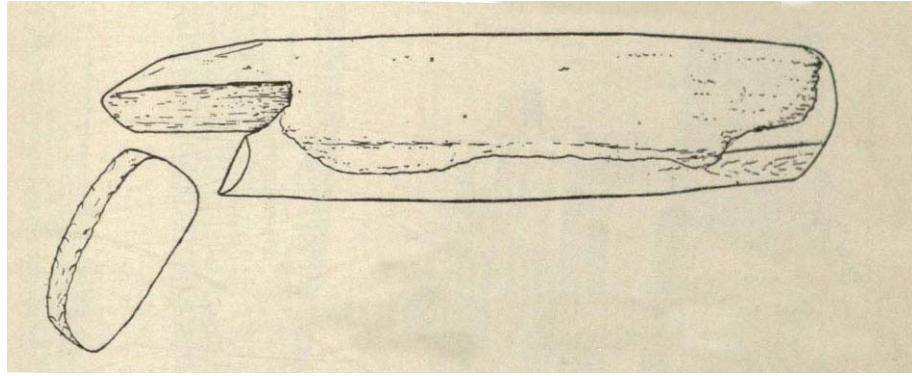


Figure 2.7. Ona hide scraper without the lashings. Handle is 12.7 cm (5 inches) (from Lothrop 1928:69).



Figure 2.8. Tehuelche women and girl with hide scraper at bottom right (Hatcher 1903:Figure 41).

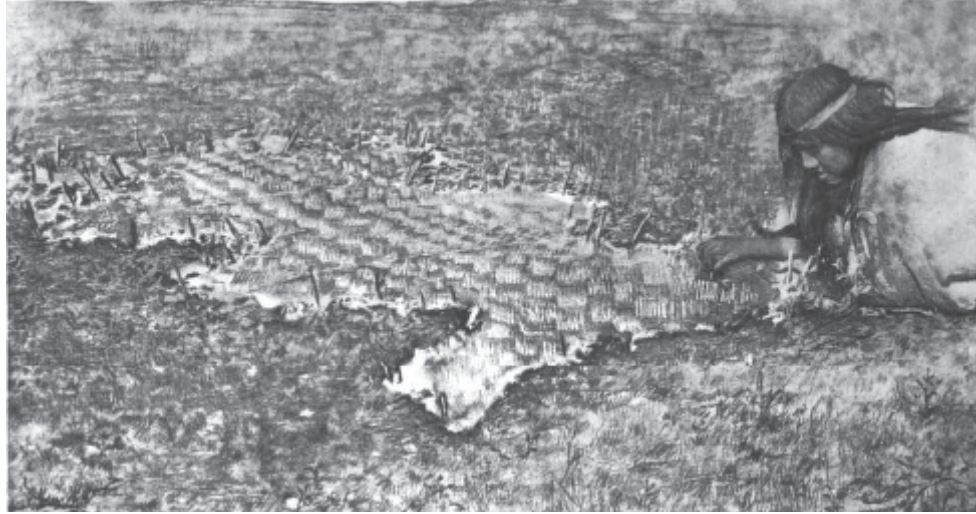


Figure 2.9. Tehuelche woman painting a guanaco skin (Hatcher 1903: Figure 42).

North America. Hafted stone tools used by women are well known from Alaska and Northern Canada. Historically, the woman's knife or *ulu* of Point Barrow, was made of ground slate, flaked flint or steel and wedged into a short handle (Murdoch 1892:161–164). The Baffin Island and Hudson Bay *ulu* was a slate blade wedged into the slit in a handle and used for cutting line, skins and meat (Boas 1907:28, 429-432). The *ulu* was used for general purposes and was considered the property of a woman (Murdoch 1892:414). Mason (1891:584) wrote that,

All of these woman's knives have crescent-shaped or plano-convex blades set in handles of wood, musk-ox horn, antler, walrus ivory, and other substances peculiar to each region. The blades are of slate, jade, or metal and are kept sharp by rubbing with the incisor tooth of a beaver. Now there is no tool more common in our collections than this same knife. It is safe to say that no Eskimo girl or woman is ever without one or more.

Another well-known implement of Alaska and Northern Canada is the stone skin scraper. The skin scraper (*ikun or ikuun*) of Point Barrow (*Nuvuk*) was used for multiple hide-working purposes, including removing flesh and fat from a skin, breaking the grain and softening an animal skin (Murdoch 1892:294-298). The skin scraper was used principally by

women (Murdoch 1892:294); however, Nelson (1899:116) remarked that, “Among the Eskimo it is customary for the men to dress skins of large animals such as reindeer, wolves, wolverines, bears, seals, and walrus, while the women prepare the skins of smaller creatures.”

Historically, the skin scraper consisted of a blunt stone blade socketed in a haft of ivory or wood to fit in the hand. The scraper handles varied in form (Murdoch 1892:295; Nelson 1899:112, 114-116). The skin was typically positioned on the left thigh and the scraper was pushed away from the user (Murdoch 1892:295). Most of the scrapers that had stone bits in Murdoch’s ethnographic sample were made of jasper or flint, though one was made of sandstone, which he was informed was a material used more often in the past (Murdoch 1892:297). The stone scrapers were triangular or circular and measured approximately 2 to 4 cm in width and 4 to 6 cm in length (Ford 1959:193), similar to the dimensions of Paleoindian endscrapers. In the 1950s, Ford wrote that the flint scrapers were replaced by metal ones typically fashioned from gun barrels (Ford 1959:192). Metal blades on wooden handles have been reported in modern accounts (Harcharek 2005:28).

Socketed Alaskan native scrapers, described by Nissen and Dittmore (1974) in their study of scraper wear, were made from chert or other hard stone material found in stream beds during the warmer months. These scrapers were wedged into sockets and secured with hide, cloth or plant material (Nissen and Dittmore 1974). Cassell (2005:108) stated that while the gender of the makers of these chipped-stone hide-working scrapers is unknown, men typically worked hard material (e.g., Giffen 1930). Osgood (1940:79-81) described hafted stone skin scrapers as made by Ingalik (Deg Hit’an) men, but used by women for processing skins.

Conducting ethnographic work in the 1970s and 1980s, Albright (1984) described Tahltan (Nahanni) women of northern British Columbia manufacturing stone tools for softening moose, deer and caribou skins (Figure 2.10). These stone tools, called *tagodi*, are hafted onto long pole-like handles (Albright 1984:56-57):

Relatively thin pebbles, oval or elongated in shape, are collected by women during the course of other procurement activities and kept until needed for manufacturing new tools....the manufacturing of new tools and resharpening of old ones are carried out at the beginning of the hide dressing stage, so that several tools are hafted and ready for use. Dressing stones are manufactured using a bipolar technique, similar to that described by earlier ethnographers (Emmons 1911; Teit 1900).... The basalt pebble is held edgewise on a large anvil stone and is struck with a hand held hammer stone. If the pebble is well struck each half can be used as a tool. Using direct percussion, flakes are removed from the edges by means of a hammer stone or by striking the split pebble directly against the anvil stone...Flaking thus creates a dulled working edge. A sharp edge is considered undesirable for softening hides as it would tear the skin. All tools have cortex remaining on their dorsal surfaces. The manufacture of a new tool takes about ten minutes.

Emmons (1911:83) described the Tahltan women splitting hide dressing pebbles by placing them on edge and striking them with a hammerstone. The edges of these stones were chipped only slightly to blunt them. The pebbles were readily accessible to Tahltan women. These hide dressing or softening tools have a long lifespan, with resharpening necessary after softening approximately three hides. Sometimes these tools are passed down from generation to generation, with some reputed to be 100 years old (Albright 1982, 1984:58). Pokotylo and Hanks (1989) described similar hafted stone tools used for hide-softening among the Mackenzie Basin Dene. These tools, called *thete*, have long use lives—one collected specimen was four years old and had been used to soften at least ten moose hides. While Dene women use these tools, men collect the raw material and make them.

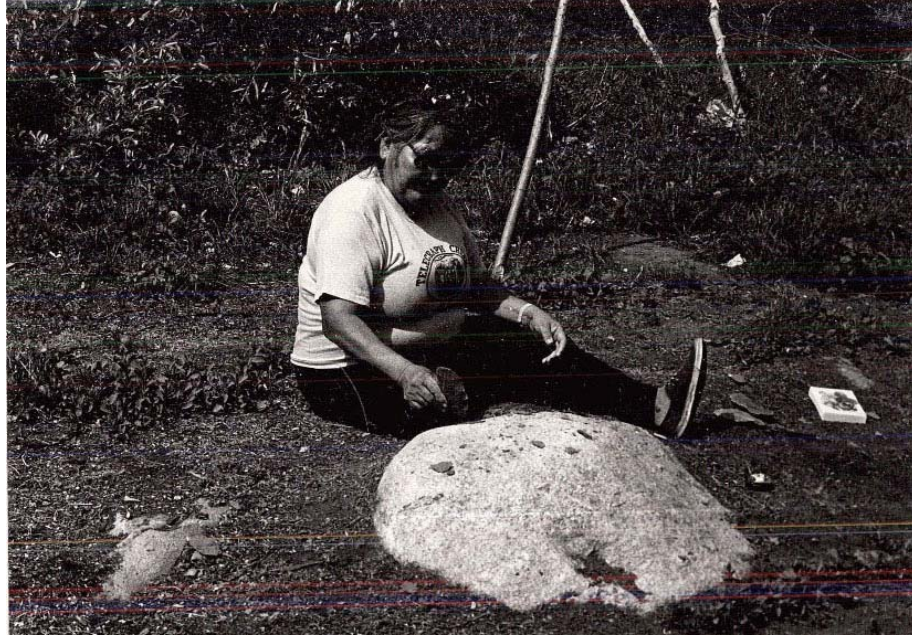


Figure 2.10 Tahltan woman flaking a hide-working scraper by it striking against an anvil (Albright 1982: Figure 23).

In Albright's discussion of skin softening tools, previously used tools as well as new blanks are prepared just before they were needed. Konso women of Ethiopia also store stone material for later scraper manufacture (Weedman 2005). From an archaeological perspective, preparing previously used and new scrapers just before use would have resulted in both scraper resharpening flakes and well as flakes produced in the initial manufacture of scrapers. A strategy of using a combination of transported blanks as well as previously used endscrapers could have been employed by Paleoindians, with associated patterns of debitage production.

Albright also discussed hand-held flake tools that were in every woman's toolkit and used for softening the skins of smaller animals. Because the handheld tools were typically used with a chalk whitening agent, Albright (1984:58) suggested that these had a shorter use-life. Both hand-held and hafted tools might have been used prehistorically by Paleoindians

for the processing animals of different sizes and the use of coloring agents, like chalk or ochre, potentially resulting in decreased tool use life and different use-wear patterns.

Examples of chipped-stone tool use have been documented in temperate North America as well. The numerous endscrapers (along with awls and bone fleshers) found on protohistoric sites on the Great Plains have been interpreted as hide-working tools (e.g., Boszhardt and McCarthy 1999; Creel 1991; Habicht-Mauche 2005:46; Schultz 1992). At the height of the fur trade, hide-working was an important economic activity and was predominantly performed by women (Catlin 1913:133; Denig 1928:50; Ewers 1955; Habicht-Mauche 2005:46; Hiller 1948; Hoebel 1978; Kroeber 1902; Lowie 1935; Scheiber 2005:59; Verbicky-Todd 1984; Weltfish 1965). Because of the demand for hides, women's labor provided the principal source of wealth in these societies (Denig 1928:112). While Plains women often processed the hides of larger animals, men and boys sometimes prepared smaller animals or animals that were not traded on the market (Denig 1928:147).

In historic times, the main implement associated with hide-working on the Plains and adjacent regions was the elkhorn scraper (Figure 2.11). Weltfish (1965:369) described a Pawnee specimen: "This tool was like an adze with a handle of elkhorn and a cutting blade fastened to the bent end. In the old days the cutting blade was made of chipped flint but at this time the women had the blades made by the blacksmith." There is some question, however, as to whether the elkhorn scraper was ever fitted with a stone bit. Lowie (1954:59) noted that the stone scrapers found on archaeological sites "do not jibe with the handle." Gilmore (2005:21), however, pointed out that there are several ethnographic descriptions of Cheyenne (Grinnell 1972), Blackfeet (Ewers 1945:10; Miles 1963:101, Figure 3.120); Sioux (Hans 1907:161), and Sarcee (Dempsey 2001) using chipped stone bits for elk antler

scrapers. Frederic Hans (1907:161), frontier scout and gunslinger, described the Sioux woman's implement for scraping buffalo hides: "She used a small implement made of flint on (sic) the general shape of an adze, but much smaller. It has a short handle of elk-horn firmly tied on with a rawhide string, and is used in one hand." Hoebel (1978:66) described the Cheyenne woman's hide-working tool: "Shaped like an adze, it is made of an elkhorn handle bent at a right angle, with a sharp chipped flint lashed across the short end." In describing Plains hide-scraping tools, Mooney (1910:592) reported that an adze shaft of wood or elk bone was fitted with a stone or metal bit. Hiller (1948:7) also indicated that before metal became prevalent among the Hidatsa, blades of the woman's scraper were made of stone. A photograph of a Blackfoot hide scraper appears to have a stone scraper hafted onto a curved handle (Ewers 1945:12, Figure 12). These observations suggest that endscrapers were a component of the bison skin thinning tools used by women in prehistoric America, though it is possible that a somewhat different handle configuration may have been used to accommodate the stone bit.



Figure 2.11. A Mandan/Hidasta woman cleans hair from a bison hide with an elkhorn scraper, ca. 1910–1915. Fort Berthold Indian Reservation, North Dakota. Photographer unknown. State Historical Society of North Dakota (00270-139), Fort Berthold Photograph Collection. Used with permission from the State Historical Society of North Dakota. (http://digitalhorizonsonline.org/cdm4/item_viewer.php?CISOROOT=/uw-ndshs&CISOPTR=5798&CISOBX=1&REC=15)

Elkhorn scraper handles were more than functional tools, they were valued heirlooms. Often lasting decades, elkhorn scrapers were passed down from mothers to daughters for successive generations. In some cases, markings were made on Great Plains scraper handles to denote the birth of children, the number of hides dressed, or the number of robes or tipis completed. In Alaska, the carvings on the *ikun* allowed the tool to transform into animal spirits and locate lost hunters. The scrapers handles, which are entirely missing from the Paleoindian archaeological record were likely highly valued and perhaps culturally significant tools as opposed to the easily replaceable stone scraper bits.

Other instances of women's stone tool use in North America have been documented as well. Like Australian women, Pawnee, Blackfeet (Niitsítapi), Assiniboiné (Nakota), Cheyenne (Só'taeo'o and Tsétsêhéstâhese) and Hidatsa (Hiraacá) women made wooden bowls (Schneider 1983:103). Pawnee women made all the wooden implements that they needed, including ladles, spoons, *hiku* sticks (multipurpose implements), wooden brackets

and pestles (Weltfish 1965:382-383). Regarding Pawnee *hiku* sticks, Weltfish (1965:385) remarked that, “Every woman young or old knew how to prepare one.” Ewers (1945:59) reported that of the Blackfeet:

Older Indians have stated that a woman who wished to make a bowl first located a large burl on an ash or cottonwood tree, cut it off with an axe and carried it back to camp. She began to hollow it out with an axe and finished the inside by carefully removing little chips from the surface with her metal bladed skin scraping tool.

This example suggests that Paleoindian endscrapers could have been used for multiple purposes including hide-working and wood scraping. The rounded end of hide-working tools might have been particularly well suited to scraping the rounded interior of bowls. It also suggests the possibility that Paleoindian endscrapers with microwear indicating use on wood were not necessarily men’s tools.

In addition to the more well-known formal tools, there are a number of examples of women’s informal stone tool use from temperate North America. Cheyenne midwives used and preserved flint knives to cut a newborn infant’s umbilical cord (Grinnell 1902:15), and in the Americas, women often cut their children’s hair with a stone flake (Mason 1895:45). Sioux women would sometimes cut themselves with flint knives as a sign of mourning (Mason (1924:252). Huron women used stone hoes shaped by percussion flaking in preparing maize fields (Fowler 1946). Fowler (1946:33) suggested that the hoes were made by women who did not have specialized skills in flint-knapping, but who required them for agricultural work. Gero (1991:170) cites a case from Holmes (1919:316) where native women were observed pressure flaking arrow points. Holmes was citing George Ercol Sellers (1886:872-873) who transcribed an oral account of his uncle, Titian R. Peale, an assistant naturalist to an 1819 expedition to the Rocky Mountains. In an archaeological context, at the

Island Site, a Late Woodland burial, women and children were interred with pressure flakers and billets (Bamforth and Finlay 2008:21).

Northern Europe and Siberia. In historic times, women often performed hide-working in Northern Europe and Siberia (Figure 2.12). Antropova and Kuznetsova (1964 [1956]:807) illustrated a Chukchi hide scraper with a stone bit and a similar one with a metal bit (Figure 2.13). Most hide-working implements, however, were made of bone or metal. The Sámi of northern Scandinavia and Russia and the Nganasans of northern Siberia processed reindeer hide with a metal-bitted scraper, called a *jiekki* in the Sámi language, that may have been stone tipped in the past. This instrument was used with two hands, sometimes referred to as a double-handed scraper (Hatt and Taylor 1969:13). The *jiekki* is an s-shaped iron bar attached to a 40-cm long wooden shaft and is used to remove fat and flesh from a reindeer skin (Figure 2.14). The skin is scraped on a scraping board using a pulling and pushing motion (Pennanen 2006:220).



Figure 2.12. Nenet woman preparing reindeer hide. Tobolsk Province. Early 20th century. Photo-archive of the Russian Museum of Ethnography (http://eng.ethnomuseum.ru/gallery24/256/606_370.htm)

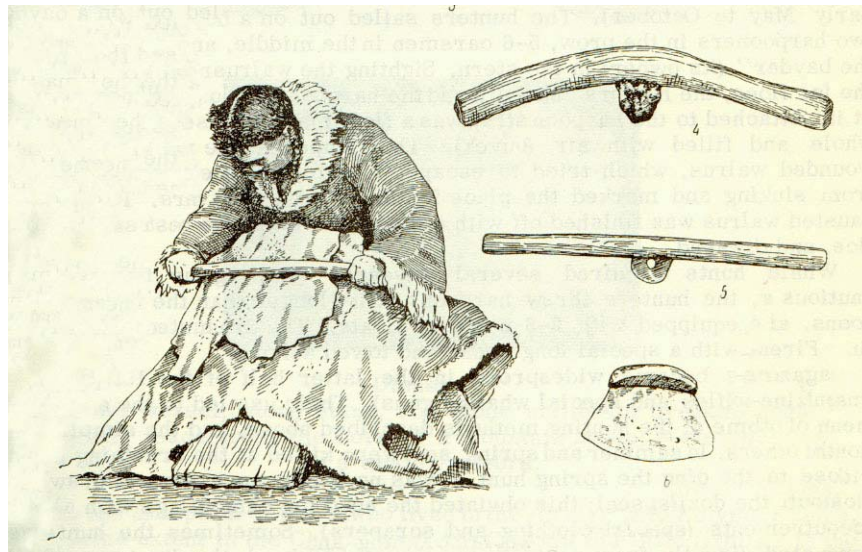


Figure 2.13. Chukchi woman working hide (left). Right from top: scraping tool with stone bit; scraping tool with iron bit; a woman's knife (from Antropova and Kuznetsova 1964 [1956]:809).



Figure 2.14. S-shaped hide scraper from Sámi culture (Klokkernes 2007:54).

Other Contexts. Other examples of women's stone tool use come from island contexts.

Manioc (cassava) graters, made from wooden boards embedded with pieces of stone, were used by women in the Caribbean (Mason 1924:38-39). In the Bahamas, stone chips were used by women for grating manioc (Roth 1924:278-280). These grater chips were likely created using a bipolar reduction technique and further modified to reduce width and create a pointed end (Berman et al. 1999). Andamanese women made quartz and glass flakes for use in scarification, tattooing and shaving (Gorman 1995:91; Man 1883:332). Among the Andamanese, it was the women who were responsible for flaking stone (Man 1883:332). In fact, flaking was the duty of women alone, and men did not use stone tools at all (Gorman 1995:89; Mason 1895:137). The two most esteemed activities in Andaman society were men's hunting and women's skill in body decoration.

Quarrying, Raw Material Selection, and Transport

In addition to manufacturing and using stone tools, ethnographic and ethnohistoric accounts indicate that women sometimes quarried stone (Ling 1899; Webley 2005; Weedman 2005). In Tasmania, Roth (1899:151) described a group of children, women and men quarrying cherty hornfels following an account by James B. Walker, writing: "There were twenty or thirty of them; men, women, and children. Noisily chattering, they were

breaking the stones into fragments, either by dashing them on the rock or by striking them with other stones, and picking up the sharp edged ones for use.” Among the Langda of Irian Jaya, Stout (2002) remarked that girls and boys accompany men in quarrying expeditions. Konso women of Ethiopia procure raw materials and manufacture their own scrapers (Weedman 2005). These hide-workers sometimes travel to quarries for the sole purpose of obtaining stone for scrapers, while at other times, procurement is embedded in other activities such as visiting friends (Weedman 2005:191). Webley (1990) reports that Khoi women travel five to ten kilometers to collect raw material for hide scrapers, but quarry visits were embedded in other activities such as collecting medicinal plants. At a quarry, Webley (1990) observed a Khoi woman fracturing stones by using an iron digging stick as well as by throwing stones against a hard rock to expose the interior. This latter reduction technique is known as “projectile percussion”. Scrapers were further reduced using a smaller stone so that they could be held comfortably in the hand and to remove sharp edges that could potentially tear the animal skin. Tahltan women also collected their own pebbles for hide softening tools (Albright 1984). In her autobiography, Mourning Dove, a Salishan writer, reminisced that

The granite around the falls had many uses. Women gathered the slabs on the east to make knives, scrapers, and other tools for turning deer hide into buckskin. This kind of rock (called quhkam, tanning rocks) was well known and preferred, so it was traded widely. Since there was no flint in the area, this granite was the substitute especially for tanning scrapers. These fan-shaped pieces of chipped rock were fitted into three-foot handles and tied with buckskin or hemp cords. The women made these scrapers by hitting the edges of a granite slab against a flat rock. Slowly one side became ready to use (Mourning Dove and Jay Miller 1994:103).

Metates were also sometimes quarried by women and shaped by direct percussion. Hopi women collected sandstone slabs from canyons and subsequently trim down their edges with a hammer to shape them into metates (Mason 1924:143).

Women transported raw material for men's tools as well. Plomley (1966) described transport of stone by Tasmanian women in the early 1800s: "They carry with them also sharp stones with which the men make their spears and waddies (hunting sticks)." Similarly, Jones and White (1988:61, 83) observed that while Australian aboriginal men flaked and prepared lithic material at stone quarries, women transported the rock away from the quarries in paper bark bundles. Other ethnohistoric accounts in southwest portion of western Australia indicate that women transported stone (Grey 1841:266; Salvado 1977:149). In the 1930s, prior to the introduction of steel, Tungei men of highland New Guinea quarried stone for axes, fearing female contamination. After the quarrying was completed, men escaped the quarry in a "ritual flight," following which women burned down the exclusively male huts at the quarry camp, destroyed the camp, and sometimes beat the men. The women then removed the axes and transported them back to the main camp in net bags (Burton 1984:235, 242). During fieldwork conducted between 1982 and 1993 among the Dani of highland western New Guinea, Hampton (1999:235, 299-300) observed that women never assisted in quarrying, but provisioned men with food at quarry sites, and transported biface blanks made at the quarry back to the residences.

Implications for Paleoindian Studies

The preceding examples make it clear that women have participated in all aspects stone tool technologies, including quarrying, selecting raw material, transporting, producing, using, and maintaining stone tools. In historic and modern contexts, women have been reported making expedient stone flakes, choppers, simple axes, and unifacial scrapers using bipolar, anvil, direct percussion, and projectile percussion techniques. The review suggests that early stone technologies might not have been exclusive to men, and that women could

have been active participants in technological organization. Moreover, many of the stone tools that have been produced and used by women are hide-working implements. Stone endscrapers, often exhibiting hide-working wear, could have been an important component of Paleoindian women's toolkits, with women potentially quarrying, transporting, producing, using, and maintaining these tools. The results of this review indicate that Paleoindian women's activities are not necessarily invisible, and that women could have played a much greater role in technological organization than previously recognized. To further explore this possibility, the following sections discuss similarities and differences in men's and women's stone tool use and production in more detail.

Differences in Men's and Women's Stone Tool Manufacture. Gero (1991) and Sassaman (1998) have suggested that prehistoric women were more likely to use expedient flakes rather than formal or intentionally modified tools. Casey (1998:84) criticized this view, arguing it implies women were untalented, passive toolmakers. The ethnographic examples discussed in the preceding sections make it clear that women made and used expedient flakes, choppers, and formal tools, such as unifaces, on a regular basis. At the same time, women's manufacture, and to some extent, use of certain types of stone tools, appears limited (Table 2.1). Bamforth and Finlay (2008) listed a number of characteristics of stone tools that indicate high levels of skill (Table 2.2). Though difficult to judge because of lack of detailed information in ethnographic and historic accounts, women's tools do not often appear have the traits outlined by Bamforth and Finlay that indicate high levels of skill, namely: (1) extreme thinness; (2) extreme length relative to width or thickness; (3) extremely complex outline form; (4) precise and regular finish flaking, or (5) complex multi-stage reduction. Women are documented to have used very large stone tools, but these are generally

minimally modified choppers. Other characteristics that Bamforth and Finlay present such as overshot flaking and platform preparation are too difficult to judge from the ethnographic record. More concretely, there are very few instances of women manufacturing bifacial tools, though women certainly used bifacial tools such as the skin softening implements of the Northwest Coast. There are two possible exceptions to the general rule that women do not often make bifacial implements. One possible example of women's biface manufacture comes from Australia, where women were documented making stone points (Bird 1993). In the second example, North American native women were reported finishing, but not making, stone arrowpoints (Sellers 1886). It is unclear, however, in these examples whether the points were made from flakes or made from bifaces.

Table 2.1. Summary of Women's Quarrying, Stone Tool Use and Stone Tool Manufacture.

Region	Type of Tool	Action	Examples
Australia	Unifacial scraping tool	Use	Spencer and Gillen (1927:545); O'Connell (1974:193)
Australia	Expedient flakes	Use	Bates (1985:245); Bird (1993); Gould (1977:131-132; 1980:124); Gould et al. (1971:163); Lyon 1979[1833]; Moore 1979:107; Mountford and Harvey 1941:158; Roheim (1933:252); Roth (1899:124); Spencer and Gillen (1927:487)
Australia	Hatchets, choppers and blocks of stone	Make using direct percussion technique; Use	Bell (1983:95, 199-200); Dickson (1981:3); Goodale (1971:154-156, 167-170); Hamilton (1980:5); Hayden (1979b:29-34, 39-41, 110-120); Love (1936:67-68, 70; 1942); Plomley 1966:897; Roth (1899:148-149); Tindale (1972:245-246); Tylor (1894:142)
New Guinea	Axe and adze	Use	Pétrequin and Pétrequin (1993:362); Poole (1981:122)
New Britain	Blade flakes	Make using a bipolar technique; Use	Bird 1993:26; Gosden and Knowles 2001:173
Africa	Unifacial hide scrapers	Quarry, make using direct and bipolar reduction techniques; use	Brandt and Weedman 2002; Weedman 2002, 2005
Africa	Hide abrader	Quarry, make using direct percussion technique	Webley 1990
Africa	Chopper	Use	Marshall 1976

Table 2.1 continued. Summary of Women's Quarrying, Stone Tool Use and Stone Tool Manufacture.

Region	Type of Tool	Action	Examples
North America	Ulu (unifacial, possibly bifacial)	Use	Boas 1907; Mason 1891; Murdoch 1892
North America	Unifacial stone skin scraper	Quarry, make using anvil percussion striking the raw material against another stone) and use	Cassell (2005:108); Ford 1959; Mourning Dove and Jay Miller 1994:103; Murdoch 1892; Nelson 1899; Nissen and Dittmore (1974); Osgood (1940:79-81)
North America	Dressing stones made from split pebbles and blunted by chipping	Quarry; make using direct percussion, bipolar percussion, and anvil percussion; Use	Albright 1984:56-57; Emmons 1911:83
North America	Unifacial endscraper	Use and resharpening	Dempsey (2001); Ewers (1945:10); (Grinnell 1923); Hans (1907:161); Hiller (1948:7); Hoebel (1978:66); Miles (1963:101); Mooney (1910:592)
North America	Axe	Use	Ewers (1945:59)
North America	Flakes	Use	Fowler 1946; Mason 1924:252, 1985:45
North America	Arrowpoints	Pressure flaking with pointed bone	Sellers (1886:872-873)

Table 2.2. Characteristics of Stone Tools that Indicate a High Level of Skill (from Bamforth and Finlay 2008:5, Table I).

Characteristic
Unusually large size
Extreme thinness relative to width
Extreme length relative to width or thickness
Extremely complex outline form
Regularity of form
Smooth symmetric cross-section
Precise and regular finishing flaking
Intentional overshot flaking
Minimal platform preparation
Very low metric variation in artifact size
Reliance on complex multi-stage reduction strategies
Consistency in production

Another observation to be made from the ethnographic and historic data is that women's flint-knapping techniques tend to be relatively simple and include mainly direct percussion, bipolar flaking, anvil reduction, and projectile percussion (Table 2.1). A single source indicated women used an indirect percussion technique to manufacture arrowpoints—the same source indicating that women were finishing arrowpoints (Sellers 1886:872-873). Though the ethnographic information is incomplete, the absence women's manufacture of complex bifacial tools is interesting. While it may be tempting to conclude the historic and ethnographic records are biased by male observers, and simply failed to record women's production of complex stone-tool forms, it is equally possible that it is a valid generalization requiring anthropological inquiry and explanation. In addition, projecting modern western value judgments of stone tools onto the past may prove to be ethnocentric and misguided. Recognizing the types of stone tools women use in no way diminishes their contributions or talents. While women appear to make and in many cases use relatively simple stone tools, the term "skill" is not entirely straightforward. Bamforth and Finlay (2008:2) stated that while archaeologists often remark on the skill involved in prehistoric craftsmanship, skill itself is often poorly defined. Skill, they argue, can be divided between cognitive understanding, "*connaissance*," and practical knowledge, "*savoir-faire*", the latter referring to motor skill. That is, even though women appear to produce simple forms, the motor skills associated with those forms may be complex. The following sections provide background into motor behavior and skill development.

Motor behavior begins with stimuli, which are then integrated and organized in the nervous system, and result in the response of muscle contractions. A stimulus is energy that affects an individual and excites a receptor, a specific type of nerve organ. Upon activation of a receptor, a nerve impulse is transmitted along nerve fibers (neurons) to the central nervous system, the spinal cord and brain. In the brain, the nerve impulses are integrated and interpreted and nerve impulses then travel out from the central nervous system. These impulses activate muscles (effectors) causing them to contract. The region of the cortex from which the majority of motor neurons originate is the motor area. The motor area is divided into the primary motor area and the premotor area—the premotor area being associated with the acquisition of fine motor skills. Most of the neurons in this area are dedicated to the mouth and hands allowing for finely controlled movements in these parts of the body.

While simple movements are part of the human genetic makeup, complex patterns of movement are learned (Sage 1973:196, 253). Most complex motor skills develop through practice, which increases speed and reduces errors (Sage 1973:311–312). New skills are built upon a foundation of previously learned skills, and learning is most effective when an individual is motivated to learn (Sage 1973:311–312). Motor skill development takes continued time and practice to become automatic, in which an individual does not have to consider each step of the activity process (Minar and Crown 2001:373). Many activities require a series of movements that must be coordinated into fluid movement or rhythmic skill. A single impulse that activates a series of motor impulses resulting in automatic movement is termed “kinetic melody” (Luria 1966). Humans can develop “kinetic melodies” associated with tool use, making it difficult to employ unfamiliar tools that require a different suite of rhythmic movements. Many activities performed in traditional societies require a

long period of training. Instruction can take many forms, including observation of an activity, guiding a person's hands, and "scaffolding," or integrating children into adult work (Wenger 1998).

If flint-knapping skill is defined according to Bamforth and Finlay's criteria, then it might be said that women were relatively unskilled flint knappers in that they produce forms that are less complex than men. If skill is defined as producing forms with speed and few errors, then women can be said to display skill in stone tool manufacture even when relatively simple forms are produced. Weedman (2010) argued that female Konso flint knappers are both proficient and skillful in creating stone scrapers using bipolar and direct percussion techniques. Though different production sequences were used, women were able to produce scraper forms that were consistent in terms of size and weight. This type of standardization increases with hide worker practice and skill (Weedman 2010:236). Plomley's description of Tasmanian women's flint-knapping also suggests ease of manufacture, and it seems likely that if women manufactured stone tools on a regular basis, they would become skilled—quick with few errors—in their manufacture.

Differences in Men's and Women's Tool Use. In addition to differences in stone tool manufacturing techniques, there are also differences in stone tool use by men and women. In many ethnographic and ethnohistoric cases, there are clear differences in the types of tools that men and women use. As Tindale (1972:245) commented, the Pitjandjara of Australia's Western Desert have "definite ideas" about the tools that should be used by men and women. In the 1900s, Australian women for the most part made implements that are required for their work (Hamilton 1980:12; Kaberry 1939:162). In the recent past, aboriginal women of central Australia and Kimberly region of western Australia made their own wooden tools such as

digging sticks and fighting sticks with stone tools (Hamilton 1980:6-7; Hayden 1977, 1979b; Kaberry 1939:162-163; Tindale 1972:245-6). In some cases, men and women used different tools for the same or similar activities. In central Australia, men and women often used different woodworking tools (Gould 1977, 1980; Hamilton 1980; Hayden 1977, 1979b; Tindale 1972:245). In general, women used minimally modified heavy chopping implements and men used hafted adzes, although women did report sometimes using adzes for woodworking (Hayden 1979b:111, 115). Hayden (1977:185, 1979b:13) and Hamilton (1980:7) commented that in the past, aboriginal women did not use adzes but rather a grinding technique for wood finishing, whereas men did not use this technique at all. In his work among the Pawnee in the 1920s, Weltfish (1965:383) observed women using hatchets and men using axes to cut wood for utensils, though woman used axes at other times.

Kent and Schultz (1993) pointed out that there was little separation of men's and women's toolkits among the Basarwa of the Kalahari. Basarwa women and men did not keep their belongings in separate containers, and tools were not tied to gender. As Kent and Schultz (1993) explained, "A digging stick is no more a female tool than it is a male tool. Both sexes use it in a variety of ways: as a walking stick, hunting club, pestle or digging stick." On the surface, the Basarwa appears to be a case where tools are strictly communal and generalized. However, the separation of toolkits between men and women in this case may be more nuanced. Certain types of tools, like digging sticks, might tend to be more communal. Other tools, such as spears and spear points, though used by both sexes, might be used in somewhat different ways and in different contexts. A similar case is presented by Brumbach and Jarvenpa. They pointed out that Chippewyen men use a hatchet (*tthelaze*) for splitting moose ribs from vertebrae, and women more commonly use the blunt edge of same

tool for pounding pemmican. Similarly, men use large knives for dismembering a carcass, while women use them for cutting meat strips for smoke drying. These examples illustrate that while tools might be used by both men and women, they are used in somewhat different ways, especially if the tasks associated with those tools are highly gendered.

Cooperation in Tool Making. While men and women appear to use different flint-knapping techniques and also use different tools in many cases, men and women make tools for each other (Bruhns and Stothert 1999:30). In the Western Desert of Australia, wooden dishes used for carrying water by women were made by men (Tindale 1972:246), and in North America, men made wood and elkhorn scraper handles and beaming tools for women (Hilger 1951:131; Kehoe 2005:133-134). Emmons (1911:41), during fieldwork conducted among the Tahltan in 1904 and 1906, observed that men made the skin dressing frames, while women used them. Summarizing Osgood's information on the Ingalik, Bruhns and Stothert (1999:32, Figure 2.2) show that 35 percent of tools made by men were used by women, and 40 percent of the tools made by women were used by men. Quivers were made by women, but used by men (Osgood 1940:206). Men made different awls, including ones for sewing, as well as *ulu* knives which were predominantly used by women (Osgood 1940:60, 71, 74). Jana Harcharek, an Inupiat woman from Barrow, Alaska, related that "My grandfather had custom-made the *ikuun* (scraper handle) for my *aaka* (grandmother) Faye. He had carved the wooden handle to fit her hand, and had fashioned the blade from steel piping. *Aaka* would occasionally pause to sharpen the tip of her blade with a fine-grained file to maintain consistency in her strokes" (King et al 2005:28). In some cases, tool-making was a cooperative effort, as in the case of a Tiwi woman collecting grass resin for the haft of a woodworking adze that her husband was making (Goodale 1971:135). Among the

Andamanese Islanders, women usually collected the shell and vegetable material used to make men's hunting weapons (Gorman 1995:91).

While men's and women's toolkits might not be separate in any idealized sense, it is possible that men and women develop different skills and use different toolkits for some tasks. I suggest that complex tasks that require long period of socialization and training are more likely to be gendered and have associated gendered toolkits. The development of complex perceptual motor skills associated with these tasks may make it difficult for untrained users to employ them effectively. It is this long period of training and development of automatic motor skills, which contributes to the gendering of tools. these ideas are further explored in Chapters 3 and 4.

Summary

Ethnographic and historic examples of women's chipped-stone tool use make it clear that Paleoindian women could have participated in all aspects of technological organization, from quarrying to discard. Secondly, there is no reason to assume that Paleoindian men alone quarried, transported, manufactured, and used stone tools. Women commonly made and used expedient flakes, choppers and scrapers, but mainly used bipolar, anvil direct and projectile percussion techniques in stone tool manufacture. More complex techniques and forms as outlined by Bamforth and Finlay (Table 2.2) are not commonly used by women in the literature reviewed here, suggesting that Paleoindian women might not have produced these more complex forms. Men, on the other hand, might have specialized in complex stone tool manufacture, being trained in skills such as biface manufacture fluting, overshot flaking, and fine edge retouch beginning in early childhood. Cross-culturally, men tend to make the long-distance weapons and there are few instances of women making complex bifacial projectile

points in the ethnographic literature. It is therefore likely that Paleoindian men made projectile points and developed the specialized skills of biface manufacture, fluting, overshot flaking, and fine edge retouch. Men's specialization in flint-knapping, however, does not necessarily imply that women were passive toolmakers. Paleoindian women may have adopted simpler flint-knapping techniques to produce the forms that they required, rather than rely on men to produce all stone tools for them. Yet, they also likely produce these forms with precision and speed. In the next chapter, I explore the possibility of Folsom women as hide-workers, and use a cross-cultural approach to examine what factors condition the gendering of hide-working activities.

CHAPTER 3

Cross-Cultural Analysis

Everything was made from skins from our surroundings. In a harsh, cold environment, we needed these superb garments for survival.

—Veronica Dewer (2005)

Many have noted that as reliance on hunting and prey size increases, women tend to do more butchering, processing, storage, and food distribution (Hayden 1981; Brumbach and Jarvenpa 1989:58-59; Waguespack 2003:136). Using the *2002 Revised Ethnographic Atlas* (an updated and supplemented version of Murdock's 1967 *Ethnographic Atlas*), I pursue these ideas in greater depth, particularly the relationship between gendering of hide-working and subsistence strategies. Looking at all societies in the database, it is rare for hide-working to be conducted equally by men and women, suggesting that this task requires specialized skills. More specifically, I find a strong relationship between reliance on hunted foods, latitude, and gendering of hide-working activities. A case is made that women's participation can be inferred to have been conducted mainly by women during the Paleoindian period, and the Folsom period in particular.

Hide-working and Subsistence

In the *Revised Ethnographic Atlas*, "hide-working" is defined as the dressing of skins (Murdock et al. 1962:390). I use the term "hide-working" rather than "leather-working" for consistency. Of the 1267 groups in the *2002 Revised Ethnographic Atlas*, 655 are missing data regarding hide-working (Variable #46), leaving a total of 612 groups. In 272 groups, hide-working is either not present, irrelevant (industrialized), or the sex differentiation is

unspecified, leaving 340 groups with information on hide-working. Data from these 340 groups reveal that hide-working is more likely to be performed either by males or females rather than being performed equally by males or females (Table 3.1). In only 6 percent of the cases examined is hide-working equally performed by men and women with no marked distinction between the tasks undertaken (Table 3.1).

Table 3.1. Sex Differentiation in Hide-working for 340 Societies in the *Revised Ethnographic Atlas*.

Males only or almost alone	Males appreciably more	Differentiated but equal participation	Equal participation, no marked differentiation	Females appreciably more	Females only or almost alone	Total
158 (46%)	7 (2%)	3 (1%)	19 (6%)	18 (5%)	135 (40%)	340

The *Revised Ethnographic Atlas* also contains information on subsistence and the degree of reliance on different subsistence strategies. These estimates of the degree of reliance were made mainly by Murdock (1967:145–154). Looking at the subsistence factors that could affect sexual division of labor in hide-working, reliance on hunting (Variable #2) reveals itself to be an important factor. In the 42 cases where reliance on hunted foods is greater than 46 percent, women are responsible for most hide-working in 100 percent of the cases (Table 3.2, Figure 3.1). In societies where hunting reliance is low (0-15%), men are more likely to do most of the hide-working (in more than 80 percent of cases). Equal participation in hide-working is far more likely in those societies where hunting reliance falls between 26 and 36 percent of the diet. Table 3.1 and Figure 3.1 include varied subsistence economies—gathering, hunting, fishing, pastoralism, and agriculture.

Table 3.2. Sex Differentiation in Hide-working and Reliance on Hunting for 340 Societies in the *Revised Ethnographic Atlas*.

	Reliance on Hunting									Total
	0-5%	6-15%	16-25%	26-35%	35-45%	46-55%	56-65%	66-75%	>75%	
Men appreciably more hide-work; Men only or almost alone do the hide-work	55 (86%)	54 (84%)	18 (42%)	27 (33%)	11 (24%)	0	0	0	0	165
Women appreciably more hide-work; Women only or almost alone do the hide-work	8 (12.5%)	8 (12.5%)	23 (54%)	39 (41%)	33 (72%)	17 (100%)	10 (100%)	4 (100%)	11 (100%)	153
Equal or Nearly Equal Participation in Leather working	1 (1.5%)	2 (3.1%)	2 (5%)	15 (18%)	2 (4%)	0	0	0	0	22
Total	64	64	43	81	46	17	10	4	11	340

Percentages are calculated within columns for each category of hunting reliance.

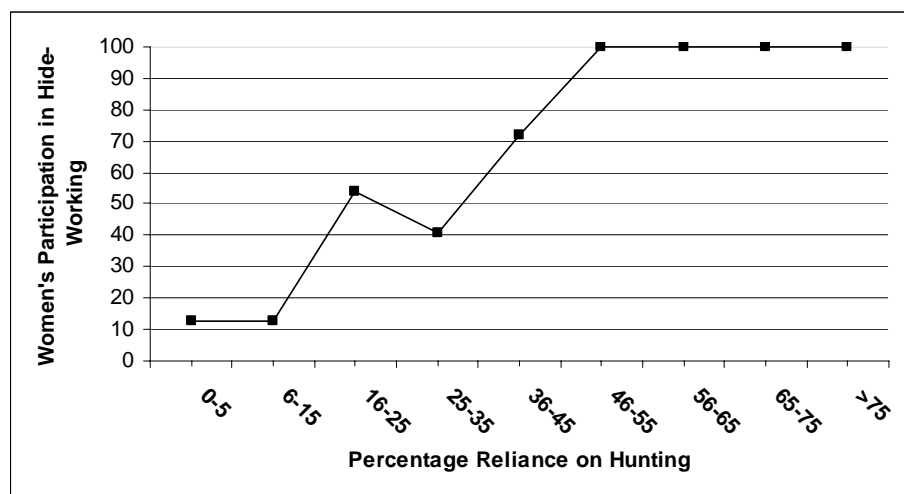


Figure 3.1. The Relationship between women's participation in hide-working and reliance on hunting (n=340).

When gathering is more important to the subsistence economy, men participate more in hide-working than women, though not exclusively (Table 3.3, Figure 3.2). Though the sample size is very small ($n=4$), when reliance of gathering is greater than 66 percent of the diet, men perform the hide-working 75 percent or more of the time. The overall trend suggests a strong correlation between subsistence and gendered participation in hide-working, not just reliance on hunting. Looking at reliance on fishing in the diet, a similar pattern as reliance on hunting emerges, with women doing the bulk of the hidework as reliance on fishing increases (Figure 3.3). With pastoralism, the pattern is more complex, suggesting that other factors are affecting the gendering of activities (Figure 3.4). This pattern will be looked at in more detail in the section on “Leather-Working and Climate”. With agriculture, there is a noticeable decline in women’s participation in hide-working as reliance on agriculture increases (Figure 3.5).

Table 3.3. Sex Differentiation in Hide-working and Reliance on Gathering.

	Reliance on Gathering									Total
	0-5%	6-15%	16-25%	26-35%	36-45%	46-55%	56-65%	66-75%	>75%	
Men appreciably more hide-work; Men only or almost alone do the hide-work	82 (77%)	22 (33%)	10 (18%)	7 (18%)	11 (55%)	15 (63%)	13 (59%)	3 (75%)	2 (100%)	165
Women appreciably more hide-work; Women only or almost alone do the hide-work	24 (23%)	42 (63%)	36 (63%)	25 (66%)	7 (35%)	5 (21%)	5 (23%)	1 (25%)	0	153
Equal or Nearly Equal Participation in Leather working	0	3 (4%)	11 (19%)	6 (16%)	2 (10%)	4 (17%)	4 (18%)	0	0	22
Total	106	67	57	38	20	24	22	4	2	340

Percentages are calculated within columns for each category of gathering reliance.

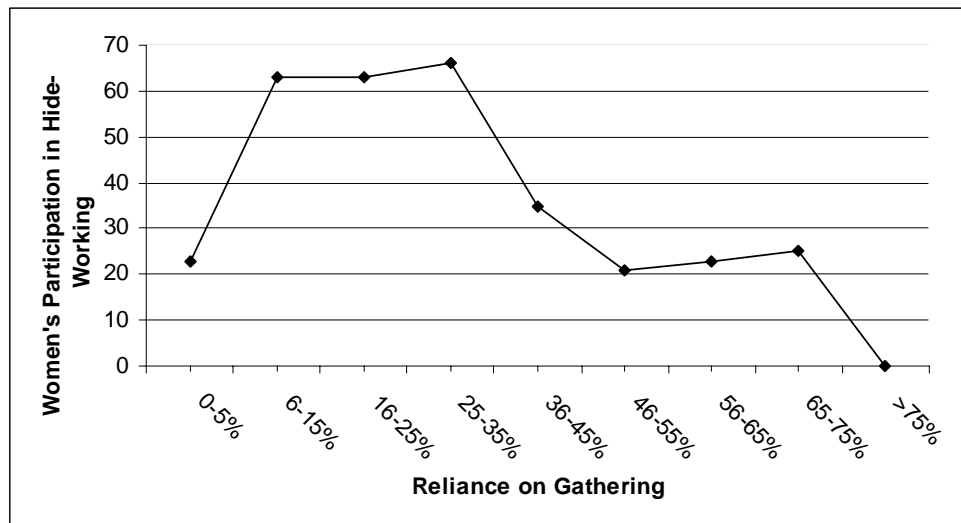


Figure 3.2. The relationship between women's predominance in hide-working and reliance on gathering (n=340).

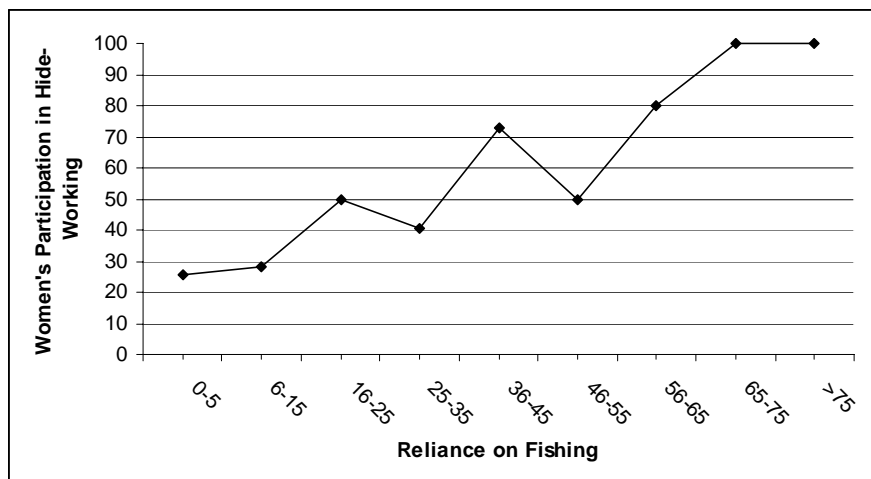


Figure 3.3. Relationship between reliance on fishing and women's participation in hide-working (n=340).

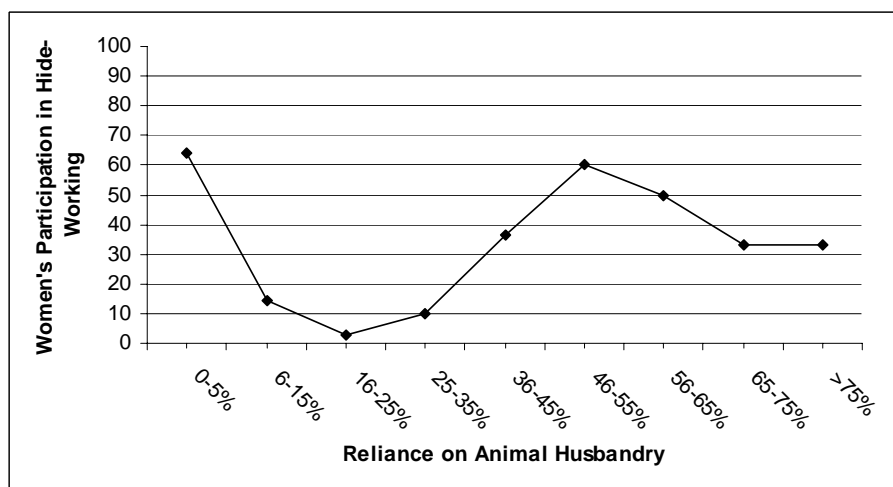


Figure 3.4. Relationship between reliance on animal husbandry and women's participation in hide-working.

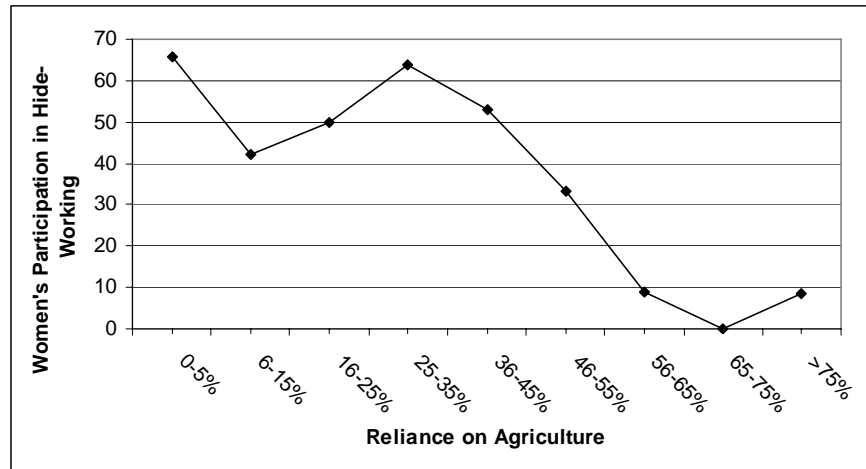


Figure 3.5. Relationship between reliance on agriculture and women's participation in hide-working.

I examine the relationship between the importance of different subsistence economies in a society (Variable #42, hunting, fishing, gathering, pastoralism, extensive and intensive agriculture), sex differentiation in hide-working (Variable #46), and whether men or women do most of the subsistence work. Tables 3.4 and 3.5 show these relationships. The numbers vary slightly from those produced by Variable 2 (Reliance on Hunting). According to the *Revised Ethnographic Atlas*, in 100% of societies where hunted foods contribute most to the subsistence economy, men do most of the hunting, and in 94 percent of these groups women do most of the hide-working. This pattern suggests that there may be a tradeoff between hunting skills and hide-working skills. The two instances in the database where men do most of the hide-work and where hunting contributes most to the subsistence economy are the Caduveo and the Achomawi. These groups, however, are documented as having 36–45% dependence on gathering and 26–35% dependence on hunting. In these cases, the database is not internally consistent. Possibly, seasonal differences in subsistence could have caused this inconsistency.

Table 3.4. Comparison of Division of Labor in Subsistence (Hunting, Fishing, Gathering) and Leatherwork for 173 Groups in the *Revised Ethnographic Atlas* (Variables 42 and 46).

	Hunting Contributes Most	Fishing Contributes Most	Gathering Contributes Most
Males Do Most Subsistence Work in this Category	54(100%)	56(92%)	0
Females Do Most Subsistence Work in this Category	0	1(2%)	56(97%)
Equal Participation	0	4(7%)	2(3%)
Males do appreciably more hide-work	2(4%)	5(8%)	26(45%)
Females do appreciably more hide-work	51(94%)	48(79%)	27(47%)
Equal Participation	1(2%)	8(13%)	5(9%)
	54	61	58

*Cases represent groups that had information on both sex differences in subsistence mode and hide-working.

Table 3.5. Comparison of Division of Labor in Subsistence (Pastoralism, Extensive Agriculture, Intensive Agriculture) and Leatherwork for 311 Groups in the *Revised Ethnographic Atlas* (Variables 42 and 46).

	Pastoralism Contributes Most	Extensive Agriculture Contributes Most	Intensive Agriculture Contributes Most
Males Do Most Subsistence Work in this category	10 (50%)	12 (28%)	42 (56%)
Females Do Most Subsistence Work in this Category	0	25 (58%)	12 (16%)
Equal Participation	10 (50%)	6 (14%)	19 (25%)
Frequency of groups in which men do appreciably more hide-work	10 (50%)	29 (67%)	67 (89%)
Frequency of groups in which women do appreciably more hide-work	10 (50%)	13 (30%)	5 (7%)
Equal Participation	0	1 (2%)	3 (4%)
	20	43	75

*Cases represent groups that had information on both sex differences in subsistence mode and hide-working.

When fishing contributes the most to the subsistence economy, men tend to do the fishing (92 percent of the time) and women do most of the hide-work (79 percent of the time). When gathering contributes most to the subsistence economy, women do most of the gathering (97 percent of the time), but groups are more equally divided on whether men (45 percent of the time) or women (47 percent of the time) do the majority hide-working. Looking at pastoralism, extensive and intensive agriculture, new patterns in gendering of tasks emerge. For pastoralism, animal husbandry is either conducted by men or men and women equally, and hide-working is conducted by either men or women, but not both equally.

For women's participation in hide-working among societies heavily reliant on animal husbandry, there is no strong correlation with subsistence and this task as there is for hunting, fishing, and agriculture. One possible explanation is that environment also has an effect on the gendering of tasks, which is further explored in the following sections. For extensive agriculture, men produce the bulk of the food 28 percent of the time while women are responsible for most food production 58 percent of the time. For hide-working, men do the hide-work 67 percent of the time, while women do most of the hide-working 30 percent of the time. It is not the case though that when women in societies heavily reliant on extensive agriculture are the main food producers that men are the hide-workers and vice versa. Instead, when men are the main producers, they are also the main hide-workers. When women are the main producers, men or women are equally likely to do the hide-work. When participation in subsistence equal (n=5), men always do the hide-work. For groups that rely heavily on intensive agriculture, men do most of the subsistence work, but in most of these groups, women almost never do the hide-work. In 89 percent of the groups who rely heavily

on intensive agriculture, men do the majority of the hide-work. In those societies that are heavily reliant on intensive agriculture, leather-working is often unimportant (40% of the time; 53 out of 132 cases). In these societies, men almost always do most of the hide-work, even when females do most of the agricultural labor. In only three cases out of 75, do women do most of the intensive agricultural labor and the hide-working. This pattern might reflect the other tasks that women tend to do in these societies such as food processing and cooking as well as the importance of leather goods.

It is clear that there is a strong correspondence between hide-working and high reliance on hunting, fishing, and intensive agriculture. The pattern becomes more complicated for pastoralists and extensive agriculturalists, suggesting that other factors such as climate, other critical tasks, and importance of leather goods could play a role in task differentiation. In those societies where leather goods are expected to have high importance, namely among societies that rely heavily on hunted foods and pastoralists, equal participation in leatherworking is 2 percent or less. Equal participation increases, but is still not high, in those societies where animals contribute less to the subsistence economy (high reliance on fishing, gathered food, extensive, and intensive agriculture). In cooler climates, where primary productivity is bound in large-bodied animals, it is suspected that hide-working should be strongly gendered. These ideas are investigated further in the following sections.

Hide-working and Climate

Environmental factors could play a role in whether men or women do the hide-working. The relationship between sex participation in hide-working and primary environment is also considered. Comparing Variable 95 (Climate: Primary Environment) in the *Revised Ethnographic Atlas* and Variable 46 (Sex Participation in Hide-working), it is

clear that women are more likely to do the bulk of the hide-work in tundra, northern coniferous forest, temperate woodland, and temperate grassland environments (Figure 3.6). In the tundra environment where there is data on hide-working (n=9), the main subsistence strategies are fishing (n=5), pastoralism (n=3), and hunting (n=1). Even though reliance on hunting is not the main subsistence strategy for these groups, in 100 percent of these cases, women perform the bulk of the hide-work. In the case of the northern coniferous forest where there is data on hide-working (n=15), the main subsistence strategies are fishing (n=9), hunting (n=2), pastoralism (n=1), extensive agriculture (n=1), intensive agriculture (n=1), and two or more contribute equally (n=1). In the case of extensive agriculture in this environment, men perform the majority of the hide-work, but in all other cases women do the majority of the hide-work. In temperate woodland environments for which there is data on subsistence economy and hide-working (n=6), the predominant subsistence economies are extensive agriculture (n=3), fishing (n=1), and mixed (n=1). In 100 percent of these cases, women perform the majority of the hide-working. These cases of hide-working in cooler climates are suggestive that climate plays a role in the gendering of hide-working tasks, with women tending to do most of the work in cooler climates.

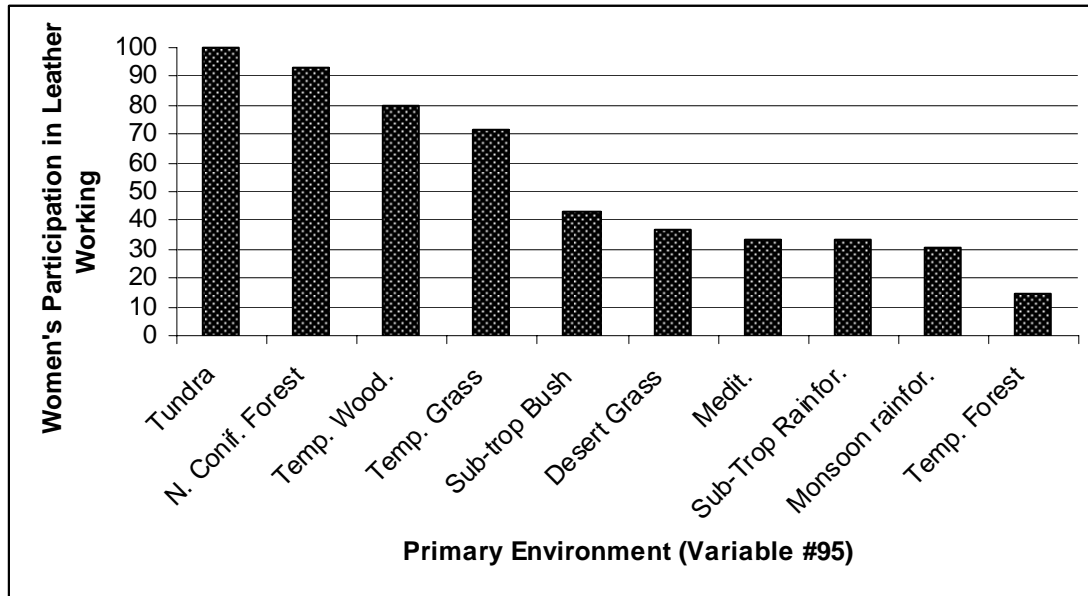


Figure 3.6. Relationship between women's participation in hide-working and primary environment.

Given the association between women's hide-working and tundra and temperate regimes, it is likely that cooler climates, in addition to reliance on hunting or fishing, affect division of labor in hide-working. Indeed, sexual division of labor in hide-working appears to be strongly related to latitude. From -41 to -50 degrees latitude and 41 to 50 degrees latitude, women begin to perform the majority of the hide-work. At the furthest latitudes (+/- 51 degrees and greater), women do the majority of the hide-work in more than 90 percent of the societies in the database (Figure 3.7). This perhaps stems from the need for dependable well-made winter gear, including clothing and shelter, where hide-working and sewing skills would be critical. High reliance on hunted or fished foods also corresponds to latitude. Above +/- 40 degrees latitude, there is a greater than 50 percent reliance on hunted/fished foods (Figure 3.8), indicating a relationship between hunting/fishing, climate, and women's hide-working.

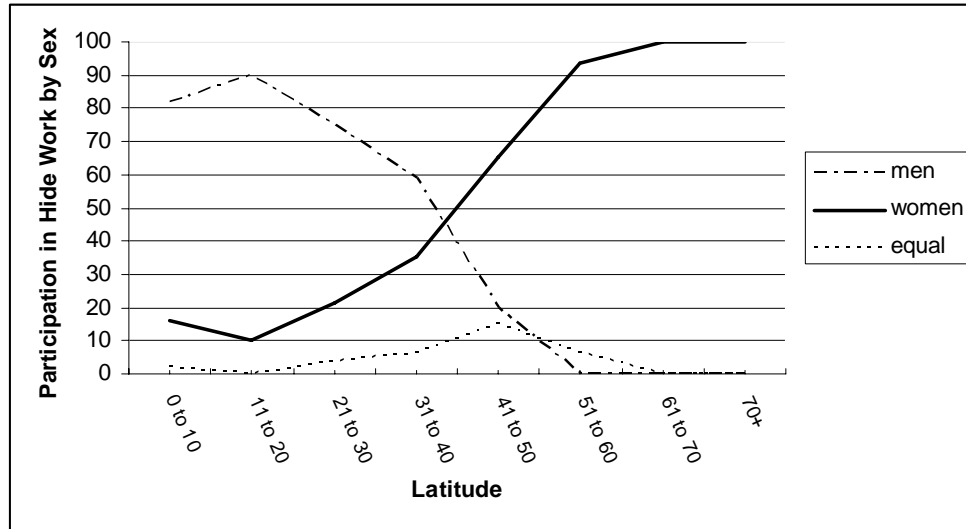


Figure 3.7. Participation in hide-working by sex and latitude (n=385).

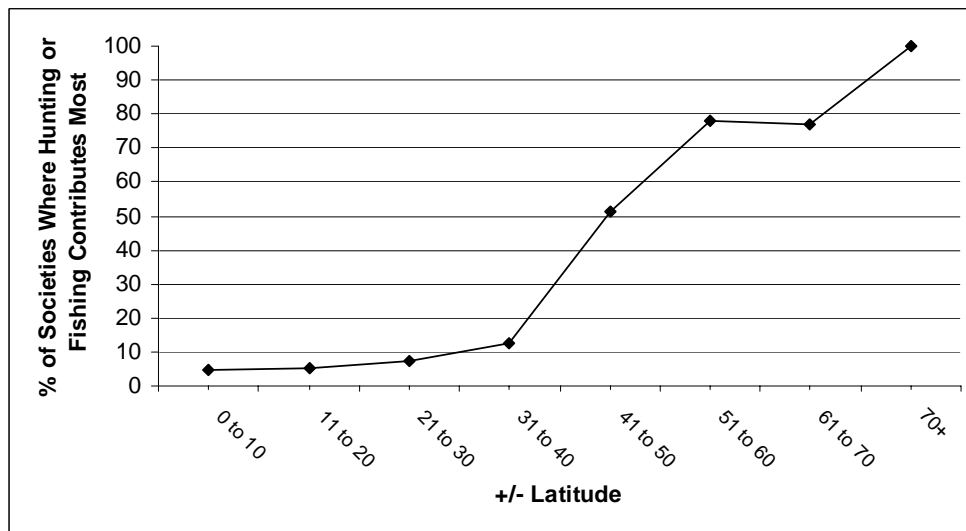


Figure 3.8. Percentage of societies with high reliance on hunting or fishing by latitude (n=1266).

Women work hides when reliance on hunting is high, even while not at extreme latitudes. In 51 societies where hunting reliance is 46 percent of the diet or more, 10 (with data on sex participation in hide-working) are at latitudes +/- 45 degrees or less. In all of these cases, women are the primary hide-workers. Women also do the bulk of the hide work at extreme latitudes, even when reliance on hunting is not high. There are four cases at

extreme latitudes (>60 degrees latitude) where women always conduct the hide-work. These include the Chuckee (a.k.a. Chuckchi: Russia), Lapps (a.k.a. Sámi or Saami: Scandanavia, Russia), and Yukat (Russia), and Yurak (a.k.a. Nenet: Siberia), all of whom historically practiced some reindeer herding/husbandry and relied on reindeer tents during winter months.

Societies that rely heavily on animal skins for shelter are suspected to have a highly gendered division of labor in terms of hide-working. Looking at societies that have residences partially made of hide (n=33), women do the majority of the hide-working in 94 percent (n=31) of these cases (Variables 81 and 83). Among pastoralists, climate appears to play a role in whether men or women conduct the hide-work (Figure 3.9). In low latitudes, men in pastoralist societies do the hide-working 100 percent of the time. In moderate latitudes, the division of labor in hide-working is either conducted by males or females. In extreme latitudes, where hide products are vital, women do the hide-working in 100 percent of the cases.

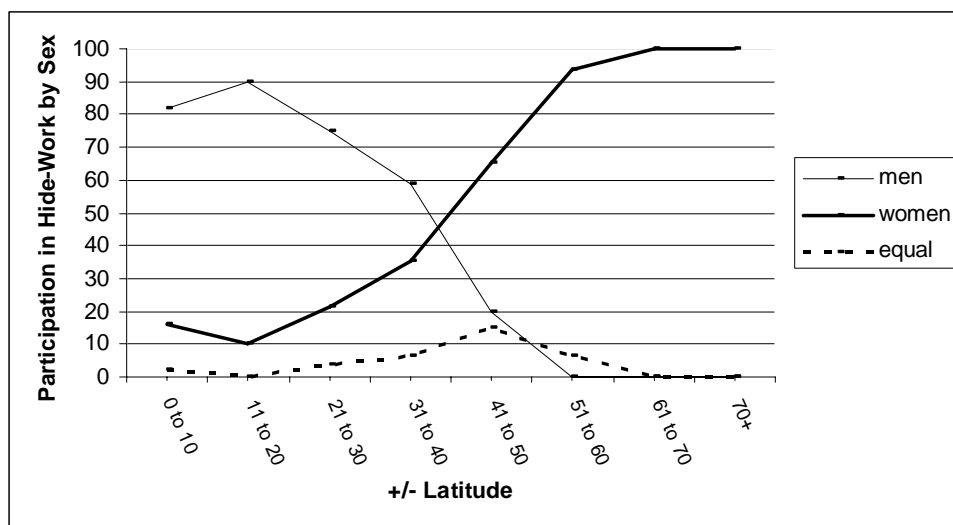


Figure 3.9. Sexual Division of Labor in Hide-working Among Pastoralists by Latitude (n=20).

Implications for Paleoindian Gendered Tasks and Toolkits

The results of this analysis show that in very few societies is hide-working performed equally by males and females. In societies that rely very strongly on hunting, gathering, fishing, or agriculture, the division of labor in hide-working is dramatic, being performed predominantly by men or by women. In particular, when hunting or fishing is important to the subsistence economy, women overwhelmingly do the hide-work. Relatedly, when hunted or fished foods contribute greatly to the food supply, men tend to perform most of the subsistence work. 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. In pastoralists economies in extreme northern latitudes, which include reindeer herders like the Chucki, women do the majority of the hide-working 100 percent of the time (n=4). In other pastoralist societies in non-extreme latitudes, either men perform the majority of the hide work, or men and women are equally likely to perform this task.

Based on the low incidence of equal participation in hide-working across all subsistence strategies and latitudes, it is most likely that either males or females performed most of the hide work during Paleoindian times. In the cross-cultural analysis, a reliance on hunted foods of 46 percent or more is associated with women's hide-working in 100 percent of cases. The data suggest that given the strong relationship between reliance on hunting and women's participation in hide-working, if Paleoindians that were reliant on bison and other large-bodied game for subsistence for even half of their subsistence needs, women likely were the primary hide-workers. Even if the Paleoindian diet were substantially supplemented with gathered foods, it is very likely that women were conducting most of the hide work based on the cross-cultural patterns. This seems especially probable in the Plains regions

where primary production is bound up large-bodied animals. If Paleoindians in other regions were reliant on fishing for about half of their subsistence needs, then women might still have been the primary hide-workers, given the strong relationship between reliance on fishing and women's hide-working.

This chapter demonstrated a relationship between subsistence, latitude, and gendered labor in hide-working. This pattern might be related to the types of activities men are doing, especially hunting, as well as the critical nature of hide products in cooler climates. In the next chapter, I examine the theoretical explanations for why complex tasks such as hide-working and hunting tend to be gendered.

CHAPTER 4

Understanding Gendered Toolkits

The most skillful, as well as tedious, process of all is the preparation of the buffalo robe.

—Frederic Malon Hans (1907:161)

The ethnographic and historic accounts reviewed in Chapters 2 and 3 raise the question of why reliance on hunting and extreme latitude are strongly correlated with women performing the bulk of the hide-work, and secondly, what might account for women's production of relatively less complex stone tools? I approach these questions using a framework of craft learning and experience-based embodied capital. Taken together, these perspectives suggest learning trajectories associated with complex stone tool manufacture could contribute to the gendering of activities. Long periods of juvenile learning and complex perceptual motor skills associated with tool production and use could in part account for differences in men's and women's stone tool production and the formation of gendered toolkits that are not shared equally or used equivalently by different genders.

Craft Learning, Embodied Capital and Skill

Rather than educating all children in all skill-sets, ethnographers have long noticed that parents in traditional societies socialize children at a young age in different tasks based on gender distinctions (Anderson and Eels 1935:89-90; Briggs 1974:269-270). As Whitehead (1981:83) wrote, "A social gender dichotomy is present in all known societies in the sense that everywhere anatomic sexual differences observable at birth are used to start tracking the newborn into one or the other of two social role complexes." This gender dichotomy is often socially reinforced by parents and other care givers. In traditional societies, artisans tend to

learn their craft from family members (Shennan and Steele 1999), with boys typically learning from fathers and male relatives and females learning from their mothers and female relatives. Parents can manipulate the time children engage in different activities in order to maximize benefits in terms of a child's future success (Bock 2002:168-169). Even if a child shows aptitude or desire for certain activities, he or she may be strongly dissuaded from pursuing them. Lepowsky (1993:93) described an incident among the Vanatinai of New Guinea, in which a young girl was throwing spears with some boys. Her mother admonished her, "Are you a man that you throw spears?" The cost of ignoring social mores regarding sex roles could be high. Among Plains Indian women, girls that were skilled at quill and beadwork, cooking and hide preparation were considered good wives (Hassrick 1964:42). "Such a girl," Hassrick wrote, "would attract fine young men of the best families, who would bring many gifts and horses as her bride-price; she would bestow honor upon her family." In this light, education and enculturation in socially appropriate activities during childhood can be seen as a form of parental investment, producing skilled workers as well as ensuring suitable marriages and familial alliances. Standardization in complex crafts such as pottery design, quillwork and beading, which might be attributed to craft specialization in the archaeological record, might alternatively have been a mechanism by which proficiency in complex skills was judged.

From a behavioral ecology point of view, Kaplan et al. (2000) discussed investments in development during childhood called "embodied capital" that result in higher payoffs later in life. The concept is subdivided into "growth-based" and "experienced-based" embodied capital, the latter encompassing skill, knowledge and understanding of social networks. Kaplan et al. (2000) argued that extended juvenile development, large human brain size and

extreme intelligence in humans co-evolved as a response to a shift to difficult-to-extract resources. Productivity is low during the extended period of juvenile learning, but training results in higher adult productivity. Kaplan et al. (2000) were most concerned about male provisioning and hunting, arguing that hunting is the most learning-intensive activity among foragers, incorporating knowledge of ecology, seasonality, animal behavior and tracking. “It takes a long time to become a hunter,” explained Silberbauer (1972:305, 315-136) “and a boy continues his training under the care of his father-in-law for several years after marriage”. Table 4.1 summarizes ethnographic reports of hunting learning trajectories, and supports the hypothesis that boys begin learning hunting skills at an early age, but do not peak in skill until mid-life.

Table 4.1. Learning Trajectories for Hunting in Traditional Societies.

Authors	Group	Comment
Gurven et al. (2006)	general	Strength alone cannot account for hunting ability with age
Walker et al. (2002:1–2)	Aché, Paraguay	Hunting skill peaks late in life.
Ohtsuka (1989)	Gidra, Papua New Guinea	Men ages 35-45 have considerably higher hunting returns than younger men.
Silberbauer (1972:305)	G/wi, Botswana	Boys do not become effective at hunting until they are fourteen or fifteen.
Harako (1976:71)	Mbuti, Democratic Republic of the Congo	The hunting apprenticeship of boys lasts from age ten to age twenty.
Steward (1933:291)	Owens Valley Paiute, northern Nevada	Boys begin to learn hunting skills from their fathers around the age of ten, with the fathers providing the weaponry.
Lee (1979:236, 242)	!Kung San, Botswana	Boys exclusively practice hunting around the ages of 9 to 12, and older boys study tracking. Men’s hunting success peaks between the ages of 30 and 45.
Washburn and Lancaster (1968:300)	Aleut (Unanga), Alaska	Boys begin practicing throwing harpoons while seated in kayaks early in childhood.
Denig (1928:148)	Assiniboine (Hoho, Nakona), Northern Great Plains	Boys practice using a bow and arrow as soon as they are able to chase after small game.

Kaplan et al (2000:168) also showed that among the Aché of Paraguay, years of skill and learning are required to extract other types of food resources, such as honey and palm starch. Among the Hadza, Aché and Hiwi, adult men and women are far more proficient than children at resource acquisition (Kaplan et al. 2000:160). Aché and Hadza children target more easily acquired foods such as fruit, and !Kung (Ju/'hoansi) and Hambukushu children are not as efficient at nut cracking as adults (Bock 2002; Kaplan et al 2000:169). Ethnographers, Kaplan et al. (2000) observed, generally cannot obtain equivalent food return rates as their study populations. Even among chimpanzees, many years of learning are needed to successfully master hunting skills (Kaplan et al. 2000:170, 172). When captive animals with complex feeding niches, such as apes, are released into the wild, they tend to be unsuccessful at resource procurement (Kaplan et al. 2000).

Though Kaplan et al. (2000) focused on subsistence activities, their ideas regarding long-learning trajectories for complex tasks may be applied to non-subsistence tasks, such as chipped-stone tool production, pottery manufacture, sewing, and hide-working. These activities require years of continued practice to become proficient, making it impractical for all individuals to become highly skilled at all tasks. In this respect, experienced-based embodied capital has relevance for tasks that are highly gendered and those that are performed more generally, and might also have implications for stone tool manufacture and use. That is, because it takes a long period of juvenile learning to master complex tasks, gendering of highly complex, skill-intensive activities ensures proficiency in those tasks. Gendering of complex, critical tasks might be especially important in contexts where activities such as hunting or the products of those activities, such as hides, were critical to

survival. The following section explores experience-based embodied capital from a non-subsistence perspective.

Skill in Non-Subsistence Activities

Ethnographic evidence suggests that some types of tool manufacture require a high degree of skill and experience. Adze-making in the village of Langda in Irian Jaya, for example, is a skill that is learned over a period of apprenticeship lasting five or more years. Stout (2002:693) wrote that “Adze-making ability is associated not only with well-developed perceptual-motor and cognitive skills but also with a wealth of technological knowledge.” Experienced knappers produce larger adzes by weight and length than apprentices (Stout 2002:705). As much as 10 years of experience is required to make the largest adzes (Stout 2002:693, 702). Stout (2002:696) also pointed out that finding material appropriate for adze making requires a great deal of skill, and experienced men lead the quarrying expeditions. Apprenticeship in stone tool use and manufacture is a form of experience-based embodied capital, requiring considerable investment of time and energy during childhood, but results in higher adult productivity.

Archaeological and experimental evidence also indicates that considerable skill is necessary in some forms of stone tool manufacture. Channel flake removal and skillful pressure flaking requires motor skills beyond that of generalized retouch or resharpening (Amick 1999:2; Ingbar and Hofman 1999:101). Flenniken’s (1978) Folsom fluting replication experiments resulted in a failure rate of 37 percent. In some Paleoindian contexts, failure rates of projectile point manufacture are high (Mason 1981:90), and Folsom fluting might even have been the domain of specialists (Bamforth 1991a). Folsom ultrathin bifaces required “advanced flintknapper skills” to produce (Jodry 1999a:206). Jodry argued that

these highly specialized knives were a response to a need for processing large amounts of meat effectively and efficiently. The same argument could be made for Paleoindian fluted point technology. Folsom points and ultrathin knives, Jodry argued (1999), are bison-specific, and the specialization and complexity of these tools results from a lack of alternative resources to bison. Bamforth and Finlay (2008: Table I) listed stone tool characteristics requiring a high level of skill, many of which apply to Paleoindian points and ultrathin bifaces.

The high level of skill required to produce complex stone tool forms coupled with a tendency toward “social gender dichotomies” in which boys and girls tend to be trained in separate skills, suggests that specialized flint-knapping should tend to be conducted by either men or women, but not both. Given the tendency in the ethnographic and historic records for women to produce relatively simple forms using relatively simple techniques, specialized flint-knapping during the Paleoindian period might have been the domain of men rather than women. This could be related to males expected high contribution to the diet, especially during Folsom times (MacDonald 1998). There is some ethnographic evidence that suggests specialized hunting weapons are typically male items, though they are occasionally borrowed by females (Watanabe 1968:74). Watanabe (1968:74) wrote, “Women have no weapons of their own which are specially made to hunt animals. If they want to hunt, they must do so without weapons or otherwise with some provisional weapons such as sticks. Rarely do they use specially made hunting weapons such as harpoons or spears.” Amick (1999:172) assumed of Folsom contexts that “it is expected that adult male activities are indicated by hunting weapon related artifacts such as projectile points, fluted preforms, and channel flakes”. If Watanabe and Amick are correct, complex forms such as Clovis and Folsom

points and ultrathin knives were likely produced by men (and boys) rather than women (and girls). Other forms that require less extensive learning and less specialized motor skill and knowledge, such as endscrapers and flake tools, could have been produced by women, untrained in specialized manufacture.

Like specialized flint-knapping, activities that are more often performed by women also require knowledge and skill to perform. Bock (2002:180) described women's grain pounding among multiethnic groups in the Okavango Delta of Botswana as having a highly stylized motion, and young girls practice "play pounding" from an early age. Hurcombe (2002:102) noted that mat weaving is a task requiring physical skills gained through experience and is best learned in early childhood. Girls older than 14 years who came to live in a Welsh village known for its seagrass weaving, could not weave as well as a native of the village (Jenkins 1972, cited Hurcombe 2002:105). Motor skills required for pottery making are also learned during childhood (Arnold 1988:205-207, 221-222). In her article examining children's painting on prehispanic vessels in the American Southwest, Crown (2001:455) wrote that ethnographic and historic documentation indicates that girls began learning pottery-making around the age of five, and were expected to be proficient around the age of 15. She pointed out that pottery making is a complex craft requiring skills in selecting and mixing materials, forming the vessels, as well as drying, scraping, slipping, decorating, and firing, in addition mastering symbolic content (Crown 2001:456).

Certain aspects of hide-working also require consistent training in early childhood to obtain a high level of proficiency. Writing about the Tungus (Evenki) of Russia, one early researcher commented, "The preparation of skins in general, requires good experimental

knowledge of the methods and personal skill which are transmitted from one generation to another (Shirokogeroff 1935:93, in Klokernes 2007:44). Klokernes (2007:44) wrote:

Skin processing technology is based on traditional knowledge; this is accumulated knowledge and experience; knowledge of materials, how materials may be physically manipulated to acquire the properties that are needed for a specific purpose, and the ability to adapt materials and methods according to current conditions.

Hide-working knowledge was typically passed down from generation to generation in North America, and a great deal of experience was needed to produce a well-made product (Mason 1924:78, 80). Among the Cheyenne, little girls were given a version of the elkhorn scraper (Grinnell 1972:215). Denig (1928:126) wrote of the Assiniboine that

As long as the child is small the mother has sole charge of it, but when it begins to speak the father aids in forming its manners. If a girl, he makes toy tools for scraping skins and the mother directs her how to use them. She also shows her how to make small moccasins, etc. The first attempts in this way are preserved as memorials of their infancy....If the child be a boy the father will make it a toy bow and arrow, wooden gun, etc.

Lakota girls were given women's implements including a knife sheath, awl case and a hide scraper when they were three or four (Powers 1986:57). In the 1800s, young Patagonian boys played with miniature bolas and lassos, while girls played at making *toldos*, animal skin tents (Musters 1872:199). In the early 1900s, girls participated hide-working among the Innu of Labrador by chewing hides to make boot leather (Hutton 1912:59). Those that learn hide-working often start at an early age. Among the Konso of Ethiopia, the oldest daughter is so occupied with other tasks that she does not have the time to learn hide-working, indicating that hide-working requires a considerable time investment to learn (Weedman 2005:188). Among the Xauta Kollaya Konso, experienced female hide-workers begin to encourage young girls from ages six to eight in the craft of hide-working, and by the ages of eight to twelve they learn the process of quarrying and hafting stone implements

(Weedman 2010:231). By 14 to 16 years of age, girls learn the art of knapping stone scrapers. Weedman (2002) wrote that even rejuvenating a worn scraper edge can take two to three years to master. According to the Xauta Kollaya, it takes between 10 and 15 years to become a skilled hide worker (Weedman 2010:232). Becoming a proficient hide worker among the Tahltan of northern British Columbia required that, “girls learn the art of hide processing about the age of 10-12 from their mother or aunt by way of observation, imitation and continued participation with them” (Albright 1984:52). A Yukon Athapaskan woman related:

In those days women sew lots, tan skin, make mukluks. I made my first mukluks when I was seven. Learn by watching my mother. I made them out of calf skin. First I cut the hair, then flesh the skin. Then scrape it with stone scraper. Then scrape it on thin board in front of me. You have to be sure there's no lumps in the skin or it splits the skin when you scrape. Then you wash the skin to get the blood out—it won't tan quick if there's blood in it. Then twist it tight and wring it out for awhile. Then stretch it on a pole (hanging vertically). Let it dry. First you smoke it. Then soak it in brain water to wash off the soap and make it soft. Leave it soak overnight. Then smoke it again. You smoke it like this maybe four or five times [Cruikshank 1979:27].

Hans (1907:162) wrote of the skill involved in buffalo hide scraping among the Sioux, where a woman “patiently and skillfully chips at the dry hide, shaving off a small bit at each blow, still not cutting too deep, until she finally obtains a uniform thickness and a smooth even surface.” Hoebel (1978:66) remarked that use of the elkhorn scraper to thin bison hides requires a great deal of skill. Though the mechanics of scraping hides might be accessible to any observer, the motor skills required for thinning a bison hide without tearing it necessitate long-term practice. In addition, knowledge of the nature of hides and how to most effectively process them also requires a great degree of skill and knowledge. Hide-working, like hunting, stone tool manufacture and pottery making is a complex activity, requiring long periods of training, which typically start before or at puberty.

If female and male children are often trained in different specialized activities, the motor skills or “kinetic melodies” (Luria 1966) that they develop might make it difficult to do those tasks and use each other’s tools effectively in those tasks. There is some ethnographic support for this hypothesis. When men and women borrow tools from each other, they tend to be less adept at using them. Among the Yankuntjara, Hayden (1977:183) observed that “Where a man would use an adze to hollow out or thin down hardwood, a woman would use a chopper. When women did attempt to use adzes, they were inevitably more clumsy than males.” Kaberry (1939) suggested that Australian men’s and women’s skills were not easily acquired and when men and women did engage in each other’s activities, they tended to be less adept. Jenness (1922:88) noted that while women had the knowledge of how to build a snow hut, and could even provide instructions, they were “awkward in fitting their blocks together as the merest novice.” In short, different genders might have some cognitive knowledge associated with tool use, but not the practical knowledge or, *savoir-faire*.

Once motor habits develop, they can become difficult to change (Minar and Crown 2001:375; Minar 2001:394). Minar (2001) argued that automatic motor habits resulted in conservatism in final twist direction in cordage among the prehistoric Alachua of north-central Florida. Arnold (1988:205-207, 221–222) observed that because new motor habits take time to learn, some technological innovations might be ignored. The time costs associated with learning new motor skills could explain the continued use of stone for hide-working tools even after metal became available. Anderson and Eels (1935:131) wrote that the only “ethnologically old” implements used by Arctic natives were the knives and scrapers used in tanning and dressing animal skins. While the high cost of learning new motor skills

might explain conservatism in hide-working tools, there is some evidence that stone tools were preferred in hide work because metal scrapers were prone to cutting holes in the skin (Wissler 1910:67, Figure 32). Similarly, Teit (1900:185) commented that while the Thompson Indians of British Columbia commonly used metal knives as beaming tools, these were more likely to pierce the skin than bone tools. Increased durability of metal tools along with reduced maintenance costs might have eventually outweighed the high cost of developing new skills. With successive generations, metal scrapers came to predominate on the Great Plains.

I argue that in subsistence contexts (high reliance on hunting) and environments (cooler, high latitude), complex but critical tasks such hunting, hide-working, and clothing production were more likely to be the domain of one gender, due to tradeoffs in the acquisition of complex skills. As Irwin (1989:247) succinctly noted, “In the arctic, the technologies of hunting, clothing manufacture, and childcare are so sophisticated, no one individual is able to become proficient at all these skills.” Similarly, Jarvenpa and Brumbach 2009:66 state that “Specialization allows both families and other small-scale units to perform a wider array of tasks than any individual alone could master. Specialized knowledge and experience permit both women and men to make conscious choices about how to best allocate their labor in the face of fluctuating resources.” Early learning trajectories of specialized skills along with the development of automatic motor skills could serve to solidify gendering of tasks and tools, despite individual proclivities or innate talent. Given these parameters and the association of hunting weapons with men, I argue that hide-working was likely a gendered task and hide-working tools were likely strongly associated with women.

Other Factors Influencing Gendered Toolkits

While I argue for separation of toolkits associated with complex tasks, I do not argue for a strict dichotomy between men's and women's tools. A number of other factors must be considered including borrowing of tools, social forces affecting access to tools, and tool use and alternate genders.

Tool Borrowing. There are a few instances of borrowing tools among men and women in the ethnographic and ethnohistoric literature, which argues against gendering of toolkits in any strict sense and could complicate the archaeological signatures of gendered toolkits. In borrowing, a tool is loaned on a temporary basis to another person. In the recent past, Australian aboriginal men nearly always made stone adzes, but women sometimes used them (Hamilton 1980:6; Hayden 1979b:13, 111; Love 1942:216; Sharp 1974:119). Sharp (1974:119, 120) described a situation among the Australian aboriginal Yir Yoront in the 1970s in which only adult men could make an axe, a symbol of masculinity. Men, women and children were permitted to use the axes with permission of the male owner, except for in procuring wild honey and fashioning ceremonial objects, activities reserved for men (Sharp 1974:122). Osgood (1940:100) observed that Ingalik women sometimes borrowed stone adzes that were made and used mainly by men. He commented, "Sometimes a woman may borrow a stone adze to take along when berry-picking, supposedly as a protection from bears. My informant says, 'of course when the bear came along they wouldn't do anything, but they kept it with them all the time hooked under their belt.'" Osgood (1940:98) also remarked that a woman can use a small axe to prepare firewood, yet men are the makers and owners of axes. Among the Basarwa of the central Kalahari, children and non-menstruating women can

reach into men's hunting bags to borrow a knife or other tool (Kent 1995:520). While some have argued that there is little separation of men's and women's tools, as among the Basarwa of the Kalahari (Kent and Schultz 1993), this model suggests that gendering of tools is perhaps more nuanced than previously recognized. While Basarwa women could reach into men's hunting bags and use men's hunting tools, they did not use them for hunting as men did. The statement that women reached into men's bags also implies that men's hunting tools were separate from other tools. Also, Basarwa digging sticks were communal tools, though these were used for a variety of non-specialized tasks including a walking stick, hunting club, pestle or digging stick. Watanabe (1968:74) mentioned that women will occasionally borrow harpoons or spears from men on a temporary basis. In general, when tools are borrowed, they appear to be often applied to different tasks, especially those tools associated with complex gendered activities.

Borrowing of women's tools by men appears to be less common. Osgood noted that Ingalik men occasionally borrowed a woman's knife to clean fish (1940:89-90). The stone skin scraper, used for scraping heavy skins, was made by men, owned and used by women, but sometimes used by men when "women persuade them to help with the heavy caribou skins" (Osgood 1940:80). Annie Ned, of the southern Yukon Territory described a similar cooperation:

Caribou skin, you fix it all over.
It's tough though. Oh, my, it's hard to clean it!
My old man helped me; we fixed three in one day. [Cruikshank et al. 1990:318]

During his Arctic expedition between 1913 and 1918, Jenness (1922:88) observed that Copper Inuit men sometimes helped women scrape hides in the fall, when daylight was limited and skins were needed for clothes for the winter season. One possibility for this more

recent borrowing of toolkits for the same tasks is that as the difficulty and skill level required for hunting and other tasks is reduced as a result of technological innovations (guns, motorized vehicles), activities and toolkits become decreasingly gendered and increasingly generalized.

Social Ideology. While different learning trajectories associated with complex tasks, motor skills, and subsistence strategies help explain differences in men's and women's tool use, other factors can influence the types of tools and raw materials men and women use. A notable difference in men's and women's tool use is the prohibition against women touching projectile weapons, which applies across many unrelated groups world wide. While men and women sometimes engage in overlapping activities, women are frequently prohibited from using or even touching men's hunting weapons (Brightman 1996; Edholm et al. 1977:119; Panter-Brick 2002). Put more succinctly, "Women generally don't handle weapons" (Wadley 1998:72). There are several ethnographic cases documenting these proscriptions. Among the Ingalik, women were prohibited from touching men's war knives, war clubs and lances (Osgood 1940:200, 209). One of Osgood's informants stated that "a woman does not know how" to use an arrow and they are thus used by men (Osgood 1940:206). Jenness (1922:88) wrote that among the Copper Inuit, both men and women fish using a rod and line, but "only men as a rule employ spears."

Australian aboriginal females of any age could not touch spears or spearthrowers, and the area where vines used in the manufacture of these implements grew was also off-limits to females (Hamilton 1980:6). Among the Tiwi "No females over about two years of age are allowed to touch a spear or even pretend to throw one" (Goodale 1971:246, 259). In his article on the adoption of steel axes among the Yir Yoront of Australia, Sharp (1952:119)

remarked that only adult men were permitted to manufacture a polished stone axe. Bimin-Kuskusmin women of highland Papua New Guinea, hunt large game on occasion, but are not permitted to use male hunting implements, and use only crude clubs and small stone axes (Poole 1981:122). One of the few activities that Vanatinai women (of the island of Vanatinai southeast of New Guinea) cannot do is to throw spears to kill animals (Lepowsky 1993:93, 114, 239).

Basarwa women of the central Kalahari use snares and sticks to catch animals (Kent 1995:518), yet women are not permitted to use bows or spears and menstruating women may not touch spears (Kent 1995:518, 520). Basarwa women, however, sometimes use spears for stirring and as knives (Kent 1995:525), indicating that in this case, the restriction is on *hunting* with weapons. Among the San !Kung (Ju/'hoansi) menstruating women may not touch hunting arrows and have a negative effect on the hunt in general (Shostak 1981:244). Draper (1975:82) and Marshall (1976:96, 97, 287) noted that Ju/'hoansi women were restricted from bow and arrow hunts and did not butcher animals. Likewise, G/wi women do not hunt or use bows, arrows or spears (Silberbauer 1972:304). However, among the Dobe Ju/'hoansi, Lee (1979:247) indicated that women could own arrows and trade them with men. Ownership of the arrow entitles a woman to meat if a kill is made.

There are also several ethnographic examples in which women are thought to be detrimental to the hunt. Women are excluded from hunting among the Nyae Nyae Ju/'hoansi because it is thought that women weaken hunters and make the hunt unsuccessful (Marshall 1976:96-97). Woods Cree believe that women can pose a threat to the hunt by transferring the ability to escape from hunters and trappers (Brightman 1996:708). Romanoff (1983:342) wrote of the Matsigenka of the Peruvian Amazon:

Women's participation in hunting does not exempt them from many beliefs about women common in Amazonia. Men say that too many women can spoil a hunt, that excessive or inopportune intercourse can lessen a man's skill, and that women's presence at a tapir trap would leave an odor disgusting to the tapir. They say that women walk slowly, and that hunters can go farther in all male groups.

Brightman (1996:703) wrote that "Women are ill-adapted to hunting because they lack education and weapons," and, "All that is necessary for its perpetuation is that the division be conceived as inevitable by the men and women whose aspirations, educations, and practices presuppose and recreate it." Brightman (1996:706) further argued that if women were not allowed long-distance weapons that men use, then they are left with short-distance weapons such as knives and clubs, thus making big-game hunting by women unprofitable. Preclusion of women from hunting could signal that men are protecting their status as hunters and providers. Big-game hunting, as argued by Brightman (1996:713-714), is likely more prestigious than foraging, based on the fat content of meat, the large package size, the variability in hunting success, and the skill involved in acquiring the resource. Hawkes (1990) argued that male hunting is a mating rather than a provisioning strategy, in that better hunters gain status and sexual partners.

These examples suggest that gendering of tools, especially hunting weapons, might be a means of protecting access to status and potentially resources. Proscriptions against women and girls handling weaponry seem difficult to explain if there is no threat of a woman or girl becoming proficient at hunting through practice, which can only be achieved by access to weaponry. Women many times resort to other means of hunting, including clubs, dogs, and traps, particularly if there are few other resources available and hunted resources are abundant as in the Agta case. It also seems possible that elaboration of hunting equipment

and the associated long period of skill acquisition might not be functionally necessary, but a kind of security against girls and women entering this domain, thereby threatening access to status and resources.

Access to raw material might also be bounded by social ideologies. Gero (1991:172) points out that women's control of lithic resources probably varied in different contexts. Hayden (1977:183, 1979b:13, 41) described a proscription against Yankuntjara women using cryptocrystalline materials: "According to her, women were not allowed to use *kanti* [cryptocrystalline rock]; only men could use *kanti*. Mary said that she had been abused by the men in the camp for using the flint which I had brought, because women were not allowed to use flint; but that the men had let it pass since the circumstances were unusual" (Hayden 1979b:41). In other regions no such restrictions existed (Hayden 1979b:111). Spencer and Gillen (1927:545) noted that Central Australian women's knives were made of coarser-grained material and that superior flaked instruments "such as we have never seen in the possession of women" were used by men (Spencer and Gillen 1927:545, see also Spencer and Gillen 1912:376). Access to quarry sites themselves was often restricted. Paton (1994:178) commented on stone resources in northern Australia saying that "access to any rock outcrop may be restricted by factors such as the myths directly or indirectly related to the outcrops, the level of knowledge of a person who may want to use or visit the outcrop or the gender of any such individual." Others have noted that the stone quarries and raw materials were sacred and powerful because of their association with ancestral beings from dreamtime (Jones and White 1988; Tacon 1991). Gould and Saggers (1985:120) wrote that Australian men exclusively made special-purpose trips to stone quarries due to the sacred nature of some lithic sites, noting that "organized lithic procurement was one of the few

domains of aboriginal daily life where such a strict division of labor by sex operated.”

Historically, among the of Tungei of highland New Guinea, only men quarried stone for axes used for general and exchange purposes. Quarrying was considered dangerous work, and men avoided female contamination during this process. During the Protohistoric period on the Southern High Plains, men sought to improve their social status through trade relations, and women may have had reduced access to exotic raw materials like obsidian (Habicht-Mauche 2005:47, 49).

The preceding examples suggest that social factors might have played a role in the development of gendered toolkits in addition to complementary skill sets between men and women. Women in some cases might be prohibited from touching stone weaponry, lack access to the highest quality toolstone, as well as be excluded from learning complex flint-knapping skills.

Alternative Genders. Though childhood training in complex activities is often divided along sex lines, in some cases, there are socially acceptable roles that permit an individual to participate in cross-sex activities. One of the more well-known “alternative genders” is the *berdache*, which Whitehead (1981:84-99) reported as occurring the in Plateau, Plains, Southwest, Prairie and southeastern regions of the United States as well as into Mesoamerica. *Berdache* (Spanish *bardaje*, Arabic *bardag*) or man-woman, were males who cross-dressed or wore a mixture of men’s and women’s clothing and participated in women’s activities (Steward 1933:238; Whitehead 1981:96). They were first observed in the New World in Central and South America (Fulton and Anderson 1992:604) and existed in 113 tribal groups from the Mississippi Valley to California to the Upper Great Lakes (Callender and Kochems 1983; Fulton and Anderson 1992:606). The *berdache* role sometimes entailed presiding over

liminal events such as birth, marriage and death (Fulton and Anderson 1992:609). The role of the man-woman began in early childhood, as a boy displayed a predilection for activities more typically associated with the opposite sex (Fulton and Anderson 1992:607). *Berdache* are thought to have been especially skilled at women's activities (Fulton and Anderson 1992:606). We'wha, a Zuni *berdache* (*lhamana*), was an exceptionally skilled potter and weaver (Mills 1995:151).

The exceptional craft skill of the *berdache* might have stemmed in part from the absence of pregnancy, nursing and childcare and the associated obligations (Williams 1992:59). Female cross-sex examples from North America are also known, mainly from the American Southwest (Fulton and Anderson 1992:606; Whitehead 1981:92). The "manly hearted women" of the Canadian Blackfoot tribe, were wealthy, high status and post-menopausal (Lewis 1941:176).

In some ethnographic cases, parents chose to teach their children skill sets associated with both sexes. Briggs (1974:270-271) reported that the typical Inuit division of labor is adjusted when no daughters are born to a family. Boys participate in typical boy's activities as well as help their mothers in domestic duties. If the family has no sons, a girl may be taught to hunt as well as conduct domestic activities. Jenness (1922:89) described a Copper Inuit girl who had a bow and quiver made for her. Out of necessity, an orphan might also learn both male and female tasks (Briggs 1974). Cruikshank (1979:10) stated that boys and girls were both taught survival skills, such as snaring small game, in the remote Yukon during World War II. This cross-sex training ran contrary to the "idealized" situation. Cruikshank's informant stated, "Girls are not supposed to use bow or arrow or slingshot when they're young, because it's boys' ammunition and a girl's place is in the home, so they

should be trained for home life,” and, “A woman’s job is to make skins, clean skins, dry meat, make sinew, make clothes, whatever clothes has to be made” (Cruikshank 1979:11). Reorganization in gendered craft specialization occurred among the Zuni in response to dramatic changes in the political economy as traditional subsistence production was lost (Mills 1995). Despite the presence of idealized sex roles, these examples make it clear that they can be adjusted when necessary. Hewitt (1989:341) commented that in a mountain community in northern Pakistan tasks fall into two categories: those that are always performed by men or by women, and those that are flexible in times of stress. This suggests that while there are idealized versions of appropriate tasks for male and females, flexibility exists in the face of environmental change and social upheaval.

Division of Labor in Hunting and Hide-working

The model presented in the preceding discussion suggests that either men or women were likely responsible for processing hides, and that hide-working tools were likely gendered. The preceding discussion and cross-cultural patterns found in Chapter 3, suggest that men’s hunting and women’s hideworking are correlated. However, it is important to clarify what is meant by hunting and to address cases in which women are known to hunt large game. If women in fact do systematically hunt in ways similar to men, requiring high levels of skill (*savoir-faire and connaissance*), then the tradeoff produced between acquiring hunting skills and hide-working and other skills is not tenable.

Cross-cultural observations indicate that men tend to specialize in big-game hunting when reliance on large-bodied game is high (Waguespack 2003). At the same time, women and children regularly participate in big game hunting by acting as drivers, game spotters, and other roles (Hudecek-Cuffe 1998). Women’s (and children’s) participation in animal

drives and surrounds has been well documented. Among the Ingalik, men make caribou surrounds, but are sometimes assisted by women in the drive (Osgood 1940:252) and Jenness (1977:158) reported that women sometimes participated in drives among Canadian groups. There are several historical accounts of men, women, and children participating in bison drives on the Great Plains (Henry and Thompson 1965:519; Hornaday 1889:487-489; McDonnell 1960:279-280; Quimby 1960:133-134). Ewers Blackfoot informant reported that women set up a travois surround into which men drove and subsequently killed bison. Women kept the bison from breaking through the surround (Ewers 1960:45-46). Hiding behind “dead men”, or piles of rocks, snow piles, brush and other material, women and children drove bison along drive lines (Arthur 1975:85-86). Arthur (1975:92) wrote that once bison were driven in the direction of the pound, “success depended on the courage and skill of those manning the dead men because the herd could break out through the drive lines at any point and escape.” Copper Inuit men, women, and children also took part in caribou drives (Jenness 1922:88). Binford (1991:37-38) described a corporate caribou drive in which women and children prevented caribou from exiting a lake once they have been driven there. Among the Thompson Indians of British Columbia, when not enough hunters were available, women and children of both sexes also participated in deer drives (Teit 1900:248). On the Great Plains of North America, smaller pronghorn were hunted with women and children using an enclosure technique (Hoebel 1978:69-70). Among the Owens Valley Paiute, mountain sheep were driven into brush corrals by men, women, and children (Steward 1933:253). Mono Lake Paiute and the Shoshone held rabbit drives in which men, women, and children participated (Steward 1933:254; 1955:109). Bates (1985:245) wrote that Australian aboriginal women and children sometimes participated in kangaroo drives

alongside men. Among the Mbuti of the Ituri Forest, women and older people act as “beaters”, driving animals into a net, where they were clubbed by men, or in rare cases killed with bows and arrows (Harako 1976:53, 54; Turnbull 1961:94-102). Harako (1976:53, 59), however, comments that no particular skill is required for this driving process, and that the minimum age for participation is about 10 years old. Women also carry the meat obtained from netting back to the main camp (Harako 1976:75).

While evidence for women’s participation in drives is overwhelming, other hunting activities, especially throwing and making weaponry appears to be a male specialization (Brightman 1993). A number of researchers have pointed to women’s participation in small and big-game hunting to refute the model of men’s specialization in the hunt; these are examined more closely below.

Cross-culturally, women are known to participate in hunting of small and medium-sized animals. For example, Hamilton (1980:11) wrote that men’s hunts are often unsuccessful, and that women in the Western Desert of Australia saw themselves “as going out primarily *for meat*.” Among the Dobe !Kung, men, women, and children collected leopard tortoise, snakes, lizards, and birds (Lee 1972:345; 1979:235). Goodale (1971:152, 160) wrote that Tiwi women hunted small game such as opossum, bandicoot, lizards, snakes, and rats. Native American women have been reported to snare rabbits (Jenness 1977:49; Theriault 2007:17). Spencer and Gillen (1912:367) reported that women and children hunted small game such as snakes and lizards. Australian women also netted fish (Gould 1980:95). Vanatinai women hunted small game such as opossum, fruit bats, and flying foxes and trapped monitor lizards (Lepowsky 1993:45, 114, 289). Osgood (1940:239) reports that

Ingalik women made, used, and owned rabbit and bird snares. Oldfield (1865:277) described Australian aboriginal subsistence:

While the men are employed in hunting or fishing, or are scouring thickets in search of eggs, the women are performing their allotted task of collecting whatever vegetable productions may be in season; of course, being thus occupied, the must frequently capture small animals or find birds' nests with eggs or young in them, but such articles never appear at the evening's meal, it is to be inferred that such are eaten as soon as they are secured.

This comment is particularly interesting, in that while prehistoric women might have engaged in small game hunting in the course of their subsistence activities, the remains of the animals might not appear in the archaeological record, having been consumed away from main campsites. Overall, it is very clear that it is common for women to hunt small game, and deliberately hunt in this capacity.

The following section explores in what contexts women hunt larger-bodied animals. These examples, while not exhaustive, suggest women hunt larger-bodied animals (1) in times of need, (2) when men are absent, (3) when meat is easily obtainable, (4) when other responsibilities are diminished.

Flannery documented wives accompanying their husbands on hunting trips among the Mescalero Apache in southeastern New Mexico. She wrote of Mescalero Apache women hunting, "I was informed by others that this was not such an uncommon feat for a woman in former times, and that as a group would be moving camp women would, if they needed food, kill whatever animals they came upon" (Flannery 1932:29). Women's pursuit of game can also be affected by men's performance in hunting (Jochim 1988). Among the Mescalero for example, there are accounts of some women hunting in the "old days" under certain circumstances, such as her husband's death or a husband's incompetence in hunting. In a similar case, Shostak (1981:244) described a !Kung women that took up hunting,

Women collect lizards, snakes, tortoises' and birds' eggs, and insects and caterpillars, as well as the occasional small or immature mammals. They also provide men with crucial information on animal tracks and animal movement that they observe while they travel in the bush. But women cannot be considered hunters in any serious way. The one prominent exception I heard about was a middle-aged woman who allegedly craved meat so intensely and was so tired of complaining that her husband was lazy that she decided to go out and hunt for herself... Those who knew her (including men) said she was a fairly proficient hunter, but it was clear that she was considered eccentric and was in no way seen as a model for other women to emulate. She earned far less respect for her accomplishments than a man would have, as was evident from the snickering that accompanied discussions about her.

This last case is particularly interesting because the woman, against expectations, was judged to be proficient at hunting. The ridicule that she faced also suggests that there can be social stigma applied to women who hunt. Landes (1938:164-169, 173) described hunting by Ojibwa women of western Ontario, who were without husbands, whose husbands were sick, or who were married to shiftless men. These women supported themselves by trapping small games (muskrat, rabbit, fox), fishing, and capturing moose and deer. However, when these women remarried, they took on more traditional female roles.

Brumbach and Jarvenpa (1997:29-30) note in their study of the Chipewyan of northwestern Saskatchewan, women hunt small animals closer to camp, and often return the entire carcass back to camp. Younger and older women with fewer child-rearing responsibilities tend to travel greater distances. However, with increased familial responsibilities, women tend to target closer resources (Brumbach and Jarvenpa 1997:22). Another example suggests that childcare plays a role in women's activities. An Alaskan Athapaskan informant stated, "All women work on skins those days. Women trap around while men hunt. Then women make fur up. When a woman fixes a skin it belong to her and

she can trade it. Most women don't hunt big animals. My mother did though; one year she got fourteen caribou. Women with lots of children stay at fishcamp instead of travel"

(Cruikshank 1979:27). Jenness (1957:176) described women hunting among the Inuit during a particularly cold period when famine was imminent:

There was a young married woman in the band who armed herself with a double-barreled shotgun and marched inland with the ptarmigan hunters as often as her husband scoured the ice for seals. I saw her return one evening with two birds, but could not discover whether in general she was more successful, or less successful than her companions. I did learn, however, that both she and a second young woman not only shot ptarmigan and other birds, but frequently joined the men in their caribou hunts and even went out alone to stalk seals. The Eskimos seemed to consider this quite natural—as indeed it was; for not every young woman, strong and active and still childless, could contently spend her days in a cabin or tent dressing skins, making and mending clothing, cooking one or at the most two meals a day...

Jenness (1922:88) also discussed women's hunting among the Copper Inuit. He observed that a few younger women take part in seal hunting, and noted that one man taught his daughter to hunt seals. One Innu informant stated that when men were not around women killed caribou during a river crossing with spears (a knife on the end of a stick) or guns (Byrne and Fouillard 2000:36). A more recent Innu example indicates that while men hunted caribou, women trapped partridges, porcupines, and rabbits, taking their children along when they went hunting (Byrne and Fouillard 2000:56).

One of the most notable examples of women's hunting is the Agta of the Philippines. Women hunt alone, with children, with other women, and in mixed groups. In some cases women hunt with bows and arrows and target the same prey as men. In this region, game can be killed and returned home in less than an hour (Goodman et al. 1985:1203-1204).

Goodman (1985:1204) cited relatively short hunting forays (less than a day) as a contributing factor in women's hunting. Hunting in the Agta case might be profitable for women, because

success is high and it does not greatly interfere with other duties. In all, 22 percent of meat by weight was obtained by women and 35 percent by mixed groups (Goodman et al. 1985:1205). At the same time, men did not provide much childcare, which was provided mainly by mothers, grandmothers and siblings. This suggests that when hunting success is relatively high, costs are low, and hunting does not compete greatly with childcare, hunting becomes profitable for women—even those with children. Gurven and Hill (2009) cite several other factors that most likely make hunting by Agta women profitable:

1) The wild carbohydrate resources provided low returns, 2) Meat was often traded for carbohydrates, 3) Agta fertility was low, leading to high availability of childcare helpers; 4) Active women hunters were sterile or post-reproductive; 5) Women used dogs for hunting; 6) Women's hunting always took place less than 5 km from camp.

In the preceding examples of women's hunting, while it is not clear what weapons these women used in all cases, how successful they were in the hunt, how often women's hunting occurred, or how they learned their hunting skills, these cases do imply that women are capable of hunting, and in some cases, faced no obvious social restrictions. At the same time, childcare and marital status do not appear to be irrelevant to women's hunting of larger game. Chipewyan women with children, for example, traveled shorter distances than those with fewer childcare responsibilities. Ojibwa women often returned to more traditional women's activities after re-marriage. The Alaskan examples of women's hunting also suggest that childcare status plays a role in the decisions that women make about hunting. Also, Agta women who are the most productive hunters are also post-reproductive. In addition, other factors such as need, plant productivity, and ease of capture also appear to play a role in whether women hunt larger-bodied animals.

Significantly, when women do hunt, their weaponry tends to differ from men's. One of the most interesting differences between men's and women's hunting are the tools they use in the course of these activities. In many instances when women hunt, they use implements that men do not, such as sticks, ropes, clubs, and often dogs to track game (Berndt and Berndt 1964:104-105; Brightman 1996:705; Brumbach and Jarvenpa 1997; Estioko-Griffin and Griffin 1981; Goodale 1971:167). Sometimes women will use implements that were designed for other purposes, such as digging sticks (Brightman 1996:705). Ainu women, for example, often hunt deer with sticks, dogs, and rope (Watanabe 1968). Using only a rope and an axe, Mescalero Apache women were reported to have killed bison (Flannery 1932:29). Women of the eastern Western desert of Australia use digging sticks rather than spears, which were used by men, to hunt small game (Hamilton 1980:7). Tiwi women of Australia targeted small game and sometimes kangaroos using hunting dogs, which were trained by women (Rohrlich-Leavitt et al. 1975:114-115). Goodale (1971) makes a report of a woman's dog catching a wallaby. Though the kill was attributed to the woman, a man actually dealt the final blow. Romanoff (1983:341) wrote that Matsigenka women of the Peruvian Amazon use dogs in hunting, but do not use shotguns or bows. Traps are also often used by women to procure animals. Silberbauer (1972:292) wrote that G/wi adolescents of both sexes will set traps for small animals and birds. Shostak (1981:91, 95, 225) also described women and children setting traps for birds among the Zhun/twasi (!Kung) in Botswana. The preceding examples indicate that men and women's hunting practices tend to be very different in terms of the types of animals targeted and the types of weapons used. Women in these examples do not use the weaponry of men, but rather use tools that are designed for other purposes, such as the digging stick.

Men also perform activities typically conducted by women, especially in times of necessity. Native Arctic men, for example, would sew on occasion or women hunt on occasion (Cassell 2005:107; Giffen 1930:33; Jenness 1957:51, 56, 140, 176-177). Among the Copper Inuit (Kitlinermiut), Jenness reported that men will occasionally cook meat, usually a women's task, if she is busy scraping skins. And sometimes, men will sew help scrape hides when producing skins for winter clothing is critical (Jenness 1922:88, 139). Emmons (1911:4) commented that while sexual division of labor is clearly defined among the Tahltan (Nahanni), men and women will help one another in times of need. Flannery (1935:83) reported that among the Eastern Cree of the James Bay region of Canada, men participated in tasks that are usually accomplished by women, including child care, however, there was a general attitude among the men that women's activities and concerns were trivial. Among the Namaqua Khoekhoen of southern Africa, both men and women own awls and needles, but women were more often responsible for sewing hide products (Webley 2005:162-163). Opler (1965(1941):380) wrote of the Chiricahua Apache, "sewing is essentially the concern of the woman, though men on the raid will do repair work". Draper (1975) wrote, "When asked, !Kung will state that there is men's work and women's work, and that they conceive of most individual jobs as sex-typed, at least in principle. In practice, adults of both sexes seem surprisingly willing to do the work of the opposite sex. It often appeared to me that men, more than women, were willing to cross sex lines." G/wi men often gather plants foods when hunting is poor and gathering is difficult (Silberbauer 1972:288, 304). Man's description of sexual division of labor among the Andaman Islanders reveals an overlap in duties at least to some extent:

The duties of the husband...consist chiefly in hunting, fishing, turtling, collecting honey...constructing canoes, building the better kinds of huts, and manufacturing the bows, arrows, and other implements needed in his various pursuits; he must also assist his wife in looking after the children, in keeping up the fire, and in providing the materials required in making their various weapons, utensils, &c.(sic); but though he has no hesitation in sharing and lightening his wife's labours up to this point, it is only in cases of stern necessity that he will condescend to procure either wood or water for the family requirements; the supply of these essentials of daily life being considered as peculiarly feminine duties and derogatory to the lords of creation [Man 1883:327].

In the case of preparing hides, Pawnee men and women could prepare hides, but tended to prepare skins from different animals, depending on the skill involved in the hide preparation (Schneider 1983:105-105). This clearly suggests that one sex was more skilled in the task than the other, though both knew the general steps involved.

The preceding examples make it clear that men can also perform women's duties in some cases, though again, it is unclear how adept they are at the more skill-intensive such as hide-working and sewing. These examples suggest that while general activities and tools may exist, there is not strict or idealized division of activities and tools in practice. What appears to be far less common is men and women being equally trained in all skill-intensive activities.

Summary

Gendering of complex stone tool manufacture is likely in part a function of the long period of learning associated with this activity, such that learning the craft precludes mastery of other complex activities, like hide processing and sewing. The need for very high skill levels in hunting and hide-working, increases with reliance on hunting and in climates where hides are critical for shelter, clothing and tools. Since a single individual cannot become proficient at all complex tasks in these contexts, and traditional societies tend to instruct

children according to gender differences, complex tasks and their associated tools are expected to be highly gendered. In contrast, less complex activities that do not require long periods of education for mastery, are more likely to be conducted by men and women and are not associated with gendered tools, especially when those activities are not vital to survival. Folsom points and ultrathin bifaces, I argue, were likely produced by men in addition to skill-intensive aspects of hunting large game, especially bison. As such, Folsom points, preforms, and channels flakes are expected to be associated with men's activities. Folsom women were likely responsible for other complex activities that involve long period of skill acquisition, including hide-working.

In addition, these complex tasks are expected to be associated with specialized automatic motor skills, or "kinetic melodies" (Luria 1966). These "kinetic melodies" make it difficult for the untrained to perform a complex task with precision, dexterity, and rapidity. I argue that as a result of segregated training in skill sets and the development of kinetic melodies, complex activities and their associated toolkits become highly gendered. This is not to say that toolkits are used exclusively by males or females in a strict sense, and that no borrowing occurs or cross-education occurs.

While long learning trajectories for complex tasks and the development of different suites of motor skills help explain gendered toolkits, social factors could also have played a role. Proscriptions against women touching hunting weapons and men's control of the allocation of stone tools and raw materials suggest that Paleoindian distribution of tools and raw materials could have been unequal. Because men could have received social benefits from hunting or trading high-quality material, blanks, or points, men might have socially excluded women from the better toolstone. Elaboration of hunting toolkits might also have

served as a kind of social barrier preventing the uninitiated from entering the domain of hunting large game, and potentially threatening access to social benefits received from big-game hunting.

In the following chapters, I investigate how observations on women's tool use in Chapters 2, 3 and 4 can be applied to the archaeological record. In Chapter 5, I outline the cultural context of the Folsom time period. Chapter 6 presents a review of approaches to endscrapers in the archaeological record. In Chapter 7, I look at the various stages and techniques of hide-working, and consider how these might affect the material residues of the archaeological record. In particular, I consider how stage of hide-working, number of hides worked, and seasonality could affect the spatial distribution of hide-working endscrapers on archaeological sites. Chapters 8 and 9 investigate how gendered toolkits might be recognized at the Rio Rancho Folsom site in New Mexico.

CHAPTER 5

Cultural and Environmental Context

I remember rather vividly when, as a little girl of about five, I sat beside my aaka, my grandmother, and watched her sew a pair of winter mukluks (boots). She had spent many hours preparing the caribou leg skins, first drying them and then scraping them with her ikuun, her skin scraper.

—Jana Harcharek (2005:28)

This chapter provides an overview of the environment and cultural background for the Paleoindian period, focusing mainly on the Folsom complex. General archaeological perspectives concerning Paleoindian dating, environment, technology, subsistence, mobility, raw material procurement and seasonal use of sites are discussed. A more comprehensive discussion of endscraper technological organization and endscraper studies is also provided in Chapter 6.

Discovery of the Paleoindian Record

The Paleoindian period (ca. 11,200-8,000 ¹⁴C yrs. B.P.) represents the early settlement of the New World at the close of the Pleistocene and onset of the Holocene. Pleistocene occupation of the New World was first confirmed in 1927 at the Folsom site (29CX1, LA 8121) in northeastern New Mexico with the association of extinct bison (*Bison antiquus*) bones and the Folsom projectile point, named after the small town near the site (Cook 1928; Figgins 1927; Roberts 1935:5). Soon after this discovery, evidence of the earlier Clovis complex came to light with the investigations at the Dent site in Colorado (Figgins 1933) and Blackwater Draw in easternmost New Mexico (Cotter 1937, 1938; Figgins 1931; Howard 1935a, b; Ray and Bryan 1938; Sellards 1938, 1952). Though Clovis is accepted by some Paleoindian scholars as the earliest occupation of North America, claims of pre-Clovis

finds in both North and South America have called into question the timing and nature of the colonization of the New World (e.g., Adovasio 1993; Adovasio et al. 1978; Adovasio and Page 2002; Dillehay 1997; Gilbert et al. 2008; Goebel 2008; Goldberg and Arpin 1999; Goodyear and Steffy 2003; McAvoy and McAvoy 1999; Meltzer et al. 1997; Overstreet et al. 1995; Overstreet and Stafford 1997; Reeves et al. 1986; Roosevelt et al. 1996; Wagner and McAvoy 2004; Waters et al. 2011). Research continues to refine the understanding of the timing and nature of the peopling of the Americas.

Paleoindian Chronology

The Paleoindian period is divided into smaller cultural units based largely on projectile point styles and manufacturing technology (Figure 5.1). Reliance on projectile point types as temporal markers can be inaccurate in that type definitions are not always distinct (Holliday 1997:175). Reviewing reliable radiocarbon dates, Holliday (2000a) compiled a summary of the Paleoindian chronology for the Northern and Southern Plains (Table 5.1). In many cases, radiocarbon ages for Paleoindian technological complexes overlap in time (Eighmy and LaBelle 1996:Figure 3; Sellet 2001). In addition, calibration of the radiocarbon time scale using ^{230}Th in marine corals and dendrochronology of European oaks reveal a discrepancy between radiocarbon dates and calendar dates, which widens beginning around 1 A.D. (Edwards et al. 1993; Eighmy and LaBelle 1996). The radiocarbon ages for 11,000 ^{14}C yr. B.P., for example, represent about 13,000 calendar years B.P., making Clovis radiocarbon ages about 2,000 years too young (Edwards et al 1993; Eighmy and LaBelle 1996:966). In addition, atmospheric $\delta^{14}\text{C}$ increased abruptly at the onset of the Younger Dryas period (discussed below) and decreased abruptly with its termination, resulting in a plateau in the radiocarbon calibration curve (Goslar et al. 1995; Kitagawa and

Plicht 1998). Because of this discrepancy and possible future changes to the calibration, radiocarbon ages are presented in ^{14}C years B.P.

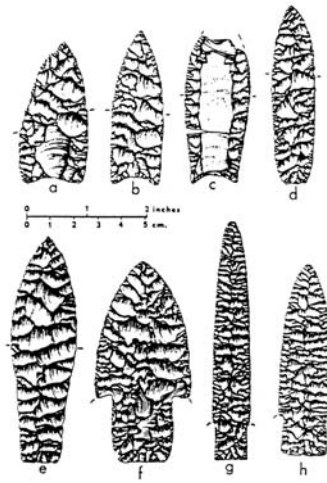


Figure 5.1. Paleoindian weaponry diagnostics. (a) Clovis. (b) Goshen. (c) Folsom. (d) Agate Basin. (e) Hell Gap. (f) Alberta. (g) Eden. (h) Scottsbluff. (Frison 1998 <http://www.pnas.org/cgi/content/full/95/24/14576>)

Table 5.1. Paleoindian Chronology on the Northern and Southern Plains (Holliday 2000a).

Region	Period	Date ^{14}C yrs. B.P.	Diagnostic Artifacts
Northern Great Plains	Clovis	11,200-10,900	Clovis point, channel flake
Northern Great Plains	Goshen	ca. 11,000	Goshen point
Northern Great Plains	Folsom	10,900-10,200	Folsom point, channel flake
Northern Great Plains	Agate Basin	10,500-10,000	Agate Basin point
Northern Great Plains	Hell Gap	10,500-9,500	Hell Gap point
Northern Great Plains	Alberta, Alberta-Cody	10,200-9,400	Alberta and Alberta/Cody I and II
Northern Great Plains	Cody	9,400-8800	Scottsbluff I and II points, Eden points
Northern Great Plains	Angostura, Jimmy Allen, Frederick, and other parallel oblique types	9400-7800	Angostura, Jimmy Allen, Frederick, and other parallel oblique point types
Southern Great Plains	Clovis	11,600-11,000	Clovis point, channel flake
Southern Great Plains	Folsom and Midland	10,900-10,100	Folsom point, channel flake
Southern Great Plains	Plainview, Milnesand, and Lubbock	10,200-9,800	Plainview, Milnesand, and Lubbock points
Southern Great Plains	Firstview	9,400-8,200	Firstview, San Jon points
Southern Great Plains	St. Mary's Hall, Golondrina, Texas Angostura	9,200-8,000	St. Mary's Hall, Golondrina, Texas Angostura points

Environment

In general, the Late Glacial was characterized by increasing solar radiation, climate warming, retreating ice sheets and sea level rising (Meltzer and Holliday 2010). No modern analogue exists for the late Pleistocene environment of North America, which featured high plant and animal species diversity and large-bodied mammals (Guthrie 1984). Guthrie (1984) described the plant and animal community of the late Pleistocene Plains as a “patchy mosaic.” The eastern Great Plains were marked by spruce forest or open spruce woodland during the late Pleistocene, while the western Plains are thought to have been grassland or *Artemesia* steppe (Markgraf and Lennon 1986), with large bodied grazing animals such as mammoth, bison, camel and horse, predominating (Anderson 1974; Walker and Frison 1980). During the late Pleistocene, temperatures were lower and seasonal differences were less pronounced than in modern times (Guthrie 1984; Harris 1985; Walker 1982). In the western United States, treelines were hundreds of meters lower than present, indicating cooler temperatures (Betancourt and Davis 1984; Delcourt and Delcourt 1981; Reasoner and Jodry 2000). During the Folsom period, which is associated with the Younger Dryas reversal (see discussion below), annual temperatures were lower, summers were cooler, and seasonal extremes were not as great (Harris 1985:120; Hill 2007:16; Walker 1982:305). Data from Agate Basin suggest that winters might have been two to three times as cold (Hill 2007:16). Conditions became progressively warmer and drier during the later Paleoindian period. In the Southwest, treelines moved upslope and climate became progressively drier (Van Devender and Spaulding 1979). Archaeofaunal evidence in later Paleoindian times in the western United States suggests an increase in mean temperatures as well as increased seasonality (Harris 1985:210; Hill 2007:258-259). With changes in seasonality, segregated latitudinal

and elevation zones of vegetative communities appeared, as well as an increase in vegetative homogeneity (Guthrie 1984).

A major climatic event during the Paleoindian period was a cold reversal called the Younger Dryas, which lasted approximately one millennium (ca. 13,000 to 11,600 cal. B.P.; $10,900 \pm 50$ ^{14}C yrs. B.P. to 9800 ± 50 ^{14}C yr. B.P.). During this period, montane glaciers readvanced and melting Pleistocene ice sheets either ceased melting or readvanced (Bond et al 1993). This climatic episode was first recognized in northern European pollen cores, and later discovered in some North American pollen profiles (e.g., Broecker et al 1988; Reasoner and Jodry 2000). The Younger Dryas climatic event was global in scale, but not necessarily synchronous. The onset and termination of the Younger Dryas oscillation is thought to have been rapid, possibly over the course of only a few decades (Taylor et al. 1997). Evidence for the climatic reversal is registered in isotopic evidence from Greenland and Antarctic ice cores (Alley et al. 1993; Dansgaard et al. 1993; Stuiver et al. 1995:350; Taylor et al. 1997), lake varves (Strömberg 1994), tropical fossil corals (Edwards et al 1993) and pollen studies (Reasoner and Jodry 2000:52). Greenland ice cores indicate a mean annual temperature of 15 degrees Celsius cooler than present, but the lowered temperature likely occurred during the winter (Denton et al 2005:1161, 1168). During the Younger Dryas, large icebergs discharged from the continental ice sheets, causing an increasingly cool, but decreasingly saline North Atlantic. This had the effect of offsetting the thermohaline circulation of the Atlantic, thereby reducing temperatures in Europe by 4 to 5° C (Goslar et al 1995; Wright 1977). The effects are thought to have been most profound in regions adjacent to the North Atlantic (Broecker 1994; Steig et al. 1998; Thompson et al. 1998).

Several ideas about the Younger Dryas conditions in North America and the immediately preceding time period have been discussed. The microfauna record of the Northern Plains suggests that temperatures during the Younger Dryas were cooler than today (Roberts 1970; Walker 1982), yet there is conflicting evidence on whether this region was moister or drier during the Younger Dryas (see Surovell 2003:51 for summary). Drawing from stratigraphic evidence and stable carbon isotopes from organic matter in dated horizons from the Southern High Plains region, Holliday (2000b) argued that relatively wet conditions existed on the Southern High Plains during Clovis times, with increasing dryness, wind erosion and eolian deposition occurring during Folsom times (Younger Dryas) that continued into the later Paleoindian periods. Plant communities shifted from predominantly cold season plants to predominantly warm season plants beginning in the Clovis period and continuing until approximately 9000 ^{14}C yrs. B.P. Holliday (2000b:1) suggested that the Folsom period might have been “the warmest of Paleoindian times,” having a strong incidence of warm season grasses and the onset of widespread regional drying and wind erosion. Meltzer and Holliday (2010:14) claimed that interior mid-latitude North America was warm and relatively temperate during the Younger Dryas.

In contrast, Haynes (1984, 1991, 1993) discussed the presence of widely distributed, highly organic black layers that date to the Younger Dryas oscillation (10,900 +/- 50 ^{14}C yrs. B.P. to 9800 +/- 50 ^{14}C yrs. B.P) immediately post-dating the Clovis period (Haynes 2008). The black mats and organically rich gleyed soils at other sites, Haynes argued, are indicative of increased moisture and/or colder temperatures during the Younger Dryas resulting in decreased evapotranspiration. Interestingly, Rancholabrean megafauna underlie these black mats, but only bison overlie the black mat sediments, suggesting catastrophic extinction for

at least some species of megafauna (Haynes 2008:6522). A peak in these black mats and other organically rich gleyed sediments suggests a cooler, moister climate during the Folsom period (Haynes 1991:441, Figure 6; 1993). Other lines of evidence supporting a moister regime during the Younger Dryas include lake levels in the Estancia Basin, ostracodes from Antelope Playa in Wyoming, gastropods and microvertebrate fauna, and pollen and phytolith records (summarized in Surovell 2003:53).

Additional evidence for increased moisture during the Folsom period comes from prehistoric settlement analysis. In the Middle Rio Grande Valley, where the Rio Rancho site is located, Folsom sites are often associated with lake playas. Later Paleoindian complexes in this region, including the Cody complex, are associated with more permanent water sources such as perennial drainages and springs (Dawson and Judge 1969; Judge and Dawson 1972). This pattern suggests that playa basins became more reliable sources of water during Folsom times, and less reliable during later Paleoindian times. Recent geoarchaeological investigations (C/N ratios and stable C isotopes) at a playa near the Boca Negra Wash Folsom site in the Middle Rio Grande Valley indicate that the playa was wetter and the environment cooler during the Folsom occupation than during subsequent time periods (Holliday et al. 2006:797). Similarly, Jodry (1999a:53) pointed out that Folsom sites in the Upper Rio Grande Valley also tend to occur around particular playa basins. These playa basins were not consistently used by earlier or later Paleoindian groups, and may have dried up following the Younger Dryas interval (Jodry et al. 1989). As in the Middle Rio Grande Valley, Paleoindian sites dating to periods other than Folsom in the Upper Rio Grande Valley are found together at more permanent sources of water (Jodry 1999a:53). Recently, Meltzer and Holliday (2010) argued that Younger Dryas conditions in the Rocky Mountains and

Great Plains regions were not extreme and did not present overwhelming adaptive challenges for Paleoindians.

Ballenger et al. (2011) reviewed data in the American Southwest and concluded that while several lines of evidence point to paleoenvironmental change during the Younger Dryas, the evidence is often contradictory. Speloethem, pollen, and alluvial chronologies, they argue, point to a shift from warmer/drier to cooler/wetter conditions during the Younger Dryas or increased winter precipitation. Yet, some lines of evidence, such as packrat middens and lake levels do not support cooler/wetter Younger Dryas conditions.

Evidence at post-Folsom sites indicates a shift toward warmer, drier climates, with increasing seasonality. At Blackwater Draw, New Mexico, pond salinity increased following the Folsom period, indicating greater evaporation and lower lake levels during the Agate Basin occupation (Haynes 1995). During Hell Gap times (ca. 10,000–9000 ^{14}C yr. B.P), it has been estimated that January and July temperatures were on the average 2.8 and 7° C cooler, respectively, than modern temperatures, based on faunal evidence at the Hell Gap site (Hill 2007:14-15; Walker 1987:360). By 9,000 ^{14}C yr. B.P, pollen and precipitation lapse records from the west slope of the Rocky Mountains show mean annual temperatures were 1.6°C warmer than today (Jodry 1999a:32). Seasonality is thought have increased following the Folsom period as well. Frost-free days at the Hell Gap site are thought to have decreased from 90 during Folsom times to 50 during Hell Gap times (Walker 1987:360).

Mobility, Hunting Strategies, and Technology

Paleoindians traditionally have been characterized as highly specialized big-game hunters, especially during the Folsom period. Mammoth and other large-bodied animals make up the majority of faunal remains in North American Clovis sites (Waguespack and

Surovell 2003), while bison appear to have been the principal prey at post-Clovis kill sites (Amick 1994a; Bamforth 1991a:358; Frison 2004:67). In many cases, such as the Folsom site in New Mexico, projectile points have been found in direct association with bison, indicating deliberate hunting, as opposed to scavenging (Frison and Zeimens 1980:233). In western and central North America, a multitude of large animal species occupied grassland and parkland regions at the end of the Pleistocene. With the extinction of most Pleistocene megafauna, bison numbers might have rapidly increased (Guthrie 1984), while their distribution may have been greatly reduced. Critiques of the general view of Paleoindian subsistence as heavily reliant on large game, suggest that too great an emphasis on large kill sites may have inflated the importance of large game in the Paleoindian diet (Meltzer 1993). It is speculated that smaller game, as well as plants, might also have contributed to the diet, at the very least intermittently (Clausen et al. 1979; Johnson 1977; Kornfeld 1988; McNett et al. 1977; Meltzer 1988, 1993; Olsen 1990; Wheat 1979:30, Table 7; Wilmsen and Roberts 1978). Also, human predation of large-bodied animals may not have been a consistent pattern in South America (Borrero 2007). Nevertheless, Plains Folsom kill sites appear to be dominated by bison remains, with very few kill sites lacking bison remains (MacDonald 1998), supporting a heavy reliance on bison during this time period.

Paleoindian mobility and related hunting strategies have received a great deal of scholarly attention. Paleoindians, especially Clovis and Folsom, have been depicted as residential and logistically mobile foragers in constant search of large migratory game, supported by a portable and flexible stone technologies (Goodyear 1989; Kelly and Todd 1988:237). Kelly and Todd (1988) proposed that Clovis and Folsom were technologically oriented in contrast to place-oriented, resulting in little redundancy in settlement. Kelly and

Todd (1988:236–237) point out that most early Paleoindian sites do not have decades-long occupations, indicating short-term use and subsequent shifting of range. Hofman (1999b) uses the term “unbounded hunters” to refer to this lack of restriction in mobility in Folsom contexts. High-quality toolstone, bifacial technology, long-use life tools and long-distance transport are thought to have complemented high mobility (Kelly and Todd 1988:237).

It has been pointed out that there is greater variation in the procurement, transport and manipulation of toolstone than the Kelly and Todd model would suggest (Bamforth 2002; LeTourneau 2000; Meltzer 1984). In contrast to Kelly and Todd, Frison (1983:124) and Hill (2007:263) argued that post-Clovis Paleoindians were place-oriented, based on sites that were visited repeatedly over long periods of time, such as Agate Basin, Carter/Kerr-McGee, Hell Gap, Lindenmeier and Jim Pitts. Surovell (2003:147-148) also argued that some Folsom sites like Barger Gulch Locality B, Bobtail Wolf and Hanson, represent long-term occupations and suggests that longer-term sites might have been occupied during cold seasons (Surovell 2003:149). The Rio Rancho Folsom site in New Mexico may represent several different occupations in addition to post-Folsom occupations. In addition, the focus on high-quality toolstone along with portable and flexible technologies may not be incompatible with reoccupation of sites.

The Folsom Complex

Based on a number of radiocarbon-dated sites, Folsom material culture dates between approximately 10,950 and 10,250 ¹⁴C yr. B.P. in the northern and southern Great Plains (Haynes et al 1992:96; Holliday 2000a:Table IIIB). More than one hundred radiocarbon dates from Folsom contexts exist, though they vary widely due to contamination and association problems (Surovell 2003:59). Eliminating outliers and questionable dates,

Surovell (2003:60, Figure 2.5) calculated an average date range for Folsom that is similar to Haynes et al.'s (1992) estimate. Eighmy and LaBelle (1996:Table 2) cite the calibrated, pooled dates for well-dated Folsom sites as 13,340 to 10,720 cal B.P. (2 σ) and 12,910 to 11,450 cal B.P. (1 σ). Taylor et al. presented similar results (1996:Figure 6b).

Geographically, the range of Folsom material culture extends from Alberta and Saskatchewan to Chihuahua, Mexico, and from just east of the Rocky Mountains to Iowa. Isolated Folsom points occur as far east as Illinois and northwestern Indiana in the Upper Mississippi river drainage basin (Gryba 1985:31; Hofman and Graham 1998:92; Morrow 1999; Munson 1990; Wormington 1957:29; Wormington and Forbis 1965:184). Though Folsom material has been discovered in the Mexican states of Tamaulipas, Chihuahua and Nuevo Leon, Folsom points are apparently not common south of the Rio Grande (Sanchez 2001). In all, the area associated with the Folsom complex is approximately 2,000 miles long northwest to southeast and 800 miles wide east to west (Stanford 1999:298), and encompasses a number of environments including the Columbia Plateaus, northern and southern Rocky Mountains, Wyoming Basin, Colorado Plateaus, Basin and Range, Great Plains, Gulf Coastal Plain and Central Lowland (LeTourneau 2000:18). Folsom material is known from elevations ranging from sea level to more than 10,000 feet, such as the Black Mountain site in the southern Rocky Mountains of Colorado (Jodry et al. 1996). While the range of *Bison antiquus* exceeded the range of Folsom fluted points (McDonald 1981: Figure 20), Munson (1990:266-267) suggested the distribution of Folsom points in general corresponds well with the species, pointing to a heavy reliance on bison by Folsom hunters.

Folsom settlement has been studied both at the site and regional scales, yet site-level analysis is more common (Amick 2000:119), particularly in the Southwest. Kill sites have

been the most thoroughly documented, yet most Folsom sites are not kill sites, but rather isolated finds, quarry locales and lithic scatters, which likely represent short-term campsites (Amick 1994b; Blackmar 2001; Frison et al 1996; Hofman 1999a; Meltzer 2006). In several cases, kill sites are associated with camps and armament sites, such as at Blackwater Draw, Shifting Sands (Amick 2000:128; Hofman et al 1990), Waugh (Hill and Hofman 1997), Stewart's Cattle Guard (Jodry 1992, 1999a; 1999b:80; Jodry and Stanford 1992), Lindenmeier (Wilmsen and Roberts 1978) and the Agate Basin site Folsom component (Frison and Stanford 1982; Hofman 1996: 62; Hofman 1999b:394; Stanford 1999:302). This association suggests that once a successful kill was made, groups would move to the kill site (Kelly and Todd 1988:236, 238), and an associated camp would be established to cook and process meat, refurbish tool kits, and to process other animal products. The absence of associated kill and campsites might be a product of lack of exposure, sampling bias or preservation (Amick 2000:128-129). Campsites and their associated tools have received somewhat less attention than kill sites, but were likely the locus of a range of different maintenance activities such as wood-working, hide dressing, sewing, cooking and other activities.

Folsom Flaked-Stone Technology. From a technological standpoint, the hallmark of the Folsom period is the fluted Folsom point (Figure 5.2). The Folsom point is a thin, relatively short lanceolate projectile, characterized by fluting on both faces, ground basal lateral margins, parallel to slightly expanding sides, a concave base with distinct "ears," and fine pressure flaking along the lateral margins (Hester 1972:124; Wormington 1957:16). Fluting involved removal of channel flakes extending from the basal margin and to the tip of the point. There is considerable variation in Folsom point size, outline morphology and reduction

techniques (Hofman 1992; Judge 1973). Some Folsom points were made from thin flake blanks and were not bifacially worked (Wilmsen and Roberts 1978: Figure 110), while others were made from bifacial cores. In some cases, Folsom points were “pseudo-fluted,” maintaining the interior flake surface of the original flake blank (Frison and Stanford 1982; Wilmsen and Roberts 1978). Sometimes flutes occur on only one face of the projectile point (Hester 1962; 1972:124; Ingbar 1992; Rovner and Agogino 1967; Wendorf and Kreiger 1959:67; Wilmsen and Roberts 1978:111–113; Wormington 1957:41). Some researchers consider the unfluted Midland point to be morphologically similar and contemporaneous with Folsom points (Amick 1995; Hofman et al 1990; Judge 1970:44; LeTourneau 2000:16; Rovner and Agogino 1967; Sellet 2001:52-53; Stanford 1999:305; Wendorf et al. 1955). Folsom and Midland points may occur in association, have some flaking techniques in common and have similar flake tool assemblages (Amick et al 1989; Hofman 1992:211; Meltzer et al. 2006:15-16; Wendorf and Kreiger 1959; Wyckoff 1999b:343). Others have suggested that Midland points might simply have been made on flakes too thin to flute successfully (Amick 1995; Ingbar and Hofman 1999:106; Rovner and Agogino 1967-134; Wormington 1957:42).

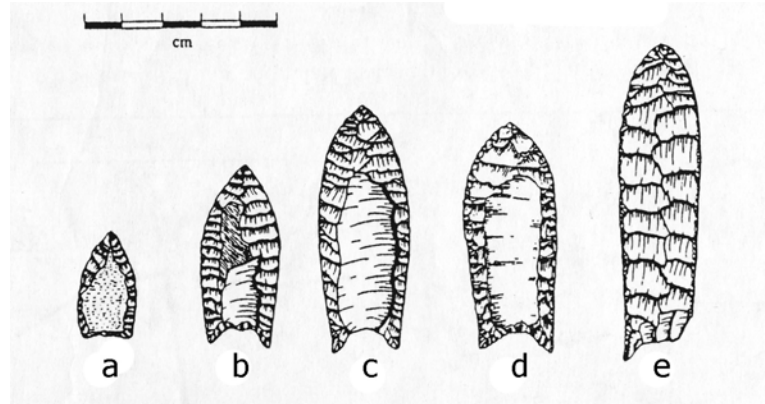


Figure 5.2. Folsom and Midland Points. (a) pseudo-fluted Folsom point; (b-d) Folsom points from Colorado, Nebraska, and Texas; (e) Midland point from Nebraska (Hofman and Graham 1998:Figure 4.4)

Folsom points were probably used on the ends of thrusting or throwing spears or atlatl darts, though the exact nature of the composite weaponry is unknown (Frison and Zeimens 1980). Like the Midland point, the Goshen point also overlaps in time with Folsom (Frison 1996; Surovell 2003:63, Figure 2.6). Goshen, however, has a smaller distribution than Folsom, being confined to the Northern Plains and Rocky Mountains. The dating of this technology remains unclear (Surovell 2003:57-64, Figure 2.4).

Folsom technological organization has often been characterized as a response to high mobility and the need to economize toolstone use. Features of Folsom technological organization as a response to mobility needs and toolstone conservation include: (1) tool resharpening, (2) portable/bifacial core technology, (3) multipurpose tools and tool recycling, (4) staging of projectile point manufacture, (5) alternative techniques of point production and (6) high-quality lithic sources (Amick 2000:136; Surovell 2003:79).

Ellis and Payne remarked that “the fluting of Paleo-Indian points, and particularly those of the western Folsom type, has received more attention than any other single lithic manufacturing technique in the New World” (1995:459). Other components of the Folsom

techno-complex include point preforms, endscrapers, sidescrapers, graters, spokeshaves, burins, piercing tools, bifacial tools, ultrathin bifaces, bifacial cores, discoidal cores, informal cores, abrading tools, choppers, wedges and other flake tools (Boldurian and Hubinsky 1994; Frison and Bradley 1980; Frison and Zeimens 1980; Jodry 1998, 1999a; Root et al. 1999; Stanford 1999:300; Surovell 2003:75). Endscrapers are particularly prevalent on Folsom sites and other Paleoindian sites (Figure 5.3). Bone implements include eyed bone needles, beads, incised bone and bone discs, a single possible serrated bone flesher, one possible antler flaking tool and possible bone projectile points (Bamforth 1991b:363; Blaine and Wendorf 1972; Bruhns and Stothert 1999:40; Dawson and Stanford 1975:15, Figures 1 and 2; Dixon 1999:136; Frison 1982a:161–171; Frison and Bradley 1980:103, Figure 69; Frison and Zeimens 1980; Hofman 1996; Stanford 1999:300; Wilmsen and Roberts 1978:126; Young et al 1987).

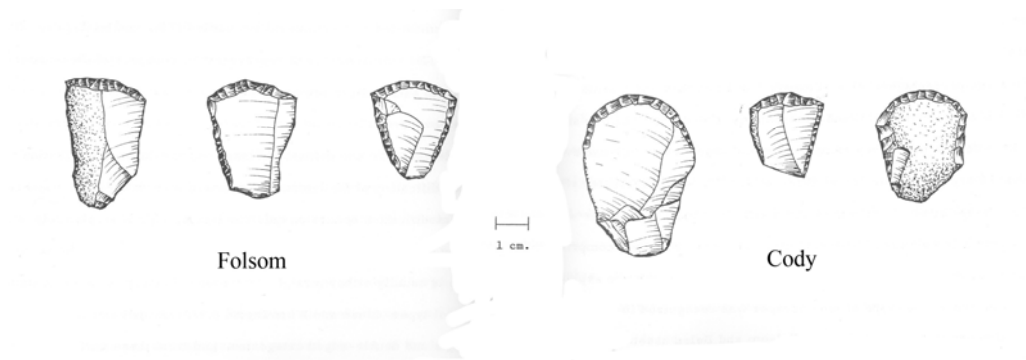


Figure 5.3. Examples of Folsom and Cody endscrapers from the Central Rio Grande Valley (after Judge 1973: Figures 11–12).

Folsom Mobility. Researchers have pointed out that the term mobility can refer to different aspects of movement across the landscape including distance moved, the direction of movement and the frequency of movement (Binford 1980; Shott 1986; Surovell 2003:111). Other aspects of mobility include individual versus group movement as well as daily, seasonal and annual cycles of movement (Kelly 1992:44). Because individual movement

might differ from group movement, Surovell (2003:121, Table 3.1) points out that the occupation span of a site (total time occupied) could differ from occupation intensity (the sum of all time spent at a site for all inhabitants) and the per capita occupation (the average length of stay per site occupant). For example, if half the population of a site leaves, the occupation span remains unchanged, but the occupation intensity and per capita occupation decrease.

Amick (2000:132) suggested that Folsom were some of the most mobile pedestrian hunter-gatherers ever known. Long-distance transport of toolstone during Folsom times is well documented, and it is not uncommon for the source of archaeological toolstone to have originated 100 to 500 km away from the location of discard (Amick 1994a:365-371; Amick 2000:131; Hester and Grady 1977; Hofman 1991; Hofman 1992:197; Hofman 1999b; Hofman et al 1991:302; Huckell and Kilby 2002; Jodry 1999a:93, Table 10; LeTourneau 2000:Appendix A; Root 2000:355; Surovell and Waguespack 2007:224). Folsom mobility and raw material conservation are often argued to have been an adaptation to bison procurement, whose movements were unpredictable and potentially incongruent with raw material sources. This is consistent with Kelly and Todd's (1988) model of highly mobile Paleoindian groups in constant pursuit of game, and moving from kill site to kill site. However, in addition to more exotic material, use of local stone has also been well documented. Both Bamforth (1985) and Amick (1999) observe variation in the use of raw material with different Folsom tools, suggesting that a number of procurement strategies were employed. Long-distance transport of raw material is more common on the Southern Plains than on the Northern Plains (MacDonald 1999:142; Surovell 2003:73). Using data from the Hanson site in Wyoming, Ingbar (1994) accounts for this pattern in that groups

encountered raw material sources more often in the Northern Plains than in the Southern Plains. MacDonald (1999) suggested that on the Northern Plains, the existence of exotic materials among more abundant local materials can be explained by individual forays to obtain mates and solidify social networks.

Others have pointed to exchange as a possible method of Paleoindian toolstone distribution, questioning the assumption of direct procurement (Ellis 1989; Hayden 1982; Hester and Grady 1977:92; LeTourneau 2000; MacDonald 1999; Meltzer 1989; Tankersley 1989:270-71). It is possible that closer secondary raw material sources are often not recognized in lithic assemblages and long-distance procurement of toolstone is sometimes assumed rather than demonstrated (Meltzer 1984; Meltzer et al. 2002:27; Shelley 1984). Low population density coupled with high mobility during Folsom times might suggest that large trade networks of raw material were unlikely (Amick 2000:132).

Some researchers have proposed models of Paleoindian movement based on raw material frequencies, incidences of recycling, core technology, and other features. Amick (1996; 2000:134) argued that Folsom movements between the Southern Plains and Basin and Range region were based on seasonality, with Folsom groups wintering in the Basin and Range region of New Mexico, using a residential strategy. He argued that traits typically associated with high mobility, such as recycling, portable core technology, multi-purpose tools and high-quality raw material are less common in the Basin and Range region of New Mexico (Amick 2000:136). In contrast, the resource structure and environment of the Southern Plains is more conducive to logistical land use during the summer months. Hofman finds a consistent pattern of movement of Edwards chert and Alibates silicified dolomite from central Texas and the panhandle, respectively, to the north and northwest and east.

Hofman (1999b:405-406) argued that Folsom groups took advantage of the Dissected Plains to overwinter, reducing residential mobility during times of most severe cold. In this model, residential mobility responded to changing seasons, but was sensitive to fluctuations in bison and climate.

Folsom Subsistence. Bison remains have been discovered at virtually every known Folsom kill site (Amick 1994a:184, 194-215; Johnson 1977:71; Judge 1973:36; MacDonald 1998).

Bison antiquus, with an estimated weight of 500 to 1,000 kg, was the largest game animal living during the late Pleistocene following the megafaunal extinction (Amick 2000:123). On the Southern High Plains, Folsom material culture occurs where bison, but not lithic resources, would have been prevalent, suggesting that it was bison that conditioned Folsom settlement and mobility in this area (Hofman 1999b:384). In lower frequencies, other animals such as elk, deer, pronghorn, mountain sheep, rabbit, duck, turtle, wolf, prairie dog, peccary, marmot, muskrat, water fowl, fish and possibly camel have also been documented from Folsom sites (Amick 1994a; Davis and Greiser 1992:265; Johnson 1987b:124; MacDonald 1998:224; Stanford 1999:301; Wilmsen and Roberts 1978:47). Faunal evidence from the Folsom occupation at the Agate Basin site might suggest a widening of diet breadth during the spring and winter seasons (Hill 2007:255). The larger element size and denser bone mass of bison, along with visibility biases and interest in “mega-sites” might have contributed to the over-representation of bison on Folsom sites, and Paleoindian sites in general (Amick 2000:120; Driver 1983:151; LeTourneau 2000:69; McCartney 1990:111; Olsen 1990:122). In addition, McCartney (1990:111) points out that large kills can act as sediment traps, contributing to their own preservation.

Many scholars argue that bison predation affected numerous aspects of Folsom lifeways, including mobility, land use, raw material acquisition, technology and social organization (Hofman 1999b; Jodry 1999a). Evidence that Folsom hunters targeted bison is important to this research, because endscrapers, in part, were likely used to process bison hides for a variety of critical items such as clothing, bedding, tools, containers and perhaps even shelter. Historically, processing the hides of smaller animals and even medium-sized animals such as deer is not as strongly associated with stone scrapers. In addition, hunting strategies, such as communal or individual hunts, as well as the season of the hunt, could have affected endscraper raw material provisioning, the level of demand for the tools, and their discard locations (Jodry 1999).

Unlike historic bison populations, *Bison antiquus* probably had smaller herd sizes and less predictable migrations (McDonald 1981:203-211). In some cases, Folsom hunters did not intensively butcher bison and underutilized the full nutritional value of each bison killed (Bement 1999a; Hill and Hofman 1997; Johnson 1987a:152; Meltzer et al. 2002:19; Todd 1987; 1991; Todd et al. 1990). This “gourmet strategy” lies in contrast to later prehistoric bison kills in which most of the animal was put to use (Frison 1982b:200). Todd (1991:218) suggested that Folsom hunters were “fat indifferent,” though data from the Folsom components at Agate Basin and Hell Gap site indicate an interest in the fattiest cuts of meat and marrow rendering. There are some other Folsom sites where bison remains were extensively processed (e.g., Jodry 1999a; Jodry and Stanford 1992). The general lack of intensive butchering could be a result of the season of the kill (Speth 1983) or the relatively superior condition of bison in terms of fat reserves during the Younger Dryas than in post-Folsom times (Jodry 1999a:329).

Techniques for Folsom bison hunting are thought to include ambushing/stalking near water sources, blowout traps, arroyo traps, and in one case, a possible cliff jump (Byerly et al. 2007; Dibble and Lorrain 1968; Jodry 1999a:53; Stanford 1999:300-301). Sites with dense bison remains, such as the Cooper site (Bement 1999a, 1999b) suggest the use of a natural or artificial enclosure, such as an arroyo trap (Hofman 1999a). Most Folsom bison kills are relatively small in terms of the number of bison killed, possibly suggesting a pattern of non-communal hunting. Todd et al. (1990:823) wrote, “For Folsom groups, the commonly accepted view is that of small, possibly non-communal hunting groups killing a limited number of animals. Folsom bison kill sites typically contain fewer than 10 skeletons. Meltzer and Holliday (2010:31) indicated that Folsom kills average 15 individuals, while later Paleoindian kill sites contain and average 60 animals. In some cases a greater number of individuals occurs on Folsom sites, such as the Lipscomb site with more than 50 bison and the Folsom site with perhaps 32 bison (Hofman 1999b; Hofman et al. 1989:17; Meltzer et al. 2002:11, 17; Todd et al. 1990, 1992). In addition, most bison kills appear to be single events (Stanford 1999:301). However, the Cooper site in Oklahoma represents three separate kill episodes, all of which occurred in late summer/early fall (Bement 1999a, b). Lindenmeier, Shifting Sands, Lubbock Lake, Cedar Creek, Rio Rancho, Hanson and Adair-Steadman also appear to represent repeated occupations (Amick 2000:124; Hofman 1999b:394; Huckell and Kilby 2002). Agate Basin, Blackwater Draw and Barger Gulch have multiple occupations cross-cutting different Paleoindian periods. The size of Folsom bison kills is significant to this study because the expectation of smaller or larger kills might have impacted how Paleoindians prepared toolkits, which in many cases included endscrapers for processing bison hides.

The season during which bison kills occurred can be estimated using tooth eruption, development and occlusal wear (Frison 1970, 1973; Frison and Reher 1970; Reher and Frison 1980; Todd 1996; Wilson 1980:97). Kills occurred in all seasons (summer/fall, winter, spring and summer kills), though the majority of Paleoindian kills with seasonal information occurred in the late fall/early winter (Frison 1982a; Todd 1987; Todd et al. 1990:822). The late summer/early fall pattern of bison kills is particularly true on the Southern Plains (Amick 2000:123). However, because breeding can occur as early as June and as late as late October, the length of the calving season can also vary, making estimations from small samples subject to error (Arthur 1975:115). In addition, tooth eruption varies with individual maturation rate as well as diet (Arthur 1975:116). Seasonality is an important issue in this study because, if some endscrapers were used as hide-working tools, intensity of processing animals for skins and fur might have increased dramatically in fall, resulting in increased demand and discard of endscrapers. The possible effects of seasonality and communal hunting on endscraper technological organization is further discussed in Chapter 6.

Summary

Folsom subsistence, mobility, settlement, raw material use and seasonality are relevant to this study because they can have an affect on technological organization of hide-working and endscrapers production, use and discard. Strategies for selecting raw material, manufacturing, and using endscrapers could have varied with environment, raw material availability, subsistence practices, mobility, and seasonal activities. The Folsom period is investigated here because bison was a key resource during this time, and endscrapers are strongly associated the presence of bison. Folsom mobility, raw material use, and subsistence strategies provide a context for understanding gendered activities and tool kits during this

period. In the next chapter, I review endscraper studies to provide background on their morphology, function, and use in interpreting gendered activities.

CHAPTER 6

Previous Endscraper Studies and Their Relevance to Paleoindian Technological Organization

If she were a woman of great taste and pride and did not wish her good man to be laughed at, or, more properly speaking, if she wished not to get herself laughed at over his shoulders, this great surface, frequently more than thirty square feet in extent, had to be uniform in thickness throughout and she could not cut through the epidermis once.

—Otis Mason (1920:72–72)

Endscrapers are typically described as distally retouched artifacts that exhibit use-wear on the steeply angled distal portion of the flake (Figure 6.1). Most commonly, the working edge of the endscraper is positioned on the distal end of the flake blank, though other configurations have been documented (Ellis and Deller 1988:115; Wheat 1979:103). The steepness of the working edge is more obtuse than that of the lateral edges, which are also often modified (Hester 1972:125). The working edges of modern-day Ethiopian hide scrapers are also positioned on the distal portion of the flake, though occasionally the proximal end is used as the bit of the scraping tool (Clark and Kurashina 1981:313). Nissen and Dittmore (1974:69) observe that some Arctic stone skin scrapers have the lateral edge of a flake as the working edge. In shape, endscrapers are frequently triangular or teardrop-shaped, with the greatest width at the working end (Hester 1972:125). A wide range of endscraper outline shapes has been documented such as parallel sided, tapered, convergent and irregular (Morrow 1997:73). The endscraper working edge is often, but not always, convex, which is true also for modern-day Ethiopian hide scrapers (Clark and Kurashina 1981:312).

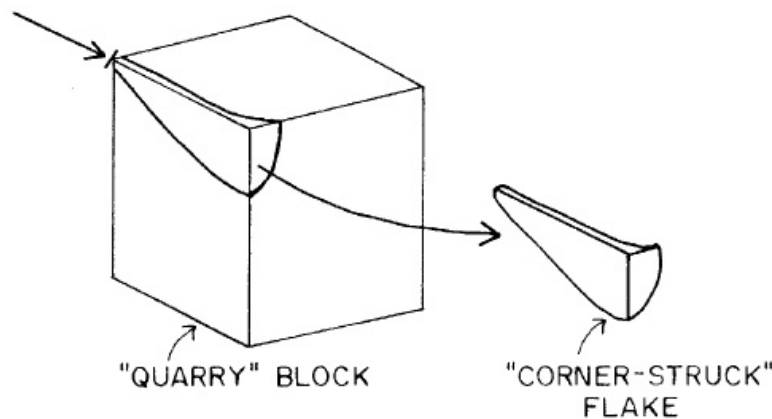


Figure 6.1. Hypothesized system of manufacture for endscrapers with curved bits from the eastern and central Great Lakes region (Ellis and Deller 1988:Figure 12).

Several researchers have attempted to define different scraper types based on morphological traits. Ellis and Deller (1988:124) argue that Paleoindian studies have emphasized tool homogeneity rather than variation. They point out that endscrapers can vary in a number of ways including “size of bit, degree of bit convexity, bit angle, curvature of the blanks, presence of tool accessories, and the nature of resharpening.” These authors describe distinctive scraper forms from five Parkhill Complex sites in the eastern to central Great Lakes region in southwestern Ontario (Thedford II, McLeod, Wight, Parkhill, and Dixon), and present an endscraper typology for this region. Irwin and Wormington (1970) outline a typology of 14 different Paleoindian scraping implements based on characteristics such as outline shape, flake size and other traits. In his analysis of Paleoindian endscrapers from the Central Rio Grande Valley, Judge (1973:177-78) used arbitrarily defined endscraper categories based on lateral modification (unmodified, both edges modified, and left or right modified). Wheat (1979:103) defined five varieties of endscrapers from the Jurgens site in Colorado based on shape, dimensions and polish and other variables. Sonnevile-Bordes and

Perrot (1954/6) created a well-known tool typology for western European Upper Paleolithic implements, including scrapers, called *grattoirs*, based on retouch, bit shape and other characteristics. Bradley used Bordes' Paleolithic typology of scrapers at the Hanson site, and at Agate Basin (Bradley 1982; Frison and Bradley 1980). Wilmsen (1970) assigned types based on the co-occurrence of tool form attributes.

Some endscraper types have been labeled with multiple names. For example, Lothrop (1989:114) suggested that the "hafted narrow endscraper" is equivalent to the *limaces* (Gramly 1982:37-40, Plate 19), flake shavers (Grimes and Grimes 1985) and hafted perforators (Ellis and Deller 1988). Narrow endscrapers that were not hafted have also been termed awls (Gramly 1982). In Europe, a frontal long endscraper is equivalent to a blade endscraper (Kooyman 2000:99).

The existence of discrete archaeological artifact types that reflect prehistoric categories in the minds of the tool makers and users has long been questioned (Ford 1954). In some ethnographic cases there appears to be little correspondence between form and function (e.g., White 1969; Gould et al. 1971; Hayden 1977:179). Several scholars have specifically questioned the utility of scraper types. Sackett (1966:357) wrote of Upper Paleolithic endscraper typologies, "It is as well indicated by the fact that the end-scraper types recognized in many classifications are in reality no more than ideal trait configurations that recur among only a fraction of the tools within end-scraper samples; it remains the individual classifier's task to exercise his own intuition in assigning the great number of specimens that vary from these norms."

Another well-known critique of tool typologies was put forth by Dibble (1987, 1995). In a comparison of Middle Paleolithic sidescrapers (called *racloirs*) from two French sites

(Combe Grenal, La Quina) and one Iranian site (Bisitun), Dibble (1987) argued that Bordes' typology of Lower and Middle Paleolithic sidescrapers does not reflect distinct artifact classes that were recognized as such by their makers, but rather simply different degrees of tool reduction. He proposed that Bordes' scraper categories are largely the result of the "Frison effect," in which tool forms are altered as they are used, resharpened and recycled (Frison 1968; Jelinek 1976). The "Frison effect" might also be applicable to Australian scraping tools. Tindale (1965) illustrates the morphology of Australian tula adzes as they change in form over time and with reduction of different edges. More recently, Clarkson (2002:22) has discussed the typological approach to Australian scrapers, which have been classified mainly according to location of retouch, curvature of retouched area, shape and size, and steepness of edge angle. Using Kuhn's Geometric Index of Scraper Reduction (Kuhn 1990), Clarkson shows that Australian scraper forms can be explained by differing retouch intensities as opposed to functional categories. Endscraper typologies then may not be the most fruitful approach to understanding the technological organization of these tools.

Endscraper Use-wear and Function

Both high-power (100-400X) and low-power (<100X) use-wear analyses have been conducted on endscrapers. High-power analyses focus mainly on polish types that are thought to distinguish among different contact materials (Keeley 1980). Low-power analyses generally focus on edge damage, and in some cases edge rounding and polish. The low-power approach is most successful at identifying hardness of the material worked and tool movement and orientation, rather than the specific material worked (Bamforth 1986b:Table 1; Broadbent and Knutsson 1975; Hayden and Kamminga 1973; Odell and Odell-Vereecken 1980:101; Tringham et al. 1974). Several high- and low-power use-wear analyses have

identified Paleoindian as well as Upper Paleolithic endscrapers as hide-working implements (e.g., Akoshima and Frison 1996:77-80; Ballenger 1996; Barnes 1932:54; Donahue 1988:363; Jensen 1982; Jodry 1999a:229, 235, Figure 74; Judge 1973; Kay and Martens 2004; Keeley 1988; Moss and Newcomer 1982:310; Rosenfeld 1971; Semenov 1964:88; Wilmsen 1970; Yerkes and Gaertner 1997:68-69).

Other uses for Paleoindian endscrapers, such as wood-working, have also been identified through use-wear analyses (e.g., Frison 1982a:47; Judge 1973:187, 221; Wiederhold 2004; Wilmsen 1968). Morse and Morse (1983:78) argue that Dalton endscrapers with acute angles and use polish were used on hides, while those with steep edge angles and crushing were indicative of use on bone or wood. Phytoliths and gloss on the working edge of the Vail site endscrapers suggest use on wood (Gramly 1982:35). In a low-power use-wear analysis (25-100 x magnification), Siegel (1984) argued that socketed late prehistoric/early historic Inupiat endscrapers were used for working wood, bone and animal hides. However, this study was criticized by Hayden (1986) and Bamforth (1986b) on methodological and analytical grounds.

Several problems have hindered use-wear studies in general, including the removal of use-wear when the working edge is refurbished (Keeley 1980; Schultz 1992); mistaking retouch scars for edge damage (Odell and Odell-Vereecken 1980:117-118); determining whether wear is due to hafting, transport, or use (Anderson-Gerfaud 1990:390); extensive examination/analysis time (Levi-Sala 1996:2); overlap in diagnostic polishes (Grace et al. 1988:220; Keeley 1980:56-61; Levi-Sala 1996:30-54); post-depositional degradation of polish (Levi-Sala 1986); and difficulties in scoring blind tests (Bamforth 1988b). Because endscrapers were retouched, removal of wear and mistaking retouch for use damage may be

particularly problematic. An illustrative quote comes from Mason (1891:585-586), citing Lieutenant Stoney regarding scrapers of Kotzebue Sound area of Alaska, “The hide-worker is incessantly touching up his scraper edge with a chipper, and that in time he wears it out to a mere stub. This constant sharpening also accounts for the fact that few specimens show signs of great wear.” In addition, endscrapers could have been repurposed for other tasks in some cases (Ingbar and Hofman 1999:105), complicating the use-wear signature. Schiffer (1987:30) uses the term “secondary use” to refer to objects that are used for a new purpose without extensive modifications. At the Cattle Guard site in Colorado, for example, an endscraper is reported to have been used as a wood planer after being used to scrape hides (Jodry 1999:229).

Another problem in some use-wear analyses is scanning electron microscopes can produce different results under different conditions (illumination, contrast, collector geometry and magnification). Perhaps most problematic is the subjectivity of wear identification from two-dimensional photographic images of three-dimensional surface topography. Some attempts have been made to make use-wear analysis more objective by studying surface topography, by using automated techniques such as profilometry, interferometry, and computer digitization of photographic negatives (e.g., Akoshima 1980; Dumont 1982; Grace et al. 1988; Newcomer et al. 1986; Rees et al. 1991).

Judge (1973) intensively studied the relationship between environmental variables and Paleoindian endscrapers in the Central Rio Grande Valley. Among other findings, he found a correlation between endscraper wear and environmental variables (Judge 1973:203-204, 229, Table 9, 12). Judge showed a positive relationship between endscrapers with use-wear indicative of a hard contact material and distance to an overview, and use-wear

indicative of soft contact materials and distance to water (Judge 1973:206, Table 10). He suggested the high incidence of hard-wear endscrapers at sites closer to overviews reflects their application for working of wooden weaponry implements. Soft-wear endscrapers were more common at processing sites near to water sources, perhaps suggestive of hide soaking and preparation (Judge 1973:204,331). However, Kehoe (2005:136-137) wrote of the Moose Medicine Wheel in southeastern Saskatchewan, “women may have taken advantage of the hilltop’s steady breeze and beautiful vista to ameliorate working on scraping hides.”

Late prehistoric endscrapers, similar to Paleoindian endscrapers, appear to have been associated with bison hide-working on the Great Plains. Creel (1991) provides evidence for the use of endscrapers in processing bison hides in late prehistoric times. On the Southern Plains, he argued, endscrapers, beveled knives and bison co-occur on the post-AD 1300 sites, whereas prior to this time, (AD 900 to 1300), bison bone, endscrapers, and beveled knives are absent, suggesting that endscrapers were used for processing bison hides. On many late prehistoric Oneota-tradition sites on the eastern margins of the Great Plains endscrapers are common, but are relatively scarce at sites closer to the Great Lakes. In Africa, there appears to be a general correlation between scrapers and hide-working, whereas backed blades correspond with bark cloth manufacture (Deacon and Deacon 1999:149, Figure 8.16). This endscraper-bison association, along with use-wear analysis, suggests their use as hide-working implements (Boszhardt and McCarthy 1999).

Endscraper Distribution and Frequency

Endscrapers occur throughout the Paleoindian period in the western United States and in the middle and late Paleoindian complexes of the Great Lakes region (Dawson and Judge 1969:151; Morrow 1997:71). They are found in Paleoindian sites in the New England and

Canadian Maritime Provinces (Byers 1954:347-349; Speiss et al. 1998). Byers (1954:349) comments that the endscrapers from Bull Brook (Massachusetts), Shoop (Pennsylvania), Williamson (Virginia), and Lindenmeier (Colorado) were virtually identical, with perhaps some subtle differences in manufacture. Endscrapers are recorded in southeastern Paleoindian contexts (Daniel and Wisenbaker 1989:334-335) as well as in the Late Paleoindian-Early Archaic Dalton complex of the Mississippi River valley. They are also found in the Alaskan Nenana complex dating between 11,000 and 12,000 B.P. (Goebel et al. 1991) and the Denali complex of Alaska (West 1996:365, Figure 4). Trianguloid endscrapers are found in early assemblages from Turrialba in Costa Rica (Snarskis 1979:132, Figure 7), El Inga in Ecuador (Mayer-Oakes 1986), and Fell's Cave (Cueva Fell), and other early sites in Patagonia (Borrero and Franco 1997:228, Table 5). Keeled snubbed-nose endscrapers along with Clovis-like points are reported from the Nieto site in Panama (Pearson 2003: Figure 4).

The endscraper is one of the most common tools found on Paleoindian sites, and is also prominent at sites of all time periods on the Great Plains. In the 1930s, Cox (1936:317) commented on the ubiquity of endscrapers on prehistoric sites in Colorado, Nebraska, and Wyoming, "In camp sites where broken bone was in evidence, I found that end-scrappers outnumbered all other artifacts, even the arrow point." Wheat (1979:108) described the endscraper as "the most ubiquitous and long-lived of all stone tools in the archaeology of the High Plains." Irwin and Wormington (1970) compared a number of Paleoindian assemblages from the Clovis to Frederick time periods, including Blackwater Draw, Lindenmeier, Hell Gap and the Frazier site. They found that at all the sites scrapers were the most prevalent tool type. They also noticed that Paleoindian kill sites received greater study than campsites,

leading to an asymmetrical interest in projectile points (Irwin and Wormington 1970). In his analysis of Folsom and Cody tools from the Central Rio Grande Valley, Judge (1973:91) noted that endscrapers were “by far the most abundant item in the lithic tool assemblage.” At the Vail site in Maine, Gramly noted that endscrapers are the second most numerous tool class (n=731), but by weight, ranked first for chert tools (1982:22, 34, Table 1). Recently, Bamforth (2002) has pointed out the discrepancy between frequency of campsite tools and amount of study they have received, and has encouraged increased study of these tools.

Temporal Sensitivity of Endscrapers

While some have suggested that spurred endscrapers are distinctive to the Paleoindian period (Frison 1987:246, 267; 1991:128, 131; Hester 1972:125; Rogers 1986; Wheat 1979:108; Wilmsen 1968), their use as a diagnostic tool is not as secure as Paleoindian points and channel flakes. The variation in endscrapers and lack of unique technology, such as fluting, and their occurrence throughout the Paleoindian and later periods, limits their use as a temporal marker. Meltzer (1981) argued that endscraper morphology is functional rather than stylistic and thus their use as a temporal marker can be problematic.

Paleoindian endscrapers, however, appear to be morphologically distinct from later Archaic scrapers. Morrow (1997) compared endscrapers from an early Archaic context (ca. 9400–9000 B.P) from the Twin Ditch site in western Illinois to endscrapers from early Paleoindian (Clovis) contexts. According to Morrow, the Archaic endscrapers differ from the Paleoindian endscrapers in that the Archaic endscrapers were larger in length and thickness, and the outline morphologies of the Archaic endscrapers tend to be parallel-sided or irregular, while the Paleoindian endscrapers were usually triangular or tapered. In addition, the working edges of the Archaic endscrapers tend to be more convex, and spurring does not

occur in the Archaic endscraper assemblage. Morrow (1997:75) also noted that Paleoindian endscrapers are also “more extensively shaped than the Archaic endscrapers.” Huckell and Haynes (2003) also comment that scrapers found in the early Holocene Ventana complex at Ventana Cave in Arizona differ from Paleoindian scrapers in that the entire perimeter of Archaic scrapers have potential working edges, while Paleoindian endscrapers are primarily reduced from a single working edge. They noted that extensively retouched ovoid scrapers are common in early Holocene industries west of the Rocky Mountains and not in Plains Paleoindian complexes (Huckell and Haynes 2003:364). However, Gramly and Summers (1986:101) observed that trianguloid endscrapers also occur in the Early Archaic period. It is likely that there is regional variation in scraper technological change or continuity, given the range of environmental and subsistence factors.

The shift in morphology from Paleoindian to Archaic endscrapers could represent a shift from a bison-focused subsistence strategy to a broad-spectrum strategy that required less intensive use of animal hides, particularly bison. If endscrapers were used as wood- or antler-working tools, then the idea that this scraper form failed to continue into the Archaic period requires explanation. Future studies that compare Archaic and Paleoindian scrapers are necessary in order to determine the nature of the differences of Paleoindian and Archaic scraper design. The continuance of the endscraper type throughout the Paleoindian period is important to this study because it suggests a continuance at least to some degree of technological strategies.

Spatial Patterning and Context of Endscrapers

It has often been observed that endscrapers tend to occur on campsites or in areas located away from kill areas. At Stewart’s Cattle Guard Site, Jodry (1998:234–235) noted

that endscrapers occur throughout the site, but are absent in the kill and initial butchering areas located in the southeast part of the site. This patterning suggests that endscrapers were largely associated with domestic or maintenance activities such as hide-working and wood-working. Endscrapers sometimes appear in low numbers on kill sites; one example is the Cody complex Seminole Rose site in west Texas, which consists of an extensive bone bed and 46 projectile points and point fragments, as well as four endscrapers (Collins et al. 1997). A single endscraper is part of the Scottsbluff type site assemblage in Nebraska (Barbour and Schultz 1932:Figure 169).

Hide-working in particular may have necessitated a particular type of location, such as one with access to water for moistening the hide to retain its suppleness during processing. In addition, a relatively large area might have been required, depending on the nature of the hide work and the numbers of skins to be dressed. Carr (1984:126, 127) suggested that hide dressing may require more space than other activities such as wood-working and flint-knapping. Albright (1984:52) noted that among the Tahltan of northern British Columbia, hide-workers used an area of up to 200 square meters. The Alyawara and San process hides some distance from the residential space away from other activities (O'Connell 1979, cited in Carr 1984:127–127). Messy activities and those that produce obnoxious organic waste that attracts animals, Carr (1984:127) argued, are conducted at some distance from the central residential area so as not to interfere with daily activities. Other activities, such as knapping, sewing, and cooking tend to occur in the central activity area of the camp (Carr 1984:127). This use of space, Carr suggested, results in residues of peripheral activities being more amorphous with a lower density of debris, since they do not require regular clean-up and can be moved laterally (1984:127).

Some attempts have been made to examine endscraper spatial patterning within Paleoindian sites. At the Shawnee Minisink site, Rule and Evans (1985:218) observe clusters of endscrapers that may represent distinct activity areas. They note that all endscraper types as defined in their study (non-hafted, spurred, full, notched snapped, thinned or tapered) occur in the two clusters, and suggest that similar activities were conducted in the two areas. They propose that these activities may have required multiple stages as reflected in the different endscraper types, writing, “It is our impression that this activity was male oriented, and the excavated portion of the Shawnee Minisink site may correspond to a focal area for a specialized male activity” (Rule and Evans 1985:218). Boldurian (1990:75) suggested that a cluster of endscrapers at the Mitchell Locality at Blackwater Draw might represent the remains of a hide processing area (Boldurian 1990:75, 78). Using K-Means analysis at Stewart’s Cattle Guard site, Jodry proposed that the northern and central portions of cluster K-1 correspond to an outdoor hide-working area, representing women’s activities. Within this general area, two clusters of endscrapers and other tools were determined to have evidence of wear from soft contact materials (Jodry 1999a:235, Figure 74). Jodry suggested that the distribution of these tools along with resharpening flakes indicates skin dressing at these two locations (1999:235). The southernmost portion of this cluster, Jodry surmises, represents men’s weaponry replacement. Endscrapers are found in all clusters at the site, but have the greatest frequency and percentage in cluster K-1. This cluster, Jodry (1999a:318) suggested, may have been situated at the periphery of the camp.

At the Lindenmeier site, Wilmsen and Roberts (1978:174) discuss the concentration of several bone needles in Unit H of Area 2. They write, “The tendency toward small distal edge tools found in Unit H should also be associated with skin working requirements”

(Wilmsen and Roberts 1978:174). At the Culloden Acres site near London, Ontario, researchers found a cluster of endscrapers and endscraper resharpening flakes in Area A with hide-working wear and no evidence of other activities. In Area B, approximately 20 meters from Area A, researchers found tool manufacturing debris and channel flakes (<http://anthropology.uwo.ca/cje/culloden.htm>).

Intra-site endscraper patterning has also been observed at non-Paleoindian sites. At the Belgium Late Paleolithic site of Meer, Cahen et al. (1979:665-666) interpret a cluster of five to eight endscrapers and their manufacturing debris as an episode of endscraper manufacture, use on a dry hide, and final discard in their place of use. They suggest that the number of discarded endscrapers is high for a single hide-working episode and that the cluster could represent multiple people working on a single hide. Guenther (1991:19-20) argued that Feature 6 at the early Middle Plains Archaic Horse Creek site in southeastern Wyoming, might have been used by women for meat, plant, and hide processing as well as tool manufacture and maintenance based on observations of sexual division of labor in historic Plains societies in which women typically processed plants and hides. Hughes (1991:38) finds evidence for endscraper manufacture around the Unit 2 hearth at the Besant Mini-Moon hunting camp site in eastern Montana. She suggested that if women were manufacturing endscrapers, they also participated in activities around Hearth 2. Gilmore (2005:32) suggested that hide products concentrated in the northern portion of Franktown Cave in Colorado (late prehistoric) could suggest gendered use of space.

In addition to campsites, endscrapers also occasionally occur in cache contexts. Kilby and Huckell (2003:2) defined caching as “implements and materials that are tightly clustered in space, the residue of their manufacture and maintenance is not present, and the only

activities they directly reflect are those associated with the act of their deposition.” Some instances of caching may be a strategy for minimizing transport costs and ensuring future material availability or “insurance caching” (Binford 1979:257). In certain contexts, this type of caching can be considered curation behavior, because it implies production of tools in advance of use (Binford 1973:242; 1979; Odell 1996:55). In other cases, caching could represent ritual behavior or association with human burials (Kilby and Huckell 2003; Schiffer 1987:79). The Anzick cache/burial contains a single endscraper among numerous other stone and bone artifacts (Lahren and Bonnicksen 1974:148). The Busse Clovis cache, located in northwestern Kansas, contains a variety of items including a worked cobble, an edge abrader, bifaces, blades (including scraping tools), gravers and flakes (Hofman 1995a). Several of the pieces in the cache were broken prehistorically and some bear traces of red ochre. The cache is somewhat different from other Clovis caches in that it lacks projectile points and some of the pieces are heavily worn. The endscrapers included in the Anzick and Busse caches, in association with red ochre, also suggest that endscrapers could have been included in caches that served ritual purposes.

Other Paleoindian caches with endscrapers have been discovered. A single spurred endscraper, a graver, and 40 complete and incomplete Scottsbluff points, were included in the Larson Cache (48W1121), a Cody complex cache found in Sweetwater County, Wyoming (Ingbar and Hofman 1987:461). This cache was excavated by landowners from a deflated sand dune. Frison (1991:353) suggested that the Larson cache might have accompanied a human interment. The Craft Cache (Texas) consisting of 25 flakes and 15 blades, 4 of which are worked into endscrapers, could potentially be Paleoindian in age as well. Ballenger (1996:305) suggested that the cache could represent a hide-working kit that

was cached in anticipation of future hide-working activities in the area. A cache that is of possible Clovis age, the Franey site (25DW74) in northwestern Nebraska, contains 58 scraping tools, most of which are described as endscrapers (Grange 1964; Kilby 2008). The cache was discovered in 1959 by the landowner, Mr. Ed Franey, while plowing his field. Mr. Franey reported that the tools were tightly packed together in soil that appeared to have been scooped out, suggesting intentional deposition. Most of the endscrapers exhibit a prismatic cross-section indicative of blade core manufacture (Grange 1964:198). The tools are potentially Clovis in age, based on the blade technology; however, direct dating of this cache was not possible. Ritzenthaler (1968) described a cache of 87 Paleoindian implements from the Kouba site including more than 300 gravers and five scrapers. The clustering of the artifacts suggests they may have been originally placed in a bag. Blades often occur in Clovis cache contexts, which may have been intended for the manufacture of endscrapers. These caches suggest that in some cases, Paleoindians may have used specialized strategies to ensure the supply of endscrapers.

A Paleoindian-age burial also contains an endscraper. The Gordon Creek burial in northern Colorado, dated to 9,700 \pm 250 ^{14}C yrs. B.P., contained remains of a 25 to 30-year-old woman in a pit and covered in red ochre, accompanied by a large biface (projectile point), a smooth slate stone, a small bifacial scraper, an endscraper, a hammerstone, a broken biface or preform, utilized flakes, animal ribs and an elk incisor (Anderson 1966; Breternitz et al 1971:170). Among the historic Plains Comanche, hide-working implements could be interred with the dead (Wallace and Hoebel 1955:152). The inclusion of endscrapers in Paleoindian caches and burials could suggest that endscrapers, or perhaps hafted endscraper tools, were interred with their users.

Technological Organization of Endscrapers

The aim of my research is not only to explore the possible gendered use of these tools, but also to examine how endscrapers were produced and supplied with raw material, especially in comparison to weaponry. In this chapter, I discuss previous research into endscraper technological organization, including raw material procurement, manufacture, design considerations, transport and discard processes.

Technological organization is a set of strategies for procuring, designing, manufacturing, using, transporting, maintaining, storing, recycling and discarding tools, as well as the integration of those strategies with each other (Kelly 1988:717; Nelson 1991:57). The goals of studying technological organization, as viewed by Carr (1994:35), are to identify prehistoric technological strategies and to explain how these strategies relate to human behavior and culture change. Several Paleoindian studies have benefited from the use of a technological organization framework (Amick 1994b; Bamforth 1985; Hofman 2003; Ingbar 1994; Shott 1989b). Bamforth (2002) suggested, though, that the study of Paleoindian technological organization has been “point-centric,” and proposed that in-depth study of other tools could provide a more complete understanding of Paleoindian technological strategies. The analytical concentration on projectile points and hunting has resulted in an incomplete examination of the spectrum of Paleoindian activities and a partial and potentially misleading understanding of Paleoindian technological organization.

In a general sense, technological organization can be seen as a means of solving problems and increasing the energy yield from the environment (Jeske 1992:469). From this perspective, technological organization can be viewed as a component of White’s (1959) “extrasomatic means of adaptation.” Historically, issues related to economics and

environment have been central to the study of technological organization, including: mobility, settlement, food resource structure, (Bamforth 1990, 1991c; Bettinger 1991:126-127; Binford 1977, 1979; Blades 2003; Bleed 1986; Carr 1994; Goodyear 1989; Hofman 1991; Kelly 1988; Kuhn 1989; Parry and Kelly 1987; Shott 1986, 1989b), regional lithology (Andrefsky 1994; Bamforth 1986a; Bar-Yosef 1991; Carr 1994; Gramly 1980; Kelly 1988:717; Kuhn 1991; O'Connell 1977:280; Straus 1980) and time stress, risk, utility and activity scheduling (Bamforth and Bleed 1997; Torrence 1983). To a lesser extent, social concerns, such as ethnicity and information exchange (Morrow 1987), social aggregation (Hofman 1994), ritual (Bradley 1991:379), political alliances, warfare (Jeske 1992), mating strategies (MacDonald 1999) and the sexual division of labor (Amick 1999; Bamforth 2002:84; Bradley 1991:379; Gero 1989; Hildebrandt and McGuire 2002; MacDonald 1999; Sassaman 1998; Waguespack 2003; Wiessner 1983) have been applied to the study of organization of technology and assemblage formation. Technological organization is sometimes approached as an optimization problem using formal mathematical models (e.g., Brantingham and Kuhn 2001; Kuhn 1994; Surovell 2003), in which the factors affecting technological strategies are divided into constraints (mobility, resource structure, social context, activity scheduling and regional lithology) and currencies (utility, time stress and risk) (Surovell 2003:25).

Chaine operateire, an approach similar to technological organization, has been defined as “the different stages of tool production from the acquisition of raw material to the final abandonment of the desired and/or used objects” (Bar-Yosef et al 1992). Sellet (1999:38) succinctly described *chaine operateire* as “all the steps through which a piece of raw material had to go, over the course of its life.” Some theorists suggest the approach

focuses on description of activities rather than processes or explanations for why those activities occur (Dobres and Hoffman 1994:213, 219, 237). Dibble (1995a) critiqued some applications of *chaîne opératoire* for ignoring the role of reduction on tool form.

Technological organization also bears similarities to Schiffer's (1972:158, Figure 1; 1995:27) flow model for durable elements in systemic context, which includes procurement, manufacture, use, maintenance, recycling, lateral cycling and discard. While similarities exist with other conceptual frameworks, my research uses the term technological organization to refer to strategies of procuring, manufacturing, using, maintaining, transporting, storing, recycling and discarding tools.

Curation and Expediency

Two much discussed and debated technological strategies are curation and expediency. Because curation and expediency subsume several aspects of technological organization, their consideration is important to this research. These issues are also significant in investigating whether and under what conditions supply of endscrapers to sites was anticipated, or whether strategies for supplying these tools were more expedient, being supplied on an "as-needed" basis.

Binford (1979:269) stated that curated tools "were produced, and then maintained within the technology in anticipation of future usage." Nelson (1991:62-63) expands on this definition, defining curation as

a strategy of caring for tools and toolkits that can include advanced manufacture, transport, reshaping, and caching or storage. It need not include all these dimensions, but a critical variable differentiating curation from expediency is preparation of raw materials in anticipation of inadequate conditions (materials, time, or facilities) for preparation at the time and place of use.

Nelson's definition makes it clear that the term curation encompasses a number of different behaviors. Most definitions of curation include either advanced manufacture of tools and/or extending the time tools are in operation (Odell 1996). Transport of tools, caching, storing and stockpiling can be considered aspects of curation because they imply manufacture of tools in advance of need in anticipation of future shortages (Bettinger 1991:69; Binford 1979; Marks 1988; Odell 1996:55). Maintenance, defined as resharpening, reshaping and recycling, is also often considered a component of curation, because it functions to extend the use life of a tool (Bamforth 1986a; Binford 1977:34; Odell 1996:60). For the same reason, use of tools for multiple purposes without reshaping (Schiffer's "secondary use") can be considered a form of curation (Bamforth 1986a). Other characteristics indirectly associated with advanced manufacture and extension of use-life are often associated with curation as well. For example, quality of raw material is related to the concept of curation in that isotropic materials facilitate resharpening and rejuvenation (Goodyear 1989). Similarly, tool hafting has also been considered a component of curation in that hafting implies production in advance of use and a relatively long use life (Keeley 1982:798-799; Odell 1996:55; Shott 1986:39).

The concept of curation has also been associated with logistical mobility, in which task-specific groups range out from residential locations in order to obtain food, raw materials and information (Bettinger 1991:66-70; Binford 1977:35). In this respect, a strategy of curation is an attempt to solve the spatial and temporal problems associated with the lack of tools or raw materials at the location of need (Camilli 1983:176-181; Kelly 1988; Parry and Kelly 1987:300). Other studies find this to be too simplistic a formulation. Shott (1986, 1989a) concludes that residually mobile Plainview Paleoindians had a high incidence of

resharpening (one aspect of curation), yet, he suggested that greater frequency of movement rather than total distance traveled corresponds to the curation (greater realized utility) of a tool. Time-stress arising from activity scheduling conflicts, Torrence (1983) argued, resulted in efforts to manufacture tools in anticipation of future use. Bamforth (1986a) argued that neither subsistence-settlement issues nor time-stress completely explain the phenomenon of curation, and proposed that raw material shortages can lead to strategies of maintenance and recycling—two aspects of curation behavior. In the same vein, Gryba (1985:31) argued that resharpening of Folsom points in Alberta, Canada, might have been caused by low raw material availability due to snow cover during the winter months. The studies mentioned here reveal that curation is a multi-faceted phenomenon and that several factors could have affected curation behavior, including subsistence-settlement, time-stress, tool function and raw material availability.

In contrast to curated tools, expedient tools are manufactured when needed and discarded in their place of use (Binford 1977:34; 1979; Johnson 1989; Nelson 1991; Parry and Kelly 1987). An implied link exists between expediency and a forager strategy in which groups make frequent residential moves to food resources, which are gathered during daily excursions (Binford 1980). As with the connection between curation and logistical mobility, this formulation appears to be over-simplified, in that raw material shortages and quality can affect technological strategies (Andrefsky 1994; Bamforth 1986a:40).

Despite the common usage of the terms curation and expediency in archaeology, a number of researchers have questioned their value, particularly curation (Bamforth 1986a; Hayden 1976:51; 1996; Nash 1996; Odell 1996; Shott 1995). Hayden (1976:49) claimed that Binford's initial formulation of curation, which was based on metal tools, is not an

appropriate analogy for stone tools, and further suggested that the concept of curation is difficult to implement in archaeological studies. In another critique, Bamforth (1986a:39) summarized five characteristics that have been subsumed under the term curation: advanced production, multipurpose tools, transport, maintenance and recycling. These strategies do not necessarily co-occur, which makes the definition of curation ambiguous (Bamforth 1986a:39). Nash (1996) too argued that curation has lost much of its meaning due to multiple definitions, and recommends dropping the term entirely. Taking a formal optimization approach to technological organization, Surovell (2003:29-30) asserted that because the concept of curation is ambiguous, it cannot be used in formal mathematical models as Binford originally defined it. Because of the ambiguity surrounding the concept of curation, my research treats the different the components of the curation concept as separate but related strategies. As such, my research uses the terms transport, advance manufacture, resharpening, utility and recycling, as opposed to the more general term curation.

Endscraper Transport and Toolstone Allocation

Folsom lithic assemblages are well known for their nonlocal materials, sometimes originating several hundred kilometers from the location of discard. The use of nonlocal sources suggests transport of tools or toolstone over great distances. Moving implements from one location to another has been considered a component of curation, because transport implies planning in advance of use (Kuhn 1992:189; Nelson 1991:65; Shott 1989b:288). Another mechanism for delivering tools or toolstone to users or locations of use is trade (Meltzer 1989), which might have been practiced for political, religious or other social reasons (MacDonald and Hewlett 1999:513). While trade might have played a role in delivering some raw material or endscraper flake blanks to tool users, Paleoindians may not

have relied solely on trade for raw material provisioning. This research assumes that most endscraper raw material was directly procured rather than traded.

Endscrapers, tool blanks or unworked toolstone could have been transported from the stone source directly to the location of need or to a location where they were incorporated into toolkits in anticipation of future use. Modern-day Konso hide-workers transport both flakes and nodules from the source to their residences where hides are worked (Weedman 2005:192). Paleoindian endscrapers might have been transported directly or as part of personal toolkits or raw materials might have been gathered and used locally. Because endscrapers might not have been completely exhausted at their location of use, they could have been transported between sites several times such that the location of use and the location of ultimate discard were not the same. A toolkit transported to a site has been termed by Schiffer (1975) the “founding curate set.” Hafting might have increased the likelihood of endscraper transport, with worn endscrapers transported in the haft until retooling became necessary. In this sense, transport of endscrapers was not necessarily an intentional strategy to supply tools to a location, but rather simply a “failure to abandon” (Kuhn 1991:191).

Using a simple simulation model of toolstone circulation, Ingbar (1994) showed how transport of tools and tool blanks coupled with discard patterns can affect raw material proportions in an archaeological assemblage. At the Hanson site in Wyoming, still usable endscrapers of relatively nonlocal Phosphoria chert were present (approximately 20 km distant). Projectile points were also more often made of this material. New endscrapers were thought to have been produced from the abundant local material and transported away from the site, and endscrapers of the nonlocal material were discarded. Ingbar’s model shows that as a result of serial production of tools, only the last sources visited are expected to appear in

the archaeological assemblage. Frison and Bradley (1980:113) suggested, however, that points and endscrapers were simply preferentially made of Phosphoria chert, and (Amick 1994a:318) argued that small task groups could have procured the nonlocal material.

Tool demand could also have impacted endscraper transport. In some cases, transport of endscrapers may have been carried in the form of “personal gear” (Binford 1977, 1979), which is carried by individuals at all times to meet generalized needs. Endscrapers carried as personal gear could have been transported great distances depending on location of need. In other cases, gearing up with endscrapers intended for hide processing could have taken place just prior to a planned kill event and transported only a short distance. In the case of communal hunting, which is sometimes associated with Cody subsistence strategies, the timing and location of kills might have been better anticipated than more generalized scraping needs. Folsom sites, which appear to have relatively smaller bison kills, might have used different strategies, such as transport of personal gear, to supply users and locations with endscrapers. In addition, multiple strategies (personal gear and gearing up before a planned event) could have been used during different times of the year as needed. While many possibilities exist regarding the types of transport strategies used by Folsom groups, it is clear that different strategies would have affected the formation of endscraper assemblages.

Apart from conceptual design, procuring raw material for stone tools is the first stage in producing stone tools. Scholars have observed the use of both local and nonlocal raw materials for different Paleoindian tool types (Amick 1999; Bamforth 1985; Frison and Bradley 1980:112-113; Ingbar 1992; Judge 1973:241), suggesting a variety of strategies was used to supply raw material to users and perhaps that different strategies were used in

different contexts. Endscraper raw material allocation could have been affected by a number of factors, including functional need, availability of raw material, procurement strategies, predictability of demand, mobility requirements and potentially the gender of the tool maker and user. The function of a stone tool is perhaps the most obvious explanation for raw material selection. In general, Paleoindian endscrapers appear to have been made more often from chert and chalcedony than obsidian, quartzite, or petrified wood, suggesting that cherts and chalcedonies were judged most appropriate for endscraper applications. Ethnographic examples of both wood- and hide-working implements indicate that cherts and chalcedonies and other highly isotropic materials were strongly favored for these tasks. Some modern-day hide-workers of southwestern Ethiopia use chalcedony, chert, quartz and quartz crystal for the manufacture of endscrapers (Weedman 2002:735; 2005:182, 190). Historic Arctic hide scrapers were also made from fine-grained chert or moderate-grade chalcedony (Hayden 1979a:210). Brittle materials, such as obsidian, might have been less effective in general for endscraper tasks (Lawn and Marshall 1979). Yet historic and ethnographic cases of obsidian hide scrapers (Campbell 2005:370, 372; Clark and Kurashina 1981; Gallagher 1974, 1977; Giglioli 1889; Habicht-Mauche 2005:49; Musters 1872:198) suggest that the supposed ineffectiveness of obsidian hide-working endscrapers might have been overstated. Blackmar et al. (2001:5) report a fragmentary Cody-age obsidian endscraper from the Flaning Site in western Oklahoma. One obsidian plano-convex scraper (Accession number 69.20.20) is reported in the 1969 inventory for the Rio Rancho Site in New Mexico. Unfortunately, this artifact is also reported as “released for obsidian hydration dating” and was not found in the collection.

The type of procurement strategy used could also have affected endscraper raw material allocation. Quarriers could have used an “embedded” strategy of procurement, in which toolstone is collected during the course of other daily activities (Binford 1979:259-261). In an embedded procurement strategy, it is possible that materials collected were suitable, but not necessarily optimal, for endscraper tasks. Ethiopian hide-workers sometimes embed toolstone procurement in other activities such as visiting friends and going to the market (Weedman 2005:191). Alternatively, procurement of material for Paleoindian endscrapers might have been exclusively for the purpose of obtaining suitable material for tools for endscrapers. Konso hide-workers sometimes travel to quarries for the sole purpose of obtaining stone for scrapers. Gould and Saggers (1985:121) also document Australian aboriginals traveling great distances for the sole purpose of collecting material. When procurement was exclusive as opposed to embedded, material collected for endscrapers might have been optimally suited for the tasks to which they were applied. Multiple strategies of procurement could have been used at different times and in different contexts in order to supply raw materials for endscraper manufacture.

Kuhn (1991:188) pointed out that the spatial and temporal predictability of demand is an important factor in supplying tools to a location of need. Fluctuating demand for endscrapers, perhaps on a seasonal basis, could have affected how raw material for endscrapers was provisioned. When demand was high and could be anticipated in advance, material might have been procured using an exclusive strategy and quarried close in time and place to the use event. At other times, when demand for endscrapers was low and unpredictable, gearing up with endscraper blanks or cores might have taken place well in advance of use and potentially transported great distances. Surovell (2003:172) noted that

maintaining a surplus of lithic material (a “rainy day” strategy), cushions the possibility of a stone tool deficit. In these instances, endscrapers (or material that could be fashioned into endscrapers) could have been transported as “personal gear,” being part of the permanent tool kit to meet with generalized exigencies (Binford 1977; 1979:262).

Strategies for supplying tools with raw material could have varied seasonally and with the nature of the hunt. Folsom kills tend to be smaller and might represent smaller non-communal kills, though the incidence of communal hunting for this time period remains unclear (Hofman 1994). Hide-working endscrapers associated with communal bison hunts might have been procured using an exclusive strategy, just prior to the kill, as the time and location of the kill may have been more predictable. For smaller kills, hide-working endscrapers might have been transported long distances from the source as personal gear, and used as needed. Strategies for endscraper raw material procurement might have varied both within the Folsom time period as well.

Another potential factor affecting endscraper raw material allocation is the gender of the tool maker and user. Based on cross-cultural comparisons, researchers suggest that endscrapers might have been used, at least in part, by women (Adovasio et al 2007:235; Amick 1999; Jodry 1999a:264; Judge 1973:205-207; Knudson 1973:132; Waguespack 2003; Wilmsen 1970:71). Waguespack (2003:155) noted that among hunter-gatherers, females tend to make a greater number of shorter logistical forays than men, especially in societies heavily reliant on hunted foods. She suggested that Paleoindian women might have had consistent access to local toolstone, whereas men would have had greater access to nonlocal sources. If Paleoindian women quarried raw materials for endscrapers, then endscrapers might have been made more often from local materials. These local materials might be of poorer quality

and derived from a smaller piece size than what was available to men. Women might have relied on local materials particularly when demand for endscrapers was low and unpredictable. Amick (1999) suggests that when demand for weapons was great, high-quality nonlocal material might have been preferentially allocated to weapons, with endscrapers being made from more local material. This research examines the question of raw material allocation by comparing endscraper and weaponry raw material from the Rio Rancho Folsom site in New Mexico. The comparison is undertaken to evaluate whether endscraper raw material was “left to chance” or anticipated and planned for in advance. Also, it explores whether weapons and endscraper production was linked or separate, which could provide clues to the gender of the tool producers.

Core Reduction and Flake Blank Selection

Previous studies suggest that Paleoindian endscrapers were manufactured using a variety of different flake blank types. The availability and nature of suitable lithic material, mobility requirements, tool function, hafting needs and the context of demand might all have affected strategies of endscraper core preparation, blank manufacture, and blank selection.

Judge (1973) examined Paleoindian endscraper manufacture in detail in his study of Paleoindian sites in the central Rio Grande Valley of New Mexico. Because Judge’s analysis is one of the most extensive studies of Paleoindian endscrapers, his findings are discussed in detail here. In general, Judge found changing patterns of endscraper flake blank selection through time, and an association between endscraper flake blank selection and different types of lateral modification. Clovis endscrapers, he discovered, differed from Folsom, Belen and Cody scrapers in that, judging from the parallel orientation of the exterior flake scars, Clovis scraper blanks were removed in a standardized manner, and Clovis endscrapers were

generally not made from primary decortication flakes (Judge 1973:286). He identified a TB endscraper type (both sides laterally modified) that was common in his Clovis assemblages, and that these were also used as sidescrapers. In contrast to Clovis endscrapers, Judge saw a lack of specialized flake removal for Folsom endscraper blanks (Judge 1973:288). Further, in Folsom assemblages, Judge observed a correlation between raw materials used for points and endscrapers and suggested that scraper blanks were selected from core preparation flakes associated with Folsom point manufacture (Judge 1973:289). Folsom TU (laterally unmodified) endscraper types have more acute core facet angles, “suggesting more acute flakes were being selected for scraper blanks in which the distal end only would be retouched, leaving the lateral edges unmodified” (Judge 1973:185). In contrast to both Clovis and Folsom endscrapers, Cody TU endscrapers were not manufactured from the same types of cores as points, and were more often made from decortication flakes. However, Cody TB scrapers might have been manufactured from similar cores as points. Also, Cody and Belen TU and TB types exhibit greater differences in exterior facet angle and divergence angle, while the Clovis and Folsom TU and TB endscraper types are more similar (Judge 1973: 269, Table 18). Judge’s findings suggest that endscraper lateral modification, flake blank selection and core reduction differ between time periods.

Some researchers have reported variety in Paleoindian endscraper manufacturing strategies within sites. At the Folsom-age Stewart's Cattle Guard site in south-central Colorado, endscrapers are morphologically varied, which Jodry attributed to differences in flake blank selection and attrition effects (1999a:225). Most Cattle Guard endscrapers were made on percussion flakes from non-bifacial cores; however, a few endscrapers were made

from bifacial thinning flakes, one was made on a polyhedral blade, and an early stage endscraper was produced from an *outré-passé* flake (Jodry 1999a:227-8, Figure 70a).

Others have found greater within-site homogeneity in endscraper flake blanks and core reduction. Goodyear (1974:44) reported out that Dalton endscrapers in the southeastern United States were also made from a variety of flake types. Hester concluded that Folsom endscrapers from the Blackwater Locality 1 in eastern New Mexico were made from specially prepared and selected flakes (Hester 1962:125). Frison (1987:245) commented that at the Cody Complex Horner site in Wyoming, endscrapers were made from percussion flakes, and that the flakes were carefully selected to reduce the need for further modification. At the Potts site, a predominantly Gainey phase site in New York just south of Lake Ontario, Lothrop (1989:114) observed that endscrapers and sidescrapers have striking platform angles indicative of block-derived blanks, whereas other unifacial tools and utilized flakes were produced from biface cores and bifacial preforms. He argued that tools with long use-lives—as judged by the extent of modification, rejuvenation of the working edge and indications of hafting—were more often made from block-derived blanks (Lothrop 1989:117). Rule and Evans (1985) observed that at Shawnee-Minisink endscraper flake blank platforms were ground or trimmed, with platform lipping, indicating production using a soft hammer technique during manufacture of the flake blank.

A number of researchers have observed an S-shape curve to endscrapers when viewed in longitudinal cross-section, suggesting that the production of this form was purposeful. The Clovis Shawnee-Minisink endscrapers were manufactured from specialized flakes, with exterior keels and curvature towards the interior of the flake at the distal margin, giving the flake blank an S-shaped appearance (Rule and Evans 1985). Ellis and Deller (1988:117) also

document curved endscraper flake blanks at fluted point sites in the eastern to central Great Lakes region (Figure 6.1). Goodyear (1974:44) described Dalton endscrapers preforms as curved: “The preform flakes for this tool are always curved to some extent, with often the greatest curvature towards the scraping end.”

Curved blanks for Paleoindian endscrapers might relate to the direction of use, hafting configuration or function. Direction of use varies for historic and modern hide-working tools. Inuit scrapers have been documented as being used in a push motion, while L-shaped Great Plains scrapers were used in sideways motion or in a pulling motion like an adze (Mason 1891:562, 570; Weltfish 1965:369). In their description of Inuit skin scrapers, Nissen and Dittmore (1974:69) found flat hide-working scrapers, and suggest this form might have been preferred. Weedman (2005:192-193) reports that among the Konso of Ethiopia, scrapers are used in a pushing motion when smaller animal skins (sheep and goats) are processed, but a pulling motion at an angle for processing the skins of larger animals (cattle), which are tacked onto a post. Goodyear (1974:44) argued that microwear traces on Dalton endscrapers indicate that endscrapers were probably used in a pulling motion, but occasionally may have been pushed. Australian adzes for scraping wood are pulled toward the user (Figure 6.2). These observations suggest that direction of use for Paleoindian endscrapers might have been variable as well, and that the longitudinal cross-section shape of endscrapers relates to the direction of use and hafting configuration. Specifically, curved endscraper bits might have been associated with a pulling motion and larger hides, especially those staked out or stretched on a frame.



Fig. 3. Nyatunyatjara man using a hafted stone adze to trim a spear.

Figure 6.2. Nyatunyatjara man using hafted stone adze to shape a spear (Gould et al 1971:152).

Other constraints that could have influenced the types of flake blanks used to make endscrapers include raw material availability, quality, and piece size and shape. Morrow (1997) investigated variation in endscraper manufacture in the context of mobility and raw material availability. In a study of endscraper assemblages from three Clovis-age sites from the Mississippi-Missouri-Illinois confluence area (Bostrom, Martens and Ready/Lincoln sites), she found that maximum endscraper thickness decreased with distance from the raw material source (Morrow 1997). Noting that flakes produced from bifacial cores are thinner than those derived from blade cores, Morrow concluded that endscrapers were made from different core forms as distance from source increased (Morrow 1997:80). Her findings indicate that raw material availability could have been a key factor in endscraper blank selection.

In other contexts, the environmental constraints of piece size, quality and quantity of raw material along with availability and difficulty of access to raw material can affect

reduction techniques (Andrefsky 1994; Rolland and Dibble 1990:484). Rolland and Dibble (1990), for example, argued that Acheulian handaxe manufacture was made possible by the availability of large piece sizes, and Levallois techniques were facilitated by high-quality toolstone. In the same way, raw material piece size could have affected how endscrapers were produced as well as their form. Use of small piece sizes and poorer quality toolstone might have been associated with unanticipated need for endscrapers. Importantly, while effective endscrapers might have been manufactured from small-sized pieces, the same might not have been true for Paleoindian projectile points, potentially creating differences in the allocation of toolstone to these two tool classes. For Folsom points, relatively large cores or flakes would have been required to produce a preform (Ingbar and Hofman 1999:101). As such, raw material piece size could have greatly affected not only the endscraper production but endscraper size and form.

This research examines the production of endscrapers through documentation of morphological traits. I am address the question of whether Folsom weapons and endscraper production was linked as Judge (1973:289) suggested, or separate. Identifying strategies of production for these tool types can potentially provide clues as to the gender of the tool makers.

Design Considerations

Design is important to this study because design features may provide clues as to function of a tool. Endscrapers of different functions might be expected to be distributed differently on an archaeological site, and could also relate to the gender of the tool user, and so are considered here. Nelson (1991:66) defined design as “conceptual variables of utility that condition the forms of tools and the composition of toolkits.” Design considerations

ultimately affect tool-making behaviors and tool form, including core preparation, flake blank selection, tool proportion, edge angle, ease of repair, use-life, hafting techniques and multi-functionality (versatility). A number of different approaches to design criteria have been proposed. Bleed (1986) considered tool design from the viewpoint of risk, introducing the terms “reliable” and “maintainable.” Reliable designs are “over-designed” with carefully fitted parts, good craftsmanship, specialist manufacturing and maintenance outside the context of use. Maintainable designs are those that can be easily repaired or converted for other uses when needed. Nelson (1991) further subdivided maintainable designs into two categories: flexible and versatile. Under Nelson's definition, flexible designs change in form to meet a variety of needs. Versatile designs are generalized tools that can perform multiple types of tasks without changing form (Bleed 1986; Nelson 1991:70; Shott 1986:19, 35-38).

Hayden et al. (1996) amended Bleed's (1986) and Nelson's (1991) approaches to design. They argued that the term “maintainability” has limited value since most tools, aside from utilized flakes, require some maintenance (Hayden et al. 1996:12). They also pointed out that some of Bleed's criteria for maintainable tools are not operational (Hayden et al. 1996:12). Others have argued that tools can be both reliable and maintainable and that some tools are neither reliable nor maintainable (Torrence 1989; Torrence 2001:83). Hayden et al. (1996:13) questioned whether the term “versatile” refers to the number of employable units of a tool (as used by Shott 1986) or whether it refers to different uses to which a tool is put. They also suggested that Nelson's definition of flexible design is equivalent to recycling and scavenging behavior, and recommend dropping the term entirely. Following their critique of previous discussions of tool design, Hayden et al. (1996:11, Figure 1) presented design considerations they feel are both measurable and unambiguous: size and weight, edge angle

and form, prehension and hafting, use life, specialization, reliability (robustness and overdesign), ease of repair and multi-functionality (versatility). They also outlined of number of constraints on tool design, including task constraints, material constraints, technological constraints, socioeconomic constraints, and prestige and ideological constraints (Hayden et al. 1996: Figure 11).

Because the design terms Bleed used suffered the same definitional problems as curation, I use the design considerations terms outlined by Hayden et al. (1996) to structure this research. The design criteria of interest in my study include outline shape, size, weight, use life, edge angle, edge shape, resharpening, hafting and multi-functionality. These design considerations clearly can in some cases affect one another and cannot be treated as completely separate features.

Outline Shape, Size, Weight and Use Life. Kuhn (1994) discussed the overlapping design considerations of size, weight (mass), and use life under the constraint of high mobility. He treated the problem of tradeoffs between portability, durability and potential utility as an optimization problem with durability and utility maximized and tool weight minimized. Because the entire length of endscrapers is not useable due to hafting limitations, Kuhn set the potential utility of endscrapers as equivalent to the overall length minus the unusable portion (1994:430, Figure 1). He calculated the optimal size of endscrapers using a simple formula of endscraper utility (usable length) divided by endscraper mass, and found that “surprisingly small artifacts” were the most efficient (Kuhn 1994:432-33, Figure 5). Because relatively small tools are more efficient than larger ones, Kuhn suggested that “it may be unrealistic to expect multi-functionality to be an important concern in designing assemblages of transported stone tools.” This principle could explain the existence of many apparently

specialized flaked tools in Folsom Paleoindian chipped-stone assemblages (Kuhn 1994:434). Kuhn's conclusion contrasts with the idea that mobile toolkits should contain tools that can be easily recycled into other forms (Goodyear 1989). Surovell (2003:216-221, 248, 318), however, tested Kuhn's model on assemblages of Folsom and Goshen endscrapers and concluded functional efficiency, rather than transport efficiency, was the main factor affecting endscraper size.

Deacon and Deacon (1980:35) proposed that differences in scraper sizes could relate to the processing of different animals in prehistoric southern Africa. Smaller scrapers, they argued, could have been used on thinner-hided animals such as duiker and steenbok to make small objects and clothing. Larger scrapers could have been used to process the skins of bovids and used to produce sleeping skins, sandals and large bags. Scrapers observed from southern Africa in the late 1800s were used to scrape fat off skins, with larger scrapers used to process larger animals and smaller ones used mainly by children to process smaller animals (Mazel and Parkington 1981:24). Weedman (2005:185) pointed out that modern Gamo hide-workers select flakes not too thin for scrapers. Endscrapers of different dimensions might be associated with the processing of different animals rather than with transport considerations.

Edge Angle and Edge Shape. Paleoindian scholars have examined endscraper edge angles as a means of determining function. The relationship between edge angle and function is complicated because edge angle might be related to reduction intensity rather than function. There does appear to be a general relationship between edge angle and hide-working scrapers. As is often stated, endscrapers used to scrape and thin hides must be sharp enough

to remove tough material, but not so sharp as to punch through the skin (Boszhardt and McCarthy 1999; Cassell 2005:107; Clark 1958:144; Semenov 1964).

In Wilmsen's (1968) examination of 269 Paleoindian endscrapers, he concluded that different edge angles are associated with different types of use-wear. He proposed that more acute angles (46-55 degrees) were associated with hide-working wear, while steeper angles (66-75 degrees) were associated with harder contact materials, such as wood and bone. In his examination of Dalton endscrapers from the Brand site in Arkansas, Goodyear (1974:45, 47) discovered that hafted and unhafted endscrapers had similar mean edge angles. However, he did find a difference in edge angle between Dalton point endscrapers (scrapers made on recycled points) and hafted endscrapers, and suggested that the former were used on hides while the latter were used on harder material.

Endscrapers are typically rounded on the working edge, though some appear somewhat straighter than others. Rounded endscrapers might be more effective at working a pliant material such as a wet hide (Goodyear 1974:43). Tahltan women of British Columbia deliberately rounded the edge of their scraping implements into a convex working edge to prevent tearing the hides (Emmons 1911:83). Australian woodworking adzes exhibited a convex working edge at the beginning of their use-lives, yet appear to have developed a straighter or even concave edge at the end of their use-lives (Figure 6.3–6.5).

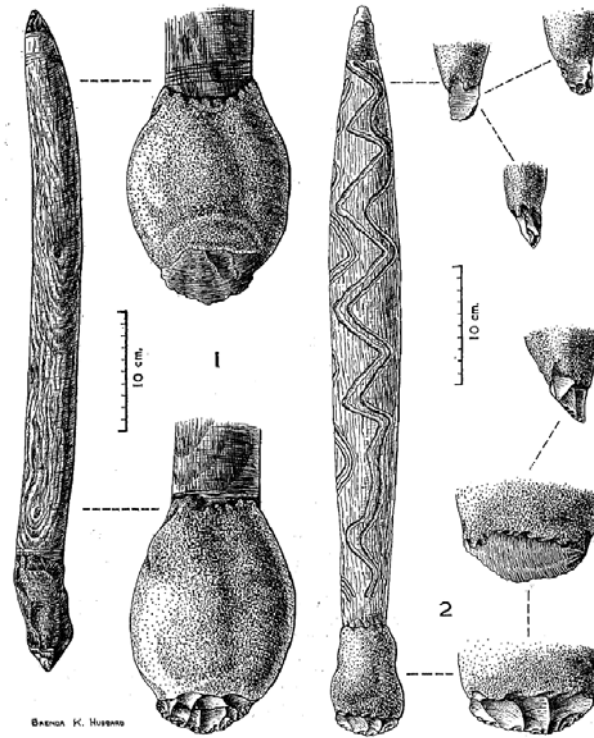


Figure 6.3. Australian hafted woodworking adzes called 'kandi 'tjuna (1) and 'kandi 'meru (2) (Tindale 1965:134).

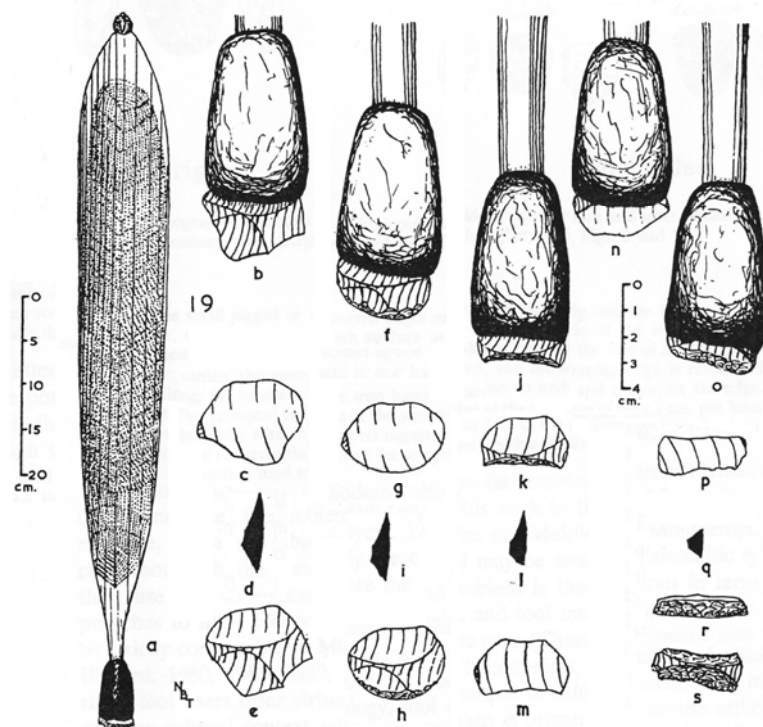


Figure 6.4. Life cycle of an Australian hafted adze (Tindale 1965:153, Figure 19). a) 'kandi 'meru used for cutting meat, sharpening spears, and making new spear shafts; b) Random flake newly inserted in position of use; c-e) two views and cross-section of the same; f-i) second day, showing retouch j-m) seventh day, with cutting edge with second margin showing resharpening; n) eighth day, with stone reversed; o) twelfth day with second margin showing resharpening; p-s) three views and cross-section of a stone at moment of discarding.

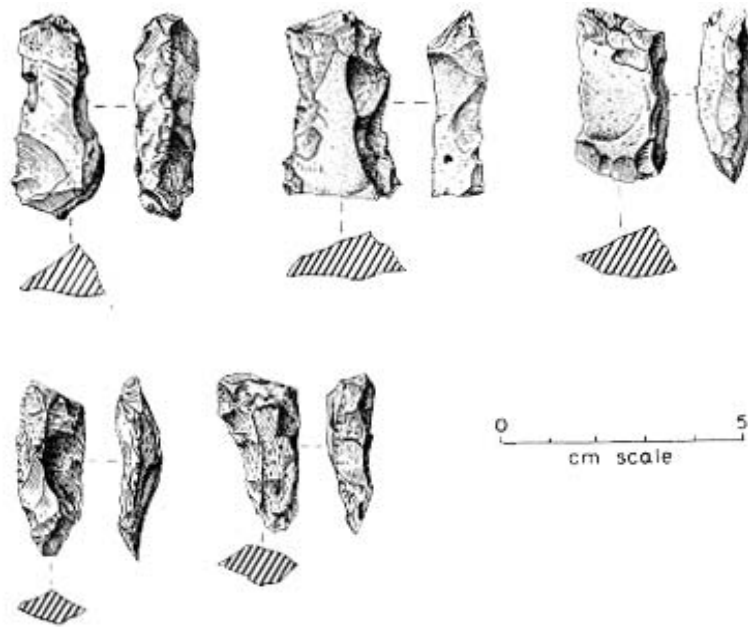


Figure 6.5. Australian burren adzes and tula adze slugs (Gould et al. 1971:154, Figure 4).

Resharpening. Kuhn (1990:583) stated, “The resharpening of tools is an economical tactic for producing sharp, usable edges while minimizing the cost of transporting multiple tools or bulky raw materials.” Resharpening extends the use life of a tool while easing transport costs. Goodyear (1979:4) referred to technologies that “can be continuously and reliably rejuvenated” as “flexible” technologies (but see Nelson’s 1991 definition). It is clear that Paleoindian endscrapers were continuously resharpened along one working edge, as evidenced by the discovery of endscraper resharpening flakes, which in some cases contain traces of use-wear (Frison 1968; Hayden 1979a:68; Shott 1995). Endscraper resharpening flakes are usually small and thin with small, plain platforms. Frison and Bradley (1980:30) reported that all unifaces at the Hanson site were resharpened using a direct percussion technique, but no specific pattern of resharpening was detected. Judge (1973:111) noted that Paleoindian scraper-resharpening flakes were the products of soft hammer flaking and retained remnants of the previous working edge. Unfortunately, because of the small size of

scraper resharpening flakes, they might have gone unnoticed in early excavations that did not use screens or employed larger screen sizes ($\geq 1/4$ in.).

Endscraper resharpening could have been accomplished with a bone tool, similar to the one pictured in the Merrill et al. (1997:119, Figure 34) guide to historic Kiowa collections at the Smithsonian Institution. Clark and Kurashina (1981) note in their study of modern-day Ethiopian hide-working that hide-workers attempted to minimize the size of the resharpening flake, thereby increasing the use life of the tool. Paleoindians might also have attempted to reduce the size of resharpening flakes in order to further economize toolstone and increase a tool's use life.

As mentioned in the previous discussion of curation in this chapter, resharpening has been considered a form of curation in that it extends a tool's use-life, advantageous under conditions of mobility, activity scheduling and raw material constraints. Other factors could have affected whether an endscraper was resharpened. Kuhn (1990) suggested that endscraper resharpening might have served to dull the working edge in order to prevent cutting through animal hides. Resharpening of hide-working stone scrapers could have been as much a function of eliminating sharp projections as sharpening the edge (Gallagher 1977). This, of course, would only pertain to those endscrapers that were used to process hides as opposed to working wood or some other material. If so, it is possible endscrapers used for different purposes could have had flakes removed from the margins for different reasons.

Hafted tools might have been more likely to be resharpened because of the time and effort involved in retooling a handle (Keeley 1982:799; Odell 1994:54; Shott 1986:39). Hayden (1977:180) reported that by resharpening an Australian adze, the user could obtain more use from the tool before having to take the time to rehaft another. Similarly, Boszhardt

and McCarthy (1999) explained that “Frequent replacement requires more raw material and is more time consuming than resharpening a tool while in the haft.” Hayden (1979a:37) reported that rehafting of an adze by using plant or tree resin took approximately three minutes. Because of the time associated with hafting a new tool, resharpening could have occurred even when toolstone was abundant and transport costs were not significant. In addition, endscrapers used in different modes (hafted/not hafted) might have been subject to different resharpening intensities.

In addition to resharpening through retouch, other techniques were used by Paleoindians to extend the use-life of endscrapers. Some endscrapers from the Lindenmeier site in northeastern Colorado had their bits truncated by burin-like blows (Figure 6.6) in order to rejuvenate them (Wilmsen and Roberts 1978:98). Similar burin endscraper resharpening has also been reported from the Hot Tubb Site in west Texas (Meltzer et al. 2006) and from late prehistoric scrapers in west central Texas (Shafer 1970). Shafer outlined three techniques for rejuvenating unifaces in which flakes are removed from the 1) longitudinal, oblique or transverse axis, 2) the interior face, and 3) the exterior face (Figure 6.7). Similar flake removal was reported by Huckell and Haynes (2003:365) on ovoid scrapers of the early Holocene Archaic Ventana Complex, and on hafted Arctic scrapers (Hayden 1979a:211; Nissen and Dittmore 1974:69). In their study of Ethiopian hide scrapers, Clark and Kurashina (1981:308) observed that the entire working edge of hide scrapers is removed during refurbishment. From his work with south-central Ethiopian hide-workers, Gallagher (1974:81) reported the entire blunted edge of hide scrapers is sometimes removed.

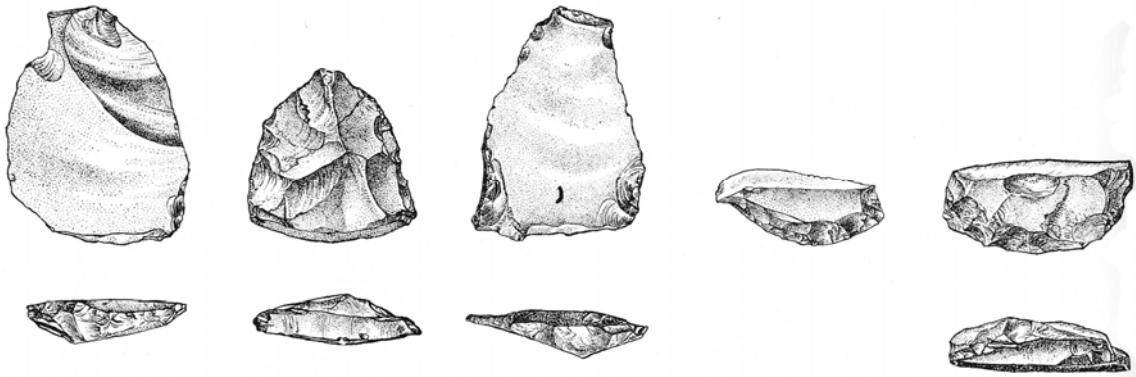


Figure 6.6. Endscrapers from the Lindenmeier Site with working edge refurbished by laterally applied burin blow (from Wilmsen 1972:98).

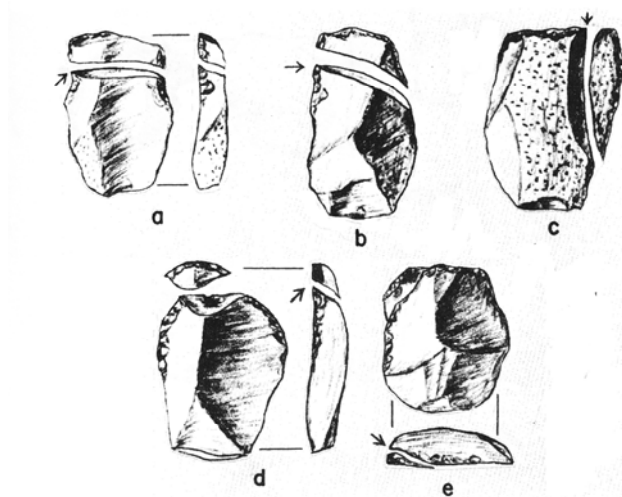


Figure 6.7. Different uniface rejuvenating techniques: a) transverse burin b) oblique burin c) longitudinal burin d) removal of exterior flake e) removal of interior flake. Arrows describe direction of blow (from Shafer 1970:481).

Hafting. Keeley (1982:799) defined hafted tools as implements “that have been (or are) inserted into or attached by some means to another element, usually a handle or a shaft.”

Rule and Evans (1985b:215) described this advantage of hafting as greater and more precise energy conversions. Hafting benefits include improved control over a tool in the presence of

blood and grease and increased mechanical force (Kehoe 1973:99; Wilmsen 1968; Wilmsen and Roberts 1978:170).

Endscraper hafting involves additional tool preparation and suggests a relatively long use-life compared to unhafted tools; therefore, tool hafting is associated with the concept of curation (Keeley 1982:798-799; Shott 1986:39). Of course, often the handle or shaft rather than associated stone tool had the longer use life (Deacon and Deacon 1980; Keeley 1982:800; Mason 1891:85; Nissen and Dittmore 1974; Shott 1986:199; 1989a:19).

In an early study of Upper Paleolithic scrapers, Barnes (1932:43) pointed out that hafting could have been accomplished in a number of ways, and suggested several factors that relate to hafting including: (1) shape of the tool; (2) wear traces on the working edge; (3) modifications to facilitate prehension; (4) comfort in use; and (5) tool size. Keeley (1982:799-801) defined three haft types, which are often used in combination with each other: (1) the jam haft, in which the tool is inserted into a slot or hole and is held by wrapping or mastic; (2) the wrapped haft, in which the tool is lashed to a handle or shaft; and (3) the mastic haft, in which the tool is attached by means of a glue, resin or tar. Keeley suggested that differences in tool morphology relate to hafting techniques rather than function. Hafted tools, he proposed, were (1) morphologically discrete, (2) small and thin and (3) had tangs, bilateral notching or shoulders.

Ethnographic, archaeological and use-wear studies indicate that Paleoindian endscrapers were often hafted, though the specific type of hafting is unknown (Clark 1958:146; Clark and Kurashina 1981; Gallagher 1977; Giglioli 1889; Kay and Martens 2004:49; Metcalf 1972; Murdoch 1892; Nissen and Dittmore 1974:69; Wedel 1970). Evidence for Paleoindian endscraper hafting has been examined by a number of researchers.

Goodyear (1974:44) argued that lateral chipping, tapering, and notching on Dalton endscrapers was suggestive of hafting, and Frison (1987:245) proposed that endscrapper lateral modification at the Horner site was suggestive of modification for hafting as well. Lateral notching, crushing and snapping, along with proximal thinning and tapering of scrapers from the Shawnee Minisink site, has been argued to indicate hafting (Rule and Evans 1985; Shott 1995). Rule and Evans (1985:216) argued that different types of modification indicate different types of hafting configurations, suggesting that notching and lateral crushing were indicative of hafting, while tapered endscrapers are indicative of socketing. Miles (1963:70) noted that Eskimo women's knives are sometimes notched to facilitate hafting, and Tindale (1972) suggested that notches on some Australian and Tibetan stone tools might have facilitated skin haftings. Facial thinning of Paleoindian endscrapers reported by Rule and Evans (1985:218) and Shott (1995:59) could represent the depth to which endscrapers were positioned in the haft. In discussing distal-edge tools at the Lindenmeier site in Colorado, Wilmsen and Roberts (1978:162) noted the uniformity in endscraper width and thickness and suggested that this homogeneity could reflect necessary proportions for hafting or socketing. At the Cattle Guard site, the bulb of percussion was removed from an endscraper, perhaps to accommodate a haft (Jodry 1999a:227).

Hafting has also been investigated using microwear traces, including linear abrasions on the interior and exterior surfaces, smoothing or abrasions on protrusions such as bulbs, and polish on lateral margins and ridges (Cahen et al 1979:681; Jensen 1982; Odell and Odell-Vereecken 1980). Beyries (1988:119-120) argued for hafting of Middle Paleolithic convergent sidescrapers based on striae, polishing and crushing occurring on the proximal two-thirds portion of these tools. Hafting wear, however, is only produced under certain

favorable conditions, and the absence of hafting wear does not indicate the absence of a haft (Odell 1996:56).

Evidence for hafting has also been described for late prehistoric endscrapers from North America. In a study of Piney Ridge site in Wyoming, endscrapers from the late 1500s C.E., Frison (1968:152) remarked that, “It is suggested that most endscrapers were hafted, judging from the polish on the ridges between the flake scars on the back of the tool.” For late prehistoric Dorso endscrapers of the lower Pecos River region, Bement and Turpin (1987) noted that wear on the exterior spine and proximal lateral edges suggest hafting onto a bone or wooden shaft, but judged that the wear is less pronounced than on Plains scrapers. Wedel (1970:38) documented a late Prehistoric Plains endscraper with lateral edge dulling, which Shott (1995:58) suggested was used to prevent cutting through the haft binding. Endscrapers at the Meso-Indian Hagen site in Alberta, Canada, may have been notched to facilitate hafting (Wormington and Forbis 1965:45).

Endscraper breakage patterns are also suggestive of hafting or socketing. Shott (1995:58-59) documented broken endscraper bits as well as tool fragments lacking bits at the Leavitt site in Michigan. He suggested that these breaks could have occurred during resharpening of endscrapers, noting that the recurrent pattern of transverse breaks just proximal to the bit are unlikely to be caused by trampling or other post-depositional processes (1995:58). At the Clovis-age Shawnee-Minisink site, 77 percent of fragmentary endscrapers were broken at the suspected hafting point, and might have snapped during tool use (Rule and Evans 1985). Frison (1987:246) also suggested that endscraper transverse breaks at the Horner site indicate hafting. At the Brand site, transversely snapped endscrapers hint at hafting, and Goodyear (1974:44) remarked that “It is difficult to see how usage in the

hand would be sufficient to snap such a thick area.” Semenov (1964:88) proposed that breakage of some Upper Paleolithic endscrapers might imply their use in handles, although Semenov (1964:88) along with Barnes (1932:44) conjectured that most Upper Paleolithic endscrapers were used without handles.

Many of the tools observed by Semenov were manufactured on long blades; he observed that approximately 80 percent of endscrapers were worn on the right side, a possible product of being used without hafts by a right-handed tool user (Semenov 1964:88). MacDonald (1968:92) made a similar argument, commenting that hafted endscrapers should exhibit wear on the center of scraping edge, whereas handheld tools should have wear on the side of the tool since the hand should be canted to the left or right, depending on the handedness of the person. Interestingly, Nissen and Dittmore (1974:71) reported that most of the socketed Eskimo skin scrapers in their sample (n=9), which were used in a pushing motion away from the user, exhibited greater wear of the left dorsal sides of the bits (at 75 X magnification).

Several examples of historical and modern-day hafting and socketing of endscrapers are available that can potentially shed light on Paleoindian hafting techniques. Historical Great Plains hide-working scrapers were hafted onto L-shaped antler or wood handles (Metcalf 1972; Weltfish 1965:369). Wheat (1979:109) suggested that the Paleoindian endscraper was hafted onto a similar adze-like haft. However, these L-shaped handles were used with metal scraper blades, and Wissler (1934) concluded that it was unlikely that stone scrapers were used with the same handles: “The chipped scraper found in archaeological collections from the Plains area cannot be fastened to the handle in the same manner as the iron blades, the latter being placed on the inner or under side, while the shape of the chipped

stone blade seems to indicate that it was placed on the outside” (1934:62-63). However, Wissler (1910:66) wrote of the Blackfeet that “Old people say that formerly, the blades were of chipped stone, but that iron has been in use for a very long time.” There is little archaeological evidence regarding how prehistoric Plains chipped stone scrapers were hafted, though curved antler handles with endscrapers still in place have been recovered from archaeological contexts (Vanderver 1977; Wedel 1970). It is possible a similar configuration was used in Paleoindian contexts.

Several different types of scraper handles and hafts have been reported ethnographically. In historic times, Inuit women used flint, jasper or even sandstone scrapers to process animal skins, which were often socketed into a handle of ivory or wood (Ford 1959:193; Murdoch 1892:294-298). Murdoch (1892:294-298) described several variants of scraper handles and observed that the wooden handles often had larger stone bits than the ivory ones, suggesting that handle material could have an effect on the size of the tool that can be accommodated in the haft or socket. Both curved and straight endscraper shafts have been reported among Alaska and Canada natives (Boas 1907:32-34; Murdoch 1892:298). Wilmsen (1968:157) noted that both Arctic and Paleoindian endscrapers exhibit lateral crushing where the haft likely made contact with the tool, and Nissen and Dittmore (1974:69) suggested that lateral modification on ethnohistoric Arctic scrapers was performed intentionally in order to fit the tool into the socket.

In their use-wear study of modern Ethiopian scrapers, Clark and Kurashina (1981:309, 312) observed discontinuous triangular flake scars along the edge of the tool that contacts the wooden socket, and that a minimum scraper length was required to secure the scraper in the handle. Among modern-day Ethiopian hide-workers, Gallagher (1977)

documented thinning the bulb of percussion area to facilitate hafting, and Brandt and Weedman (2002:51) report modern-day Konso women of Ethiopia using chert and quartz scrapers socketed into wooden handles. Among the Gamo of Ethiopia, two different scraper forms and scraper handles are used (Weedman 2002). Adzes used for woodworking by Australian aboriginals had the bulb removed, perhaps to facilitate hafting (Hayden 1979a:34, 114).

From a Later Stone Age context in southern Africa, Deacon and Deacon (1980) described a small convex scraper with adhering resin. In another archaeological example from southern Africa, the handle and resin are intact, with a portion of the stone scraper remaining (Figure 6.8). Combining observations from these two artifacts, Deacon and Deacon (1980) surmised that prehistoric scrapers may have been mounted at a nearly right angle to the handle rather than end-mounted. They further suggested that these tools were used for hide-working, and point to similarities between the archaeological specimens and the larger modern stone hide-working implements observed by Gallagher (Deacon and Deacon 1980:35).

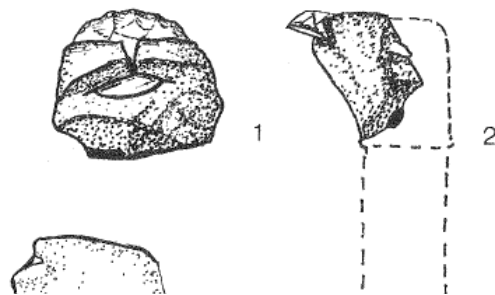


Figure 6.8. Archaeological convex scraper from Later Stone Age southern Africa and speculated hafting configuration (Deacon and Deacon 1980:32, Figure 1).

While there is considerable archaeological, ethnographic and ethnohistoric evidence to suggest that Paleoindian endscrapers were often hafted, this may not always have been the case (Frison 1987:246). A single group could have used a variety of hafting techniques or used both hafted and unhafted tools for the same purpose (Keeley 1982:801). Keeley (1982) argued for hafted and non-hafted endscrapers at the Late Paleolithic site of Meer II in Belgium. Evidence for both hafted and unhafted endscrapers was observed at the Potts site as well, a predominantly Gainey phase site in southern Oswego County, New York (Lothrop 1989:114). Handheld endscrapers might have been used to scrape difficult to reach areas of the hide such as the area around the lashing or stakes (Jodry 1998:229). Unhafted endscrapers may have been used at the Dalton-age Brand site based on the absence of an oblong endscraper shape and lack of lateral modification (Goodyear 1974:45). In the recent past, Tahltan women of northern British Columbia used both hafted and handheld stone tools for softening animal hides (Albright 1984:57-58). Today, both handheld and hafted scrapers are used by modern-day hide-workers to process cow hides (Clark and Kurashina 1981:308). In Australia, woodworking scrapers were also sometimes handheld (O'Connell 1977:276).

These ethnographic and ethnohistoric examples indicate that several different hafting techniques are possible for scraping tools. Techniques such as lateral modification, bulb removal and notching could have been used by Paleoindians to facilitate the hafting of endscrapers. The particular type of haft used could have affected how an endscraper was modified as well as the type and location of use-wear and hafting wear. Because Paleoindian endscrapers might have been used for different purposes, with different hafting requirements, variations in modification could be associated with different endscraper function. Paleoindian

endscrapers that were not hafted would not exhibit modifications associated with hafting or socketing such as lateral retouch, facial thinning and bulb removal. In addition, non-hafted endscrapers could exhibit different reduction intensities than hafted ones. In this study I look at endscraper morphometrics at the Rio Rancho Folsom site to explore whether endscrapers were similar in terms of dimensions, which possibly also suggests similar hafting configurations as well as function. These data can potentially provide information about activities that took place in different areas of the site as well as provide further clues as to the gender of the tool user.

Multi-functionality. Paleoindian endscrapers sometimes display modifications that imply other uses. Spurs on the distal corners of Paleoindian endscrapers are common, suggesting modification for boring (Byers 1954:349; Frison 1991; Morrow 2000; Rogers 1986; Wilmsen 1968; Wormington and Forbis 1965:187). Endscrapers with spurs are only weakly diagnostic of the Paleoindian period (Frison 1987:246, 267; 1991:128, 131; Hester 1972:125; Rogers 1986; Wheat 1979:108; Wilmsen 1968) as they also occur in the later occupations of North America (Irwin-Williams 1973). Although spurs occur on Clovis endscrapers, they appear to have been more common during the Folsom period (Hester 1962:125). Rule and Evans (1985:214, Figure 9.2) recognized two types of spurs—primary and secondary—in the Shawnee Minisink endscraper assemblage. Primary spurs were “incorporated into the tool during initial manufacture” and secondary spurs were produced on broken endscrapers. In both cases, spurs were interpreted as intentional modification. In a study of 1,448 Paleoindian tools, Wilmsen (1968) discovered that artifacts with spurs fell within the edge angle range of 66 to 75 degrees, which may indicate that spurs were associated with certain endscraper functions. From this perspective, spurs were intentionally created after the working edge had

become dulled, and used in conjunction with the previous scraping task, such as cutting animal skin after processing it (Goodyear 1974:55; Judge 1973:101–103). Spurs might have been used to work wood. Osgood (1940:94) described an Ingalik stone bone cutting tools that bears some resemblance to endscraper spurs. In the recent past, Australian stone adzes of the Western Desert were mounted on a spear thrower. At one end was a wood chisel and the other end was a wood engraving tool, similar to an endscraper spur (Gould et al 1977:155, Figure 5; Tindale 1965:136-138).

Endscraper spurs could have been the unintended result of resharpening events rather than intentional functional elements (Morrow 1997:75; Nissen and Dittmore 1974:71; Rule and Evans 1985:14; Shott 1995:60). Shaping the lateral edge of an endscraper for socketing or hafting, in combination with reduction of the working edge, could have created a spur at the corner of the lateral and working edges. Nissen and Dittmore (1974:71) reported a spur on an historic socketed Inuit endscraper, and argued that the spur could not have easily functioned as a tool while still fastened to the handle, and therefore was not intentionally created. Similarly, Shott (1995) suggested that the “sharp projecting corners” recorded by Clark and Kurashina (1981) on Ethiopian hide-working endscrapers were incidentally created through resharpening. More recently, Weedman (2002, 2010) has argued that spurs found on Gamo Ethiopian hide-working tools are largely the result of inexperienced hide-workers.

Notches also occur on endscrapers, sometimes in conjunction with spurs. Judge (1973:92) reported the presence of notches on endscrapers from the central Rio Grande Valley and suggested that they may have acted as spokeshaves. Notches occur on Folsom endscrapers at Agate Basin (Frison 1982:45). In some cases, notches might not have been used as functional working edges, but to facilitate hafting.

In this study I look at endscraper morphometrics at the Rio Rancho Folsom site to explore whether endscrapers were similar in terms of multi-functionality and modifications, which can possibly provide information about function. These data can potentially provide information about activities that took place in different areas of the site as well as provide further clues as to the gender of the tool user.

Discard Processes

Because this research compares the distribution of weapons and endscrapers, it is relevant to discuss discard processes, especially differences in the context of discard for these two tool types. The processes by which items in a cultural system enter the archaeological record are called formation processes (Ammerman and Feldman 1974; Binford 1973, 1977; Schiffer 1983; 1987:7). One important component of formation processes is discard. Discard processes such as breakage, loss, recycling, abandonment, and depletion affect the use life of a tool, which can be defined simply as the length of service of a tool or tool class (Shott 1989a:10). Shott (1989a:17) outlined six different types of discard processes: (1) depletion, (2) abandonment during or after production, (3) loss or breakage in use, (4) recycling, (5) abandonment in use and (6) breakage in production. Other discard processes could include interment in burials and caching (Schiffer 1987:47). Shott (1989a:12-13) observed that without considering discard processes and use life in the formation of !Kung San camps, there was no clear correspondence between camp activities and assemblage composition, and only through consideration of discard process, use life and camp activities could the relationship between !Kung San camp activities and camp residues be understood.

One type of depletion is attrition, which Schiffer (1987:48) defined as the removal of part of a tool's surface during use. The second component of tool depletion is resharpening,

in which a tool is refurbished by removal of material from the working edge. Paleoindian endscrapers were clearly resharpened, as evidenced by the discovery of endscraper resharpening flakes, which in some cases have traces of use-wear (Frison 1968; Hayden 1979a:68; Shott 1995). Both attrition and resharpening would have a direct effect on the use life a tool and the likelihood of discard.

Knowing the rate at which endscrapers were depleted is important in understanding how endscraper assemblages might have formed. The rate of attrition for endscrapers during use could have been affected by a number of factors. For example, Shott (1995:66) suggested that for endscrapers used on hides, raw material resistance, hardness, and grain, the presence of grit and sediment, the degree to which hides are worked, and wet versus dry conditions could have affected the endscraper attrition rate. Interestingly, Albright (1984:54) noticed that Tahltan hide-workers were careful to keep a skin being dressed clear of dirt as this would create a difficult-to-remove black stain.

Resharpening, defined as the removal of mass from the working edge of the tool, is the second component of depletion. Resharpening effectively increases a tool's use life. Both experimental research and ethnographic studies suggest that endscraper depletion in hide-working (attrition and resharpening) may have been quite rapid (Table 3.1). It is possible that most Paleoindian endscrapers were discarded in their place of use, resulting in what Schiffer calls "primary refuse" (1987:58). However, the experimental and ethnographic information can be difficult to interpret because tool depletion during use can be measured in a variety of ways, including number of strokes taken before resharpening (Gallagher 1974:181, 1981; Hayden 1979a); number of times used; and overall time used (Shott 1989a:10).

Breakage. Endscraper breakage, a second discard process, could have occurred during resharpening events, when excessive force was applied to the edge, or alternatively, endscrapers could have broken during use from excessive pressure on the tool. It is expected that endscrapers used on harder materials such as wood and antler were more susceptible to breakage during use than those used on softer materials such as wet hides. At Ringkloster, a late Mesolithic site in Denmark, Jensen (1982:324) found that broken blade scrapers showed a higher frequency of wood use-wear than did unbroken scrapers. He suggested that the woodworking scrapers may have had a tendency to break more often than hide scrapers, or the broken implements could have been used for delicate woodworking. Weedman (2002:739) found that breakage rates for modern-day Ethiopian Gamo endscrapers are low (4.8%) and reports that breakage typically occurs among inexperienced hide-workers. Breakage patterns are relevant to this study as they could potentially help identify different endscraper function, and possibly provide clues as to the gender of the tool user.

Recycling. Schiffer defined recycling as the “routing of an element at the completion of use to the manufacture process of the same or a different element” (1995:27). Recycling is sometimes thought of as another component of curation because it extends the life of the useable toolstone (Binford 1979; Goodyear 1989). Goodyear (1989) considered recycling of tools a flexible strategy for dealing with situational contingencies in which tools could be put to use for a range of purposes. As with resharpening, Goodyear (1989) suggested that highly isotropic raw materials are conducive to creating tools that could be successfully recycled. Recycling, like resharpening, economizes the toolstone supply when future shortages are anticipated (Bamforth 1986a).

Paleoindian endscrapers were sometimes recycled into other tools, and in some cases, other tools were made into endscrapers. In his study of the Leavitt (Parkhill phase) and Gainey (Gainey phase) sites in Michigan, Shott (1989a) found that the Leavitt site endscrapers exhibited greater incidences of recycling than in the earlier Gainey site. His findings are compatible with his premise that frequency of movement rather than total distance should be associated with greater tool recycling. At several Dalton-age sites, Goodyear reported that Dalton points were reworked into endscrapers (Goodyear 1974:33-37; Wyckoff 1999b:54). At the Lindenmeier site, Wilmsen and Roberts (1972:99) documented reuse of the lateral edges of an endscraper after breakage (Figure 6.9), and pointed out that at the Lindenmeier site projectile points were sometimes converted into scrapers (Wilmsen and Roberts 1978:172, Figure 150). Ellis and Deller (1988:118) described a trianguloid endscraper from the eastern and central Great Lakes region that was recycled into what they termed a “narrow endscraper.” Similarly, Gramly (1982:40) reported that trianguloid endscrapers were reworked into limaces at the Vail site in Maine. At the Jurgens Site in Colorado, a biface had an endscraper configuration at one end (Wheat 1979). An endscraper was reportedly made from a channel flake from the Elida site in eastern New Mexico (Warnica 1961). As many as 50 percent of endscrapers were converted into *pièces esquillées* and cutters at the Vail site (Gramly 1982:34-35), and endscrapers were recycled into *pièces esquillées* at Nobles Pond in Ohio as well (Gramly and Summers 1986:104). Wormington and Forbis (1965:186) indicated that at several Cody localities in Alberta, Canada, broken points were sometimes used to produce scrapers. Likewise, at the Vail site, projectile points were recycled into endscrapers (Gramly 1982:28). At the Piney Ridge site, a

sixteenth century A.D. bison kill and butchering site in northern Wyoming, Frison (1968:154) documented a sidescraper that was modified into an endscraper (Figure 6.10).

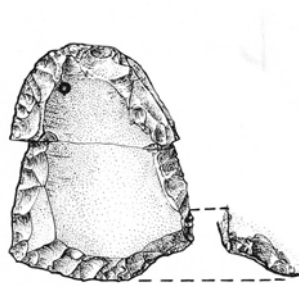


Figure 6.9 Broken and refitted endscraper from the Lindenmeier Site indicating reuse of lateral edges after breaking (Wilmsen 1972:99).

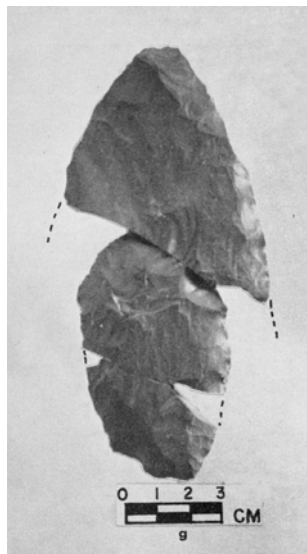


Figure 6.10. Endscraper made from broken sidescrapers (Frison 1968:151, Figure 2g).

In many cases, endscrapers seem to have been created from existing tools, rather than transported as finished endscrapers to sites. In these instances, it is possible that scraping tasks were not anticipated in advance, and tool accommodations were made spontaneously, or as “situational gear.” In other cases, endscrapers were recycled into other tools. It is possible that these tools, such as graters, were related to the type of scraping task.

Tool Abandonment. Schiffer (1972:159) observed that tools with some remaining use life occur frequently in the archaeological record. He points out that tools might have been simply lost, or the cost of recycling, maintenance and transport might have been higher than replacement costs. Schiffer (1987:89) described the type of refuse associated with this practice as “de facto refuse,” in which still usable tools, facilities and structures are left behind when an activity area is abandoned. Binford (1979) referred to this second technological strategy as “scuttling.” Abandonment of endscrapers could have occurred in cases where material was abundant, or the future abundance of raw material was anticipated, or when demand for scraping tools was low or all of the above. As with the case of the Hanson site, which had abundant local material, still usable endscrapers were abandoned, while new ones presumably were added to the existing toolkit.

Hafting Effects on Discard. As mentioned, hafting could have played a role in how tools were discarded. Keeley (1982:798) made the important point that hafted tools are not always discarded in their context of use, due to retooling at other locations. In contrast, unhafted tools, are more likely to be discarded where they were used. Keeley also noted that retooling of hafted tools can occur when it is convenient, rather than when immediately necessary, and can occur when material is abundant in “anticipation of future shortages” (1982:804). In an area where toolstone is readily available, hafted tools may be conserved for later, while handheld tools might be preferred (Keeley 1982:803). In this way, hafting is a critical component of this research, as it could have had consequences for both endscraper morphological traits as well as discard patterns.

Endscraper and Weapons Discard Processes Compared

Discard processes for weaponry and endscrapers were likely quite different given their different contexts of use. Hofman (1999) outlined several predictions concerning Paleoindian weaponry loss, taking into account factors such as carcass density, duration of processing, retooling, reuse as knives, site conditions and visibility. Meltzer et al. (2002:26) suggested that “where in the animal the projectile points were embedded, the degree of butchering, whether the point-bearing parts of the animal were removed from the kill area and further processed, and perhaps whether there was a need to recover the artifacts” could all affect recovery. Because Paleoindian weapons were used in the killing of animals, and projected away from the tool user, they were likely more prone to loss and breakage than endscrapers. In her sample of Central Illinois Woodland projectile points, Roper (1979) found that projectile point breakage was most likely due to stresses during use, rather than metric proportions or hafting modes. Weapons breakage, or abrupt mechanical failure, has been studied using experimental approaches as well (Bradley 1974:194-5; Frison 1989; 1991:295; Huckell 1982). Weapons loss might also have varied with experience. Walker et al. (2002:13) discussed how the arrows of young Aché hunters are more likely to be lost than those of more experienced hunters. Despite the expected high incidences of projectile point loss, broken projectile points in spear or dart shafts or in carcasses may have been returned to residential bases, where the weapons toolkit was replenished (Binford 1977, 1979; Keeley 1982 cited in Nelson 1991:79).

In contrast to weaponry, endscraper use life was more likely a function of depletion from attrition and resharpening. Loss is expected to have occurred less often with endscrapers than projectile points as they were used in camp contexts (but see Odell

1981:332-333, 335). Hafting probably also reduced the incidence of loss, such that non-hafted endscrapers may have experienced a greater incidence of loss than hafted ones. Because points undergo a series of steps in manufacture, which can include preforms, abandonment during manufacture may be more recognizable for projectile points than for endscrapers.

Formation of Endscraper Assemblages

In addition to discard processes already discussed, other factors contribute to assemblage formation, including the types of activities conducted at a location, the intensity of these activities, where activities were conducted on the site, and how activities were scheduled in time and space (Ammerman and Feldman 1974).

Activity Intensity. Some attempts have been made to estimate the amount or intensity of scraping activities at prehistoric sites. Again, the problem of tool use life and the amount of material depleted from the original flake blank remain a challenge. An additional problem in these types of investigations is tool transport, because endscrapers could have been removed from their place of use and discarded elsewhere, making inferences about activity intensity at a site difficult. If hides were dressed in a cooperative manner using endscrapers, as has been documented historically, then this would affect the amount of wear accrued on each scraper, and potentially the total number of scrapers discarded. As Binford and Binford (1966: 242) noted, “The number of tools used in processing a hide will be directly related to the number of individuals engaged in the activity and the number of hides processed.” These and other factors make interpreting archaeological scraper assemblages difficult in terms of intensity of activity or number of hides processed.

Despite the difficulties in estimating scraping intensity, Shott (1995) attempted to estimate “how much” scraping activity occurred at the Parkhill Phase Leavitt site in Michigan. He estimated both the flake blank area lost during endscraper depletion and platform area of endscraper resharpening flakes. From this he calculated that nearly 500 resharpening flakes should have been generated from each endscraper. While there were 24 exhausted endscrapers on the site, only 209 resharpening flakes were recovered—a small fraction of what should have been there if all the scrapers had been entirely reduced at the site (i.e., 1200 resharpening flakes). From these calculations, Shott argued that the Leavitt endscrapers were transported to the site in an already highly depleted state. Shott (1995:66) acknowledged that not all resharpening flakes were likely recovered, that some endscrapers could have been removed from the site, and that broken endscrapers were not considered in his estimates. The total number of endscrapers deposited at a site could also be complicated by the nature of their use. Jodry (1999a:235) argued that since different animals have different skin thickness and toughness, the total number of endscrapers used to process different animal hides should vary, affecting the total rate of endscraper discard. Albright (1984:56) commented that animal skins worked by the Tahltan of British Columbia were thickest in the fall and took longer to process in all stages of hide-working. In addition, different animals might have been processed using different techniques. Among the Tahltan, moose, caribou and deer were dehaired, while beaver, bear, sheep and goats were dressed only on the flesh side (Albright 1984:51). Emmons (1911:84) commented that among the Tahltan Indians, skins of smaller animals required very little labor, and only required cleaning, washing and softening. The age of a bison might also affect how intensively the hide was processed. Among the Pawnee, old thin bison hides or hides with thin wool had

their hair removed and were used for bags, moccasins, shirts and other implements (Weltfish 1990:370). The intensity of processing of hides or other materials would also affect the total discard rate. Nelson (1899:115, Plate L, No. 5) described the skin dressing tools of birds and other small animals, which were made of deer antler, as opposed to the stone scrapers used to process larger mammals. The issue of activity is significant, because strategies for supplying endscrapers with raw material might have varied with intensity of scraping activities at a site. Activity intensity could also have an affect on where the scraping activities were carried out and thus on discard behavior.

Seasonality and Activity Scheduling. Seasonal changes in tool use, an important anthropological issue, was brought to the attention of archaeologists in the 1960s (Flannery 1968). Yet, Hurtado and Hill (1990:294) pointed out that few studies have quantitatively examined seasonality among modern-day foragers. They discussed how seasonal changes in technology can be so great that they might be mistaken for cultural differences. Moreover, they pointed out that men's and women's activities and tool demands can change dramatically with season. If women were using endscrapers and their use varied seasonally, it is expected that endscraper technological organization should also change.

Jodry (1999a) discussed the relationship between the seasonal organization of hide processing and endscraper discard. Using ethnographic information, she argued that intensity of hide processing might have varied from season to season, which in turn would have impacted discard rates of endscrapers. Large-scale fall hunts of the Great Plains provided not only a winter's supply of dried meat, but also bison hides for robes, lodges, bags, saddles, bedding, clothing and trade items (Hans 1907:187). Because bison wool was in better condition in the fall, Plains groups made robes and bedding during this time, requiring the

scraping of only one side of the hide (Fletcher and La Flesche 1911:272; Mason 1891:571). Bison robes would deteriorate by summer and the hair would completely fall out by autumn (Weltfish 1965:368), at which time they would be replaced. Adult robes required an entire mature skin, while children could be robed in the skin of a buffalo calf. Since bison shed their winter coat in spring or summer, items that required the removal of hair, such as moccasins, tent covers and clothes, were made during this time (Fletcher and La Flesche 1911:272; Weltfish 1965:368; Wilson 1987:118). Buffalo Bird Woman, a Hidatsa woman born in 1839, reported that tent covers were made in the spring when bison began to shed their hair and skins were thin (Wilson 1987:118). Brink (2008:69, 224-225) reiterated this statement, suggesting that tipi covers were also made in the summer months as fall hides were too thick to be suitable. In recent times, Tahltan hide-working peaked in spring and summer following the capture of large numbers of animals (Albright 1984:52). Jodry (1999a:238, 243) proposed that rawhide and buckskin were likely made in the late summer/early fall, and argued for a peak in hide scraper use during this time due to the need to remove bison hair in addition to hide-thinning. She suggested that winter hides would have required fewer endscrapers due to the retention of the bison wool for robes. Other factors that could have affected endscraper discard are the different hide-working techniques associated with different seasons. Boszhardt and McCarthy (1999) proposed that late prehistoric Oneota would have used endscrapers in winter to scrape the interior of wet bison hides, while summer hide processing would have been dry hide scraping. Dry hide scraping could have resulted in a higher rate of endscraper discard during the summer months than the winter months, assuming that dry scraping promotes higher rates of attrition. Caribou, which may have been a prey item for Paleoindians in eastern North America, have hair that is easily

loosened from the skin, which may have influenced the rate at which new clothes were made (Klokkernes 2007:50). Clothing made from caribou is best when processed after the June growth of new fur has begun. Groups focused mainly on caribou rather than bison might have had different rates of clothing and bedding manufacture and different demand for endscrapers.

Another component to seasonality in endscraper discard is communal hunting. Bison cows have a relatively high fat content and good hide quality in autumn (Ewers 1955:152; Frison 1991; Verbicky-Todd 1984:51). Driver (1989:21) argued that communal hunting in higher latitudes (above 40°) in general should occur in the fall. Obtaining bison hides in higher latitudes is a major reason for organizing communal hunts (Driver 1989:15, 20). In this way, hide procurement and communal hunting could go hand-in-hand, potentially affecting endscraper use and discard. While increased endscraper discard per bison could have occurred during the summer as Jodry proposed, it is also possible that greater total discard may have occurred during the fall/winter given communal hunting and the better condition of wool and during this season. While historic Plains hide processing provides valuable insight into prehistoric hide-working, it might not be directly comparable to the Paleoindian organization of hide-working. As Benedict (1993:39) pointed out, “Women are certain to have processed far fewer skins in prehistoric times than they did during the frenetic years of the hide trade, when a single individual might tan as many as 25-35 buffalo robes in a winter.” Nonetheless, peaks in endscraper discard could have occurred during seasons of heightened hunting, when both fat content and hide conditions were optimal.

Storage might also complicate the rate of endscraper discard. Mason (1891:562) described spring as a busy time for skin processing in the Arctic, where stored skins of

winter-killed game were processed at this time. Albright (1984:52) also mentioned that the Tahltan stored hides in snow for later spring processing. Recycling of previously scraped robes and tent covers during the summer months might have lessened the need for summer hide processing. In addition, the natural slipping off of bison hair would have negated the need for scraping both sides of the animal hide or reduced scraping intensity. Both recycling of hide products and alternative techniques of scraping could have affected the demand for endscrapers and, ultimately, their rate of discard. Paleoindian hide-working might also have been seasonally scheduled so as not to interfere with women's subsistence activities such as plant gathering, trapping and hunting of small game. Crown and Wills (1995) argued that Southwest Puebloan women faced scheduling conflicts between pottery production and subsistence activities, which peaked at similar times. Thus, hide-working could have been scheduled during times when plant gathering and hunting returns were minimal and when hide-working was feasible.

Seasonal demand for hide products could have affected strategies for toolstone provisioning for endscrapers. Timing and location of fall bison processing for robes may have been anticipated in advance and consequently supplied with tools in a different manner than hide processing at other times of the year. At certain times of year, Folsom hunters may have anticipated being at a particular location. At the Folsom-age Cooper site, three late summer/early fall cow and calf bison kills are represented (Bement 1999a, b). Bement (1999b:115) stated that, "the seasonal redundancy of all three kills suggests that these hunters planned on being in this region during a specific season." Lipscomb, 65 km west of Cooper, also is a late summer/early fall cow and calf kill, and might represent reuse of the general area during the fall. Bement (199b:118) argued that the projectile retooling index and raw

material use varies independently of planned seasonal movements. However, it is not clear if this holds true for other tool types, such as endscrapers.

Amick (1999) examined how demand for tools in conjunction with raw material availability could have affected raw material proportions in Paleoindian assemblages. Comparing raw material allocation to weapons and maintenance tools (including endscrapers) from several Folsom sites, he found that when point manufacture was high and raw material was scarce, nonlocal material was more often allocated to weaponry. These findings indicate that tool demand and regional lithology can play a role in raw material provisioning, and the formation of archaeological assemblages. Weapons production may have taken precedence over maintenance tasks when demand for weapons was high. Whether demand for endscrapers could have affected the supply of raw material to projectile point manufacture is an interesting corollary question to Amick's work.

Demand for endscrapers that were used for woodworking might also have fluctuated seasonally. Mazel and Parkington (1981:22) proposed that in prehistoric southern Africa, demand for woodworking tools might have increased as a function increased plant collection and wood availability. Weltfish (1965:389) stated that wood for Pawnee bows was best collected in the fall before the hunt. It is possible that maintenance activities and tool production increased during downtimes or when need was particularly high, resulting in higher incidences of endscraper discard during certain times of the year.

Summary

This review of endscraper studies discussed several facets of endscraper technological organization including raw material allocation, production, design, hafting, use-intensity, discard. While many endscraper typologies have been proposed, these are complicated by the

“Frison Effect”, in which reduction affects tool form. Use-wear studies have in many cases revealed Paleoindian endscrapers to be hide-working tools, though other functions have also been identified.

The nature of curated and expedient tools is relevant to the technological organization of endscrapers. Rather than use the controversial term “curation”, I prefer to use terms such as transport, long use-life, and anticipated demand to refer to issues associated with curation behavior. Endscrapers used for processing large animal hides tend to be made of high-quality material, especially cherts and chalcedonies. Use of high-quality material is often associated with anticipation of future tool demands, long use-life, and in some cases long-distance transport. Amick (1999) has suggested that for Folsom sites, when demand for weapons was great, high-quality nonlocal material was preferentially allocated to the weapons assemblages and away from maintenance tools. The question of whether Paleoindians supplied different toolkits in different ways depending on demand is explored in this study. Specifically, this study examines whether Amick’s hypothesis holds for the Rio Rancho site in New Mexico, where there is ample evidence for weapons production. The results, discussed in Chapter 9, have potential implications for how men’s and women’s toolkits were supplied with raw material and the factors that might have affected that allocation.

The production of Paleoindian endscrapers varies widely, and may differ between regions and in different environmental contexts. Endscrapers used in a pulling motion, especially on large hides that are staked or framed appear to be s-shaped as well as hafted. Judge suggested there was little standardization in the production of Folsom endscrapers compared to Clovis endscrapers. This study examines the nature of endscraper production at the Rio Rancho Folsom site in light of Judge’s work in the region. Endscrapers made from

the biproducts of point manufacture may not have been anticipated prior to the site's occupation. Variation in endscraper flake blank production could also suggest that a specific form was unnecessary, and a particular tool type and form was not anticipated prior to arrival at the site. The nature of the production of endscrapers has potential implications for how men's and women's toolkits may have been linked or separate in terms of production and raw material allocation.

This chapter also considered the attrition of endscrapers and the types of factors that could influence how endscrapers were discarded. Hafting, size, breakage, seasonality, and demand could all affect the discard rate of endscrapers. The discard of weapons and endscrapers were also compared, and the issues surrounding comparing the raw material distributions of the two tool types.

In the next Chapter, I review the stages involved in hide-working, especially those related to stone endscrapers, and reflect on the archaeological signatures that these stages might produce. In addition, I examine how these stages, the number of animals processed, and seasonality might affect the archaeological distribution of endscrapers.

Table 6.1. Ethnographic and Experimental Observations on Endscraper Attrition.

Author	Type of Contact Material	Raw Material	Attrition
Brandt and Weedman (2002:52)	Thinning semi-dry cowhide	Chert, quartz	Edge of tool becomes dull after about 60 strokes
Weedman (2005:185)	Thinning cowhide	Chert and obsidian	Resharpener with iron billet after 281 strokes, yielding 407 resharpening events. Four to five stone scrapers used to process a hide
Brink (1978:97, 105)	Thinning interior dry cowhide	Chert	Hide work is hard on the working end, causing rapid dulling; Tools lost their sharpness quickly. After 500 to 800 strokes the tool was noticeably dull; after 1200 strokes the tools removed little hide; after 1500 strokes the tools were working poorly
Brink (1978:98)	Thinning interior dry silty cowhide	Chert	Effective use life of the scraper was 400 strokes
Brink (1978:99)	Graining (dehairing) soaked cowhide	Chert	Tool removed hair effectively 1000s of strokes (stopped experiment at 2500 strokes)
Broadbent and Knutsson (1975)	Cowhide	Quartz	Reduced efficiency after 1000 strokes
Gallagher (1977:411)	Thinning dry cowhide	Obsidian	Endscrapers used on cowhides were reduced at the rate of over 1 cm per hour
Gallagher (1974:181)	Unspecified, thinning interior of hide	Obsidian	Four scrapers exhausted on one hide. Four to six hours to scrape one side of a large cow hide. Obsidian scraper resharpening after 50 to 100 strokes
Hayden (1979a:225)	Hide	Obsidian	Working an almost dry skin for 10 minutes resulted in severe attrition
Keller (1966:507)	Hide	Nevada obsidian	Endscraper dulled after 90 strokes
Levitt (1979:102)	Hide	Jasper	Resharpener required every 8-12 minutes
Osgood (1940:80)	Hide	Black slate-like stone	Sharpened five or more times while scraping one caribou skin
Schultz (1992:345)	Hide		Endscraper was effective in fleshing or scraping an area 2000 sq. cm before resharpening required
Gould et al. 1971:165-166; Hayden 1979a	Tula and burren adzes		Resharpener after 6 to 7 minutes of use
Gould 1977:164-165	Mulga wood (hardwood)	Isotropic stone	“One adze flake is good for an average of 3058 useful strokes of scraping.” Adze has about 20 resharpenings.

Table 6.1 continued. Ethnographic and Experimental Observations on Endscraper Attrition.

Tindale 1965:135, 160)	wood	Opaline silica, igneous rock	“A Nakaka or Pitjandjara (<i>kandi</i>) flake is placed in a chisel or on the end of a spear thrower handle and resharpened many times, then it may be turned about so that two opposite margins become worn.”
Mulvaney 1969:71–72 cited in Gould et al. 1971	Cutting, shaving, incising, scooping wood	Stone	“The stone working edge required continual resharpening, which resulted in a step-flaked, undercut edge.”
Wiederhold (per. comm.) cited in Jodry 1999a:346, Appendix A, Table 57	Bison hide	Stone	Endscrapers require nearly eight times more resharpening when scraping the hair side versus the flesh side
Hayden 1979a:35	Woodworking	Various isotropic stone	Hayden provides numerous tables of times of implements used in woodworking, including choppers, adzes, flakes
Albright 1984:53	Defleshing animal hide		“defleshing takes two hours”

CHAPTER 7

Procedures and Tools Used in Hide-working and Their Relevance for Identifying Women's Toolkits

In those days women sew lots, tan skin, make mukluks. I made my first mukluks when I was seven. Learn by watching my mother. I made them out of calf skin. First I cut the hair, then flesh the skin. Then scrape it with stone scraper. Then scrape it on thin board in front of me. You have to be sure there's no lumps in the skin or it splits the skin when you scrape.

—Athapaskan woman, from Cruikshank 1979:27

Hide-working is an ancient human industry, yet hide products tend not to preserve except in anaerobic environments such as those found in peat bogs, salt mines, freezing or extreme dry conditions (Hatt and Taylor 1969: 11; Waateringe et al. 1999). While remains of other perishables such as wood extend back into the Middle Pleistocene at Shöningen (Thieme 1997) and Lehringen, Germany (Movius 1950), evidence for Middle Pleistocene hide processing is either lacking or ambiguous, bone needles are absent and stone tool microwear is indicative of only the initial stages of processing (Hoffecker 2005:61–62). European Upper Paleolithic sites, in contrast, have compelling evidence for hide-working, including hide polish on scrapers, figurines with apparent fur clothing, eyed bone and ivory needles dating to as early as 35,000 years ago (Hoffecker 2005:89), and the Sunghir burials which suggest beaded clothing. Though most Venus figurines are not clothed, the Buretj figurine (Figure 7.1) and Mal'ta figurine discovered near Lake Baikal suggest hooded fur garments. The Levantine rock images from Spain (ca. 6000–3500 B.C.E.) clearly depict clothing on men and women (Beltran 1982:14–15, 73), the women's skirts being reminiscent of hide skirts made today by the Konso. Ötzi the Iceman, found in 1991 in northern Italy and dating to ca. 5300 B.P., represents early direct evidence of hide-working, being equipped

with a leather pouch and strap, deerskin quiver, leather goatskin leggings, goatskin garment, leather shoes, a leather loincloth and a bearskin cap (Condra 2008:10-11). All of the Iceman's garments were tanned. In rare cases in North America, dry cave contexts have preserved early animal hide remains. Spirit Cave Mummy (Burial 2), dated to ca. 9400 ¹⁴C yrs. B.P., is a partially mummified adult male skeleton discovered in a Nevada rockshelter in 1940. He was buried with fur hide footwear and a twined rabbit skin fur blanket (Dansie 1997:17; Dewar 2004:193). Twined rabbit skin blankets, similar to the one interred with Spirit Cave Mummy, were still being made into recent times (Farnham 1916:76-81; Theriault 2007:17-18), suggesting long-term continuity of this technology. At Smith Creek Cave in Nevada, a Pleistocene-age rockshelter site, remains of both bison and camelid hair were discovered, suggesting the use of the skins of these animals at an early date (Bryan 1979:185).



Figure 7.1. Venus of Bourtj, Siberia. Image by Locutus Borg (used with permission).
([http://en.wikipedia.org/wiki/File:Buretj_\(venus_figurine\).gif](http://en.wikipedia.org/wiki/File:Buretj_(venus_figurine).gif))

In addition to these finds, evidence for Pleistocene hide-working in North America derives from microwear studies on endscrapers as well as the recovery of eyed bone needles (Bamforth 1991c:363; Blaine and Wendorf 1972; Bruhns and Stothert 1999:40; Dawson and

Stanford 1975:15, Figures 1 and 2; Dixon 1999:136; Frison and Bradley 1980:103, Figure 69; Frison and Stanford 1982:161–171; Frison and Zeimens 1980; Hofman 1996; Stanford 1999:300; Wilmsen and Roberts 1978:126; Young et al. 1987). Historically, eyed needles were used for sewing hides, as well as for making baskets, containers, nets and woven materials (Hutton 1912:268; Owen 1999). In addition, environmental conditions on the Great Plains and adjacent regions during the Pleistocene suggest a need for hide clothing, bedding and perhaps hide shelters.

Examining the traditional ways in which historic and modern hide-workers practiced their craft can provide insight into Paleoindian archaeological record, including endscrapers and other tools used in hide processing activities, the variation in tool manufacture in different contexts, the time required for various procedures and the organization of hide-working labor. If as argued in Chapter 3, Folsom Paleoindian women were likely responsible for hide-working, then examination of traditional hide-working activities and tools can provide insight into the organization of women's activities and the residues of these activities in the archaeological record.

I begin by discussing the nature of animal skin, and how animal species in turn affect hide-working tools. I then discuss various steps in the hide-working process, especially the distinction between wet and dry scraping, and the tools and procedures associated with each. I conclude that stone scrapers, while used in several different hide-working contexts, are strongly associated with dry hide scraping and especially thinning bison hides, and that these tools are also strongly associated with bison procurement in the archaeological record (e.g. Creel 1991; Boszhardt and McCarthy). The review suggests that Paleoindian scrapers, at least on the Plains, were likely used at least in part to thin bison hides.

The Nature of Animal Skin

In common usage, the terms “hide” and “skin” are synonymous. Among tanners, the term “hide” is usually associated with larger animals such as bison and ox, whereas the term “skin” usually describes the pelts of smaller animals such as deer, pronghorn and goats (Edholm and Wilder 2001:59; Farnham 1916:17; Reed 1972:13). The term “kips” is sometimes used to refer to young or yearling skins of large animals (Farnham 1916:17). The difference between the terms is slight, and I used the terms “hide” and “skin” synonymously.

Because different tools and procedures are used in the removal and processing of different elements of skin, it is necessary to provide some background on skin biology. Skin is composed of several different types of tissue listed below from Reed (1972:14):

Connective tissue:	Supports other tissues by providing cohesion and strength
Nervous tissue:	Detects and responds to environmental and body stimuli
Glandular tissue:	Secretes substances like hormones and enzymes, and often helps to eliminate waste materials
Adipose or fatty tissue:	Makes, stores, and distributes fatty (lipid) materials
Epithelial tissue:	Provides protection against light, water and fluids

Skin has three basic components: the epidermis, the dermis and the hypodermis (Edholm and Wilder 2001:5; Reed 1972:15). Figure 7.2 provides a simple graphic depiction of these layers. The epidermis is the outermost component of skin, consisting of epithelial cells, which are arranged in layers (Reed 1972:16). The uppermost part of the epidermis consists of dead cells, which are replenished by the lower layers (Edholm and Wilder 2001:5; Farnham 1916:17-18). The epidermis is composed of mainly keratin, which is produced in the lower layers of the skin as well as hair and hair bulbs (Edholm and Wilder 2001:5).

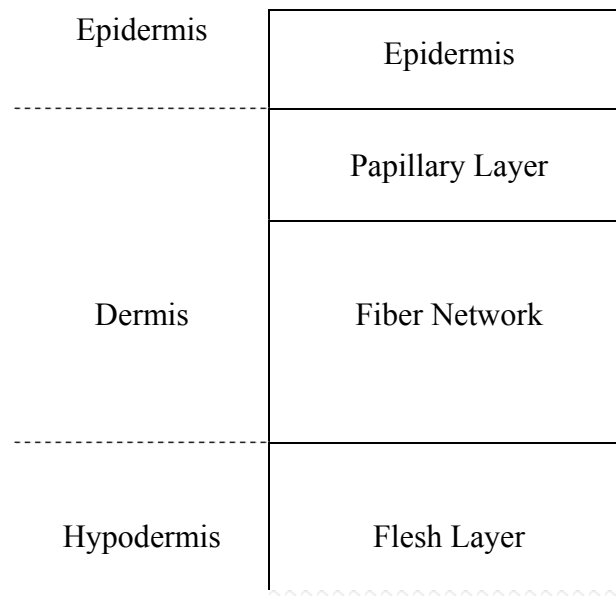


Figure 7.2. Diagram of skin layers (Reed 1972:18, Figure 3).

Below the epidermis lies the dermis or corium, composed mainly of collagen in fibrous bundles surrounded by the protective ground substance (Edholm and Wilder 2001:6; Reed 1972:25-29; Richards 2001:33). Most processed hides that have had their hair removed, consist solely of a portion of the dermis (Farnham 1916:18; Richards 2001:29). Ground substance is composed mainly of mucopolysaccharides, a type of mucus, that react strongly with water (Edholm and Wilder 2001:6; Reed 1972:31). The ground substance acts to prevent large molecules such as bacteria from entering the skin as well as tanning lubricants, and thus must be removed when preparing a hide in this manner. The dermis is composed of two main layers—the papillary layer and the fiber network (reticular layer) (Figure 7.2). The surface of the papillary layer is known as the grain pattern, which has a rough appearance. Together, the papillary layer and grain pattern, are often referred to simply as the “grain.” The grain consists of tightly woven collagen and elastin fibers supported by ground

substance. The grain also contains blood and lymph vessels, sweat glands and fat glands. These grain fibers have a finer, tighter weave than the underlying fiber network, though there is no distinct separation between these two layers (Edholm and Wilder 2001:7; Reed 1972:25). Hairs continue from the epidermis into the grain, but do not extend into the fiber network below (Edholm and Wilder 2001:7; Reed 1972:16).

The second component of the dermis is the fiber network or reticular layer (Reed 1972:16). I will hereafter refer to this layer as the “fiber network.” Typically, when the hair is removed during hide preparation, it is the fiber network that forms the animal skin product. This layer is composed of dense connective tissue of three main components: fibers organized into long wavy bundles (mainly collagen, some elastin and reticulin), connective tissue cells, and ground substance (Reed 1972:17, 29). The upper part of the fiber network consists of relatively smaller fibers that are coated with more ground substance than the underlying layer of fibers. The fiber network is typically not uniform in thickness. For example, shoulder areas tend to be coarser and thicker (Reed 1972:35), often requiring more processing time.

The hypodermis, also called the membrane or adipose tissue, is at the contact point between the skin and flesh of the animal. The membrane allows the skin to move somewhat separately from the underlying muscles. This portion of the skin consists of loose fibers. The membrane is always removed when preparing hides, though sometimes it is sufficiently removed in the act of skinning alone. Membrane must be removed in order for the tanning solution to penetrate the hide.

All animal skins are different and often require different techniques and tools to prepare. Smaller skins such as rabbit can be dried without fleshing or tanning (Levitt

1979:41). On the Great Plains, different animals such as elk, deer and antelope required different tools to work them than bison on the Great Plains because of the relative thinness of the skins (Schneider 1983:105). Younger animals tend to have thinner skins with more tightly woven fiber networks than adults, and these skins were often used to make clothing for infants and children. As the animal ages, it retains the same amount of fibers, but these grow larger and the fiber network becomes more open (Edholm and Wilder 2001:59). Additionally, female skins tend to be thinner than male skins. Cattle hides can be more difficult to soften than bison hides (Levitt 1979:42), adding an element of complexity to archaeological experimental studies on hide-working.

Seasonality is another factor affecting the condition of skins. Skin thickness, depth of hair roots, hair thickness and depth of vein tracks can all vary seasonally and can affect the condition of the hide (Edholm and Wilder 2001:60). Prehistorically, seasonal conditions likely played a role in decisions about when hide processing was most effectively conducted and what hide products were made in which season. In some places, fiber clothing was used during the summer and skin clothing was worn over the fiber clothing in colder seasons (Batchelor 1892:48).

Steps in Hide Processing

In the ethnographic, historic, and modern literature, the tools and procedures used in hide-working vary somewhat from group to group as well as with the species of animal skin processed. Because Paleoindians would likely have been tanning the hides of bison, deer, elk, mountain sheep and pronghorn, given the prevalence of their remains on archaeological sites, I focus mainly on the literature pertaining to these animals, though other types of hide preparation are mentioned.

Skinning. Initial cuts in skinning can be made using a number of tools. Flakes and flake tools may have been effective butchery tools (Clark and Haynes 1970). This is borne out in the ethnographic literature. For example, an early account of a springbok killing in South Africa described an episode in which the native hunter, upon realizing that he had no knife, located some nearby stones and butchered the animal with flakes struck from the stones (Stow 1905:66). Others suggest that bifacially flaked tools are more effective at animal butchery because of their relatively large size, and that the preponderance of flakes at butchery sites could represent resharpening debris rather than butchering tools (Jones 1980). Jones argued that bifaces are easier to handle. Supporting this suggestion, the Wakama of Kenya prefer heavier butchering implements to lighter ones (Jones 1980:154). Bone skinning knives are another possibility, and were used by the Tahltan Indians (Nahanni) of British Columbia (Emmons 1911:80-81:Figure 23).

With larger carcasses, the animal is often cut ventrally down the centerline of the belly, with incisions made along the medial sides of the legs (Oakes 1991:102). Leg joints are often broken manually. Depending on size, the animal might be hung while these incisions are made or left on the ground. In some historic accounts, adult bison hides were removed in two halves, with incisions made down the middle of the back and mid-belly, though calves could be skinned whole (Brink 2008:227; Denig 1928:540; Dorsey 1884:311; Ewers 1958:110-111; Paterek 1996:94; Wilson 1924:246). Because adult bison hides were heavy and often unwieldy, robe makers preferred to process each half separately, sewing them together for the final product. The decision to split the hide in two pieces could also be a function of the intended products (Ewers 1945:11). Other techniques on bison were used, however. Historically, the Hidatsa turned bison cows on their backs and skinned them whole

if an entire skin was needed (Wilson 1924:192-193). The particular type of fur needed can dictate the initial incision. For example, the modern Inuit preserve the white belly fur of caribou for clothing trim (Oakes 1991:102).

After the initial incisions, the skin was removed. In order to ensure that the hide was not scored by knives, which could result in large tears, knives were not used to cut the skin off, but rather the skin was “fisted” or peeled off manually. Historically, skins of the larger animals were sometimes loosened first by pounding with a hammer or flail (Spier 1970:115). This technique continues to be used by modern tanners (Campbell 2005:369; Edholm and Wilder 2001:70-71; Farnham 1916:32; Jones 1980; Oakes 1991:102; Richards 2001:38-42; Silberbauer 1981:223; Spier 1970:115; Wallis and Wallis 1955:40; Wilson 1924:273). At the Cooper Site in northwestern Oklahoma, cobbles associated with the upper bison kill have been interpreted as possible pounding stones for removing the hides (Bement 1999a:79, Figure 28).

For some animals, the membrane allows the skin to be removed relatively easily after the initial cuts are made, and removing a deer hide in this manner takes as little as 15 minutes (Richards 2001:38). The actual skinning process ideally involves few tools, though difficult areas such as the neck and chest sometimes require sharp implements. Among the historic Menomini, knives were used sparingly during the removal of the hide with the exception of the neck area (Skinner 1921:225). After the hide is successfully peeled, some muscle matter and connective tissue remain on the hide, and can be removed during the fleshing process (Reed 1972:17; Richards 2001:42).

Modern and historic accounts suggest that skinning is easiest when conducted shortly after the animal’s death (Edholm and Wilder 2001:73; Richards 2001:39; Skinner 1921:21).

Prompt skinning might have been necessary for bison hides as well. The thickness of their hides and the density of hair provide bison with excellent insulation in cold climates. During an aerial survey at Elk Island National Park, infrared was used to detect heat from animals during an aerial survey (Brink 2008:172). In contrast to moose and elk, bison were difficult to spot because they lost so little heat to the environment. Other experiments indicate that in very cold weather, bison metabolism actually decreases rather than increases, in contrast to other large animals such as yak and cattle (Brink 2008:173-174). While this capacity for heat retention makes bison hides an ideal source of warmth, it might have also created a need to butcher and process animals quickly so as to prevent spoilage (Brink 2008:174). The susceptibility of bison meat and hides to spoil quickly possibly explains the rapidity with which Plains women processed bison hides during the autumn hunts:

At the time of the “great fall hunt,” there was no rest or excuse for her. She must work at any and all hours. If the herds were moving the success of the hunt might depend on the rapidity in which the women performed their work on a batch of dead buffalo. This animal spoils very quickly if not disemboweled....It was the women’s work to skin and cut up the dead animal; and oftentimes when the men were exceptionally fortunate, the women were obliged to work hard and fast, all night long before their task was finished (Dodge 1883:253).

For Paleoindian hide-workers, the necessity of quick skinning might have even been greater given the larger size of Pleistocene bison. The tendency for bison to spoil also suggests that mass killings of bison by small groups might have had little benefit, given the time required to skin and butcher a large number of animals unless only favored cuts were taken as it suggested by the Cooper site (Bement 1999a).

Fleshing. Fleshing is the process of removing tissue and fat from a hide interior in addition to the hypodermis (membrane), the inner layer of skin. If the hypodermis is not removed, the skin becomes impenetrable to tanning solution. Modern deer tanners often soak hides before

the fleshing process; however, it is possible to skip this step as long as the hide does not dry out during fleshing (Edholm and Wilder 2001:104). If the hair is desired on the finished product, then soaking time is kept to a minimum (Edholm and Wilder 2001:248). Several historic accounts indicate that hides, bison hides especially, were very often fleshed shortly after a kill (Dorsey 1884:310; Fletcher and La Flesche 1911:344; Mooney 1910:592; Schneider 1983:104; Weltfish 1965:90, 217; Wissler 1910:63); modern brain tanners report that fleshing is easier on a fresh hide (Gidmark 1980:28; Riggs 1979:19). Also, if a hide is to be processed with the hair intact, the tanning process must be conducted quickly before bacteria and enzymatic action cause the hair to slip out (Edholm and Wilder 2001:248).

In bison fleshing on the Great Plains, the hide was typically stretched on a level surface and secured with wooden stakes (Catlin 1913:52; Dodge 1883:253; Ewers 1945:10; Wallace and Hoebel 1955:61). Where trees were scarce, Arctic groups also pegged out animal hides for preparation (Driver and Massey 1957:343). The Inari Lapps (Sámi) and the Utsjoki Lapps (Sámi) used about ten 25-cm-long pegs for staking reindeer hides (Itkonen 1948:523). Within the recent past, some African groups used a staking technique as well (Silberbauer 1981; Vaughan-Kirby 1918:37). Binford (1983:133) observed the Nunamiut using stones to weigh down caribou hides while drying. An alternative to staking on the ground was stretching the skin on an upright frame, a technique usually reserved for larger skins (Driver and Massey 1957:343). Upright frames were also used in places where wood could be easily obtained or could be stored at a habitation site. Another method, involving fleshing on a wooden beam, is more strongly associated with the processing of smaller game such as deer and caribou. Fleshing on a beam, however, has a tendency to break and damage

the hair, whereas the other two methods provide some protection for the fragile hair (Edholm and Wilder 2001:246).

One of the most common hide-working tools recognized in the ethnohistoric and ethnographic literature on the Great Plains is the serrated bone flesher or bone chisel flesher (Figure 7.3). It is also commonly found on prehistoric sites in North America (Steinbring 1966:575), and has a wide distribution. Fleshers were often, but not exclusively, used on hides staked to the ground or on an upright frame. These tools continue to be used today by modern hide-workers (Kehoe 2005:137; Steinbring 1966:575).



Figure 7.3. Chisel bone flesher. *Hide Scraper*, 18th century. Bone, red pigment, hide, 8 11/16 x 2 3/8 in. (22 x 6 cm). Brooklyn Museum, Brooklyn Museum Collection, 13.17. Creative Commons-BY-NC (http://www.brooklynmuseum.org/opencollection/objects/6875/Hide_Scraper)

Historic chisel bone fleshers were typically tapered, rounded and serrated at the working edge, and were used to remove fat, tissue and membrane from the interior of a fresh hide (Albright 1984:52; Denig 1930:540; Dorsey 1884:310; Emmons 1911:81–82, Figure 24; Ford 1959:194; Lowie 1910:13; Mason 1891:567; Mooney 1910:592; Murdoch 1892:298-

299; Schultz 1992:336; Weitzner and Wilson 1979:253; Weltfish 1965:217, 369). The teeth or serrations at the working end of the flesher served to grab the flesh and membrane adhering to the skin (Steinbring 1966:580). Modern tanners report that the bone flesher must be sharpened frequently and the teeth rechiseled periodically (Edholm and Wilder 2001:245; Steinbring 1966:580). While flesher sharpening today is accomplished with a steel file, if similar implements were used during Paleoindian times, rough stones may have served to keep fleshers sharp. Abrasive stones on Paleoindian sites could have served the dual purpose of removing the hide from the carcass and as bone tool sharpeners.

Historically, the bone flesher was made from the leg bone of a moose (Curtis 1928:28, 68; Steinbring 1966:578), bison (Howard 1965:53), elk (Denig 1928:146; Dorsey 1884:311; Grinnell 1972:214; Kroeber 1902:26; Morrow 1975; Schultz 1992:336), horse or steer (Fletcher and La Flesche 1911:343; Mason 1891:Plate XC; Wissler 1910:68), caribou or even grizzly bear (Emmons 1911:81). In the case of some tibia fleshers, a portion of the femur remained attached (Lowie 1954:58, Figure 46; Wissler 1910). To increase leverage and control, wrist straps were attached to the flesher through drilled or natural holes in the proximal end of the tool (Dorsey 1884:310, Figure 27; Ewers 1938:50; Fletcher and La Flesche 1911:343; Grinnell 1972:214; Mooney 1910:592; Weltfish 1965:217, 369).

Fleshers were used in a downward chipping motion (Figure 7.4). Weltfish (1965:218) described a Pawnee woman scraping a bison hide that has been staked to the ground, "White Woman bent over from a standing position, striking the fleshing tool downward and towards her against the hide." These bone fleshers were often in service for long periods of time, being handed down from generation to generation (Steinbring 1966:576, Figure 2); one

flesher had been in use for 11 years by Northern Ojibwa (Anishinabe) hide-workers. Many were highly decorated (Steinbring 1966:581).



Figure 7.4. Blackfoot woman fleshing hide with a chisel bone flesher with wrist strap, ca. 1926. Photo by Edward Curtis. Braun Research Library Collection, Autry National Center. Object I.D. P.37871. (<http://theautry.org/research/braun-research-library>)

Following the introduction of metal, an iron blade attached to a straight or a crowbar-shaped shaft replaced the flesher (Lowie 1935: 75, Figure 2, 1954:58, Figure 46; Merrill et al. 1997:121, Figure 36; Mooney 1910:592; Schultz 1907:172; Schultz 1992:336; Standing Bear 1928:19; Turner 1888:294; Wissler 1910:68, 1934:62). In some cases, modified gun barrels were used (Grinnell 1972:214), and the Mandan made bison dressing implements from sheet iron (Edholm and Wilder 2001:211). Another variation was that wood was sometimes substituted for bone (Mason 1924:83; Wissler 1910:68). Less commonly, hafted and unhafted stone tools were used in the fleshing process. An early flesher form among the Cheyenne was a flat oval stone of slate or quartzite modified to have a sharp edge; some were large enough to be used with both hands (Grinnell 1972:214). Other instances of hand-held flat stones have been documented for this procedure (Lowie 1910:13; Sapir and Sapir 1989:404; Wallace and Hoebel 1955:93). Schultz (1992:Table 2) reported that hafted stone scrapers were sometimes used in fleshing. However, in experimental studies, Brink (1978:95)

found hafted stone scrapers to be completely ineffective at fleshing a fresh cow hide. An early account of springbok hide-working from South Africa indicated that large flaked stone scrapers (63.5 mm to 76.2 mm in width) were used unhafted in the fleshing process (Stow 1905:73). In the Arctic and Sub-arctic, hides were often fleshed with the women's semi-circular *ulu* knife with a shale, slate or metal blade, in a motion away from the hide worker's body (Driver and Massey 1957:343). Murdoch (1892:294) reported that the hafted scraper with its blunt stone blade was an all-purpose hide-working tool, used for fleshing, graining, scraping, and softening.

A serrated bone flesher from redeposited sediments at the Agate Basin site in northeastern Wyoming (Figure 7.5) has been interpreted as being Folsom in age (Frison and Craig 1982:171). The caribou bone flesher from the Old Crow locality in the Canadian Yukon Territory, was originally dated to 27,000 ^{14}C yr. B.P. on the apatite portion of the bone. However, because of the possibility of diagenetic exchange of carbon on the inorganic portion (apatite fraction) of bone, the organic bone protein of the flesher was redated to less than 3000 ^{14}C yr. B.P. using AMS (Nelson et al. 1986).



Figure 7.5. Possible Folsom bone flesher from the Agate Basin site (Photograph by Pete Bostrum, used with permission).

Historically on the Plains, beaming tools (Figure 7.6) rather than chisel bone fleshers were used when processing smaller game such as deer (Campbell 2005:369-370; Emmons 1991:210; Ewers 1958:111; Lowie 1935:75; 1954:67; Russell 1898:183; Skinner 1987:72; Turner 1888:293; Wissler 1910:65, 69; 1934:63). The Assiniboiné and Pawnee, however, were reported to have used a wooden beam to deflesh bison (Denig 1928:146; Weltfish 1965:218). Conversely, caribou and smaller animals were sometimes staked or framed and fleshed with a chisel bone flesher, and chisel bone fleshers were used on a beam to process caribou hides (Turner 1888:294).

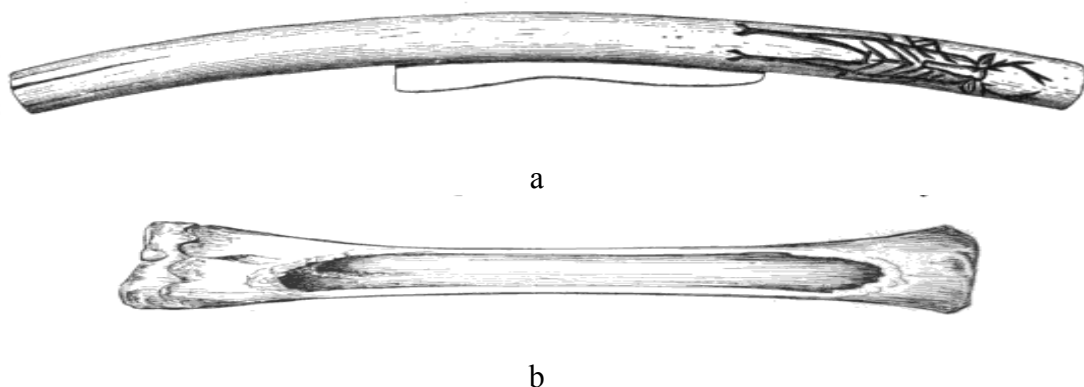


Figure 7.6. Examples of beamers (a) Arapaho beaming tool (wood 39 cm) with metal insert and engraved with a deer on one face and an antelope on the other (Kroeber 1902:27); (b) Northern Saukteaux beaming tool manufactured from a long bone (from Skinner 1912:126, Figure 43).

Beaming tools or “beamers” were made from split leg bones, rib bones, deer tibia, or a wooden stick with a metal, bone, or slate blade (Grinnell 1972:215; Skinner 1911:256; Wissler 1910:69). Upper Paleolithic smoothers or “lissoirs” may have been used in a similar way (Figure 7.7). Beaming tools were pushed away from the worker on a skin draped over an angled wooden beam (Curtis 1913:64; Kroeber 1902:26; Parker 1856:198-199; Schultz 1992:338; Skinner 1911: Plate XLIX). Like chisel bone fleshers, prehistoric beaming tools would have required some sharpening during use (Edholm and Wilder 2001:217), which could have been accomplished with an abrasive stone.

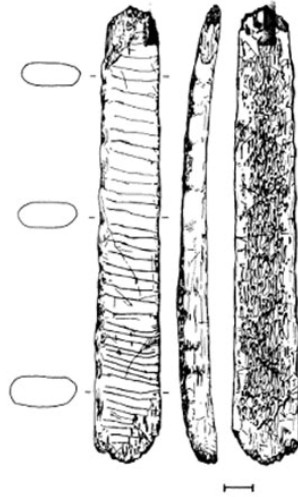


Figure 7.7. Possible skin smoother made from a rhino or mammoth sized rib, Hohlefelds AH II c (from Münzel 2001:450, Figure 2).

Similar tools are found in areas distant to North America. For example, in the 1950s the Gonaqua of southern Africa were using a bone “reamer” made from a sheep rib bone to remove hair from animal hides (Clark 1958:144). The Nganasan of the Taymyr Peninsula in Siberia used a reindeer leg bone split lengthwise (*bieda*) to remove hair from reindeer skins, along with similar implements made of metal (Popov 1966:88). This implement was used in conjunction with a wooden scraping board (Figure 4.12). Similar bone tools were found in the proto-Maglemosan culture at Star Carr (Clark 1958:144). No tools similar to beaming tools have been found in Paleoindian contexts.

Drying. After fleshing, the hide can be dried for storage. Removal of fat and grease is necessary before drying; otherwise “grease burn” can occur. Grease burn is undesirable because the fat melts into the skin and weakens the fiber network (Edholm and Wilder 2001:1, 88). When drying a hide, the edges need to be kept moist as the interior dries. Sawdust or dry dirt can prevent the edges from curling (Edholm and Wilder 2001:93; Riggs 1979:17). Hides can be dried hair side down, and they may be staked down which allows for

stretching, making it easier for the hide to take up water later (Edholm and Wilder 2001:92). Skins can be dried flat on the ground, staked down with wooden sticks or rocks, sewn into a frame or dried by placing long sticks horizontally and vertically over the hide (Klokkernes 2007:55). When ready for continued processing, the hides must be soaked and stretched in order to become pliable again (Edholm and Wilder 2001:92, 105). If a skin was allowed to dry without being stretched first, it could not be made into a suitable robe (Dodge 1883:253).

Graining. The removal of the hair, epidermis and grain layers of skin is often collectively referred to as “graining” (Richards 2001:31). If the grain is not completely removed, the tanning solution will not fully penetrate the hide, leaving that portion of the skin harder, and the smoking process will leave white streaks where the grain was missed (Richards 2001:86). Historically, not all hides were grained. In many cases, the hair was preserved on the skin for use as bedding and warm clothes, such as the well-known Plains bison robe. Hide processing with retention of the hair is sometimes referred to as “fur dressing” (Spier 1970:115).

Soaking the hide in a solution can facilitate the removal of grain. The duration of the soaking process is critical, as the hide can rot before the grain is ready for removal (Edholm and Wilder 2001:106). Some modern tanners simply soak hides in water before graining. Soaking can also be accomplished in an ash/lime/lye solution, which was used in several contexts in native North America (Catlin 1913:52; Campbell 2005:370; Dodge 1883:254-255; Driver and Massey 1957:343; Hunter 1823:288; Schultz 1992:334; Wallace and Hoebel 1955:93). Commonly, lye was produced from a mixture of wood ashes and water, and lime was obtained by burning rock. Known as “bucking,” soaking causes the skin to swell and allows the hide worker to distinguish between the grain and the underlying layers (Richards 2001:31). In the soaking process, skin swelling is caused by hydroxyl ions attached to water

molecules that enter the hide (Richards 2001:32). The alkalinity of the lye or lime solution (presence of OH⁻ ions) causes the layers of the grain to become more cohesive, making this layer easier to remove (Richards 2001:32). Additionally, the alkaline solution breaks up the mucopolysaccharide-water bonds in the fiber network, allowing the ground substance to be removed and eventually replaced by the tanning solution (Richards 2001:33). The alkaline solution itself, however, can itself be difficult to remove. Washing the hide of unwanted hair, alkaline solution and other materials is sometimes referred to as “scudding” (Levitt 1979:36). One of the most effective means of removing the alkaline solution is by placing the skin overnight in running water, such as a stream (Richards 2001:35). The running water also releases the ground substance (Richards 2001:89). An alternative to removing the alkaline solution is to use a weak acid solution (Richards 2001:89). If the ash solution is not removed, it will stain the hide (Richards 2001:77). In order for alkaline soaking to be effective, a water source, ideally running water, is necessary. If Paleoindians employed a soaking method to assist in hair and grain removal, processing sites would ideally have been located near running water.

Other soaking techniques to facilitate the graining process are known. Nissen and Dittmore (1974:67-68) write of Alaskan native hide processing in the 1970s, that the hides were scraped, treated with urine for its sodium chloride and lime content, and then rolled into a bundle with the hair facing inward until the hair loosened. In the mid-1900s, G/wi hide-workers used urine and plant juices in hide preparation as well (Silberbauer 1981:224). Historic reports of hide-working in South Africa indicate hides were dehaired by leaving them for a few days with the leaves of the Hottentot fig (*Carpobrotus*) rubbed into them (Webley 2005:158).

Another technique that facilitates hair removal involves allowing the hair and/or grain to sweat or rot off, and has been documented among groups along the Northwest Coast, British Columbia, Alaska and eastern Canada, and among the Sámi in Scandinavia (Emmons 1911:81; Emmons 1991 (1911):210; Issenman 1997:77; Spier 1970:115; Steinbring 1966:576; Turner 1888:293; Wallis and Wallis 1955:40). The length of time the skin is allowed to decompose must be timed well or the fiber network will become damaged (Issenman 1997:77). Spier (1970:115) described this process as a “controlled rotting of the hide.” The sweating or rotting process could be accomplished in a number of ways. In the past, hair was sometimes steamed off or the hide was buried in moist soil to loosen the hair (Campbell 2005:370; Paterek 1996:433). Otak (2005:75) wrote of treating the caribou epidermis by exposing it to direct sunlight, using it as a blanket, freezing or wrapping it around the body during work.

The graining process could be accomplished through wet- or dry-scraping. Wet-scraping does not scrape as deeply into the dermis as dry-scraping, typically leaving a thin portion of the grain on the skin (Edholm and Wilder 2001:21). This was the most common means of graining deer skins in Native North America (Edholm and Wilder 2001:19). In wet-scraping, the skin was placed over a beam, typically of wood, and scraped with a dull instrument, such as a deer rib. Dulling the beaming tool is essential; otherwise it is easy to cut through the skin (Edholm and Wilder 2001:37). Stone tools, unless very finely ground, would be too sharp for wet-scraping, and would damage the hide (Edholm and Wilder 2001:217). For wet-scraping, the only essential tools are the beam and a beaming tool (Edholm and Wilder 2001:27). Reporting on an expedition in the late 1800s, Russell (1898:185) wrote that, “with no other tools than a knife and the leg bones of the animal

killed, and no other tanning agent than its brain, an ‘old wife’ can convert a green mooseskin, weighing fifty pounds, into light serviceable leather in five days.” Because wet-scraping can be accomplished with bone tools, prehistoric wet-scraping did not necessarily involve stone tools. Gramly (1982:37) suggested that Paleoindian hide-working might have been accomplished using only bone tools, and that endscrapers and sidescrapers might have been used on wood. In addition to bone beaming tools, a number of other tool types for grain removal have been reported. Khoikhoi (Khoekhoe) of southwestern Africa used a bone chisel to remove hair from skins, and bone and ivory chisels also appear in archaeological contexts in South Africa (Clark 1958:144). However, Clark did not specify whether the hide preparation involved wet- or dry-scraping. In Labrador, seal hair was sometimes removed using a seal shoulder blade (Hutton 1912:110). Use of a large mussel shell to remove hair has also been reported among coastal groups (Curtis 1913:64).

In wet-scraping, a thin portion of the grain remains on the skin (Edholm and Wilder 2001:21). In contrast, in dry-scraping, the entire grain is removed, exposing the underlying fiber network (Edholm and Wilder 2001:21). While wet-scraping with bone tools is strongly associated with animals such as deer or sometimes caribou, larger animals like bison were almost always dry-scraped. Modern brain tanners Edholm and Wilder (2001:63) report that, “We have never encountered any account of wet-scraping buffalo; they were seemingly always dry-scraped.” In preparation for bison dry-scraping, particularly on Plains bison hides, skins were framed and dried (Campbell 2005:369; Denig 1928:146; Dodge 1883:256; Ewers 1945:10; Hunter 1823:288; Wissler 1934:58). Dry-scraping, unlike wet-scraping, required a sharper tool, such as a stone or metal scraper. In addition, dry-scraping involves different skills and experience, because it is difficult to ascertain how deep the implement is

penetrating the skin (Edholm and Wilder 2001:21). One benefit to dry-scraping is that skins tend to absorb the tanning agents more readily than wet-scraped skins (Edholm and Wilder 2001:21–22). However, they may lose some elasticity gained in the wet-scraping process.

On the Great Plains, bison wool from the dried and stretched hide was often removed using a hafted stone scraper, the elkhorn scraper (Dorsey 1884:311; Ewers 1945:10; Grinnell 1972:214; Kroeber 1902:26; Schultz 1992:334; Spier 1970:115; Wilson 1924:292; Wissler 1910:66; 1934:58). Figure 7.8 shows a hide-worker using a metal-tipped elkhorn scraper to remove hair. This tool was also typically used in the removal of the membrane and thinning. Alternatively, the wool might be pounded off with a stone (Ewers 1938:10; Kroeber 1902:26), especially when rawhide was desired (Figure 7.9). The pounding method might have been used to maintain the thickness of the hide for items such as shields (Wissler 1910:66). Dorsey (1884:422) reported that neck portions of bison or ox hides to be made into shields were “deprived of hair, soaked, rubbed, pounded, cut into shape and then dried.” Pounding the hair off can leave the grain intact, producing a thicker skin, but one that would not easily take up a tanning solution. Because pounding stones appear to be associated with production of rawhide, and rawhide products were often made in the warmer seasons when wool and hair were at their thinnest, the appearance of stones might be more prevalent at summer habitation sites than winter habitation sites.



Figure 7.8. Graining by Northern Ojibwa hide worker with steel-bitted scraper (Steinbring 1966:575, Figure 1).



Figure 7.9. Pounding off the hair from an animal skin with a large stone (Wissler 1910: Plate I).

Thinning. As with the graining process, removal of the remaining hypodermis or membrane could be accomplished through wet- or dry-scraping techniques. Wet-scraping is strongly associated with deer and to a lesser extent caribou, whereas dry-scraping is strongly

associated with bison hide preparation. For deerskins, the same beaming tool used to remove the grain is again used to remove the membrane.

In the dry-scrape method on the Great Plains, bison and elk hides were typically staked out on the ground with wooden pegs, or stretched on an upright frame if special delicacy was needed (Denig 1928:146; Dodge 1883:256; Schultz 1992:334; Wallace and Hoebel 1955:94; Wissler 1910:70; 1934:54). An upright frame was also used during winter seasons, when driving stakes into the frozen ground was difficult (Wissler 1910:70). In addition to removing membrane, working the interior of bison hides also served to thin the hide considerably. Bison skin thickness in the neck area could be as much as one inch (Samuel Hearne cited in Brink 1978:171). Denig (1928:146) reported that the Assiniboiné (Nakota) scraped off approximately one-third the thickness of the bison hide. This thinning was essential because it allowed the tanning solution to penetrate the skin (Schultz 1992:334). Dry-scraping the membrane and thinning of bison hides appears to have been most effectively accomplished with stone or metal tools, in contrast to the bone beaming tools. Hafted Paleoindian endscrapers could well have served this purpose, as several microwear studies have shown (see microwear discussion in Chapter 6). Further, the occurrence of endscrapers suggests a dry-scraping process, which very likely, but certainly not exclusively, would have included bison hide preparation.

Historic Great Plains hide-thinning scrapers were often hafted onto L-shaped antler or wood handles (Dodge 1883:256; Kroeber 1902:26; Merrill et al 1997:119, 120, Figure 34, 35; Metcalf 1972; Weltfish 1965:369). Hiller (1948:7) described the fashioning of an L-shaped elk antler scraper as being formed from the branching part of an antler spike. The “elkhorn scraper” or “elbow scraper” was moved towards the user in the manner of an adze

(Dorsey 1884:310), with the user often in a standing position if the hide was staked to the ground (Figure 7.10, 7.11). Historically, the elkhorn scraper was tipped with a metal bit; however it is thought that the implement originally had a stone bit (Denig 1928:146; Kroeber 1902:26; Wallace and Hoebel 1955:94). The metal bit was sharpened by whetting with a river cobble (Dorsey 1884:310; Grinnell 1972:213, 215). Denig (1928:146) provided the dimensions of the Assiniboine metal bit on the elkhorn scraper as 3.5 inches long and 1.5 inches wide, comparable to Paleoindian endscraper dimensions. In addition to scraping hides, these implements were sometimes used for other purposes such as digging roots (Kroeber 1902:26) and cracking open squash (Wilson 1917:79). The Sámi and Ngansan dry-scraped caribou skins with a metal s-shaped scraper than could be flipped over when one edge dulled (Klokkernes 2007:50; Popov 1966:86-87).

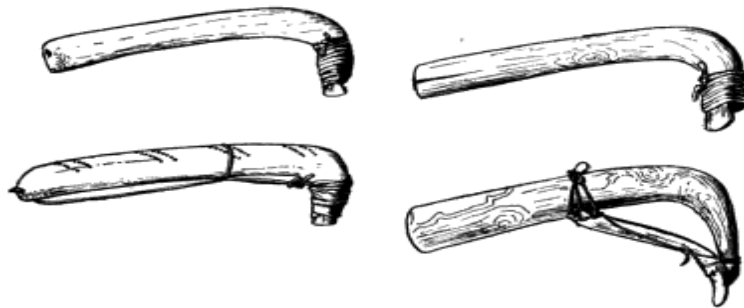


Figure 7.10. Elkhorn scrapers used for thinning hides (from Wissler 1934:61, Figure 21).



Figure 7.11. Blood (Káínawa) woman thinning a bison hide (from Wissler 1934:59, Figure 20).

Skins can be fleshed and thinned while frozen (Albright 1982:107-108; 1984; Schultz 1907:92; 2003:82). One report from an early trader in contact with the Blackfeet tribe in the 1800s indicates that the more frozen the bison hide is, the easier it can be thinned (Schultz 2003:82). The Naskapi (Innu) of inland Labrador, Canada, peg out their caribou hides, which are subsequently scraped while frozen (Mears 2008). Itkonen (1948:524) commented that caribou hides intended to be used with the fur on are kept cold as the epidermis is easier to remove. When scraping frozen hides, the implement used is a sharp metal tool rather than a dulled bone tool. Paleoindians are thought to have stored meat in freezing conditions (Frison 1982:363), and might have also processed some hides in this manner.

Once scraping the membrane and thinning was completed, no further treatment was necessary if rawhide products were desired (Ewers 1945:11). If rawhide remains dry, it will preserve well. The collagen within the reticular layer causes the fibers to adhere to each other, creating a hard inflexible product. If further processing was desired, the hide was

stable at this point, and could be transported for future processing (Fletcher and La Flesche 1911:344).

Though not relevant to Folsom and later hide-workers, accounts of elephant hide-working are of interest to Clovis and potentially pre-Clovis occupations. African elephant hides have been recorded at 9.5 to 25.4 mm and are a “tough proposition for the tanner,” even with metal tools (*National Geographic Magazine* 1911:103). In one instance, a portion of a hide shipped from Africa to the United States weighed 858 pounds (*National Geographic Magazine* 1911:103). Processing adult mammoth skins on a large scale might not have been feasible or productive during Clovis times. Bison might have been killed during the Clovis period, not only for their meat, but for their skins, which would have been more manageable than mammoth skins.

Application of Tanning Agent. Tanning produces leather, which retains the collagen fibers in the dermis, but is more flexible and less prone to decay than unprocessed skins (Farnham 1916:18; Goffer 2006:333). Tanning methods include vegetable, mineral (tawing), oil and smoke tannage (Forbes 1966:5; Goffer 2007:333; Reed 1972; Van Driel-Murray 2008). Different tanning agents can also be combined (Farnham 1916:20).

Vegetable tanning involves the application vegetable tannins to animal skins (Spier 1970:116, 118; Van Driel-Murray 2008). Tannins are a plant’s natural defense against fungal and bacterial assaults. Some equate true tanning with vegetable tanning, and argue that true tanning did not exist in North America (Driver and Massey 1957:341; Farnham 1916:71), though there are historic accounts of applying plant solutions to hides (Lawson 1967; Skinner 1912:34; 1987:73; Weltfish 1965). Today, most modern tanners use chromic acids rather

than tannic acids in the production of leather (Edholm and Wilder 2001:11; Richards 2001:16).

Indigenous North American groups used mainly oil tanning methods often based on oils from the brain, liver and fat of the animals killed. Fats and oils oxidize and form insoluble bonds in the collagen structure (Klokkernes 2007:59). The oil tanning process produces “chamois” and wash leather products and is sometimes referred to as *chamoising* or wash leather dressing (Goffer 2007:335). Often, if the method involves animal brain, the process will simply be referred to as “brain tanning” or “brain currying.” Oil tanning is particularly useful in creating clothes and other objects that are worn close to the skin, because unlike other types of leather, they are resistant to alkaline fluids present in human perspiration (Reed 1972:68).

Oil tanning consists of three main stages: 1) opening up the fiber structure and removing the ground substance; 2) working fats and oils into the skin; and 3) mechanical softening (discussed below in the softening section). Brains and other tanning agents such as egg yolks contain emulsifiers (i.e., lecithin and glycerin) that have a fatty end and a polar end (Edholm and Wilder 2001:124). The polar end binds with the collagen fibers in the fiber network, leaving the fatty end on the outside of the fiber. This coating of fat lubricates the collagen fibers and allows them to slide past each other rather than bind to each other (Edholm and Wilder 2001:124). Once saturated, the hide can then be manipulated manually to soften and stretch it.

In some cases, hides were soaked before the tanning solution was applied, particularly if the hair was removed (Hassrick 1964). Before the tanning solution is added, excess water must be squeezed or wrung out, so that the fibers in the reticular layer or fiber core do not

hold so much water that they prevent the absorption of the tanning mixture (Edholm and Wilder 2001:126-130; Richards 2001:35, 95). If the hair is to remain on the skin, excess water must be squeezed out gently or the hair will be damaged (Edholm and Wilder 2001:247).

In North America, tanning ingredients included animal brains, liver, spinal fluid, grease, fish oil, eggs, yucca, mescal fiber, castor beans, meat broth, maize, lard, flour, pine or punk oak, and even wine (Campbell 2005:372; Curtis 1913:64; Denig 1928:146-147; Dorsey 1884:293, 310; Driver and Massey 1957:343; Edholm and Wilder 2001:2; Ewers 1945:11; Grinnell 1972:216; Harmon 1903:287; Hilger 1951:130; Hunter 1823:287; Lowie 1935:76; Mooney 1910:592; Skinner 1911:225; Turner 1888:294; Wallis and Wallis 1955:40; Wissler 1910:64; 1934:59). Among the Pima, saguaro seeds were used in skin dressing (Russell 1975:118). Eggs and cornmeal were used by the Choctaw in the tanning process (Bushnell 1909:11). Young Indian corn was also reported as an agent of tanning in the Southeast (Lawson 1967:184). Along the Northwest Coast, fish grease was known to have been used (Emmons 1991:211). Cheyenne hide-working for very fine skin products involved applying the grease produced from pulverizing and boiling bones (Grinnell 1972:216). Likewise, Ponca informants indicate that they used marrow (Howard 1965:52). Historic and recent tanners of caribou hide used a soap made from animal fats and water, which was then left for up to a week to saturate the hide (Andrews and Creed 1998:49; Speck 1911:216-217). Historically, Australian natives used grease to increase the flexibility of kangaroo hides (Salvado 1977:144). Webley (2005) described the use of mutton fat in addition to vegetable products in southern Africa in the hide-working process. Among the Konso, butter is added to the hide before stretching and softening (Weedman 2005:185).

Brains and grease were perhaps the most common oil tanning agents historically and into recent times. An early report on Zulu (amaZulu) hide-working noted that brains were used to soften wildebeast skins (Vaughan-Kirby 1918), and brains were also reported in hide preparation of larger animals among the G/wi of the Central Kalahari (Silberbauer 1981:224). Caribou brains continue to be used to tan caribou skins in northern Canada (Byrne and Fouillard 2000:159). Brains and other tanning agents must be mashed up before application to the skin.

Smashed bison skulls from historic Great Plains sites suggest the removal of the brain for tanning (Brink 2008:163, 213). At the Gull Lake site, bison skulls were smashed through the frontal bone or basally, breaking the squamous, temporal and occipital bones after removal of the mandible and tongue (Kehoe 1973:152). One bison skull at the Jurgens site might have been smashed to gain access to the brain, while other skulls were fragmented into small pieces (Wheat 1979:144). The relative lack of bison skulls from Locality 1 at the Jurgens site (Wheat 1979:29), might be associated with the use of brains for brain tanning. At the Lehner site in southeastern Arizona, mammoth skulls could have been smashed for brains, given the large number of skull fragments and the lack of complete skulls (Haury et al. 1959:29).

On the Great Plains and adjacent regions, the tanning solution was rubbed over the hide with the hands, a smooth stone or brush until it was thoroughly saturated (Campbell 2005:372; Dodge 1883:256; Ewers 1945:11; Lowie 1954:66; Skinner 1911:225; Turner 1888:294; Wallace and Hoebel 1955:94; Wissler 1910:64, 70; 1934:59). Two-thirds of the animal brain was sometimes sufficient to tan a hide (Dorsey 1884:310). Several applications of tanning solution were often necessary to adequately tan a hide. The hide might also be

stretched during this process to open up the fiber network. The hide was then allowed to soak in the tanning solution for a period (see Table 6.2). Several observers have described the skin being left overnight to soak in the tanning solution (Denig 1928:147; Emmons 1911:82; Grinnell 1972:216; Lowie 1910:13; Sapir and Sapir 1989:404), though it could be longer (Campbell 2005:370 reported a day to a day and a half for deer). Mooney reported that the hide was then covered with dried grass, saturated with hot water, and wrapped into a ball and soaked overnight (Mooney 1910:292). Insects are known to avoid some plants such as sage (*Artemesia*), cedar and mugwort among others (Edholm and Wilder 2001:89), and thus the addition of these ingredients might have served to thwart insect damage.

Water was sometimes used to rinse the hide of the tanning solution (Denig 1928:147; Lowie 1910:14; Wissler 1910:64). Dorsey (1884:311) wrote that after the tanning solution had dried, Omaha hide-workers soaked the hide in a stream for two days. Tlingit hide-workers soaked hides in urine to remove the grease (Emmons 1991:211). Stripping removed excess tanning solution and water from the hide. One way to remove moisture in hides that had the hair removed, was by twisting the hide into a rope and squeezing out the excess moisture (Mooney 1910:592). The hide might also be staked out tightly and a broad-edged tool dragged along the hide from top to bottom to squeeze out excess moisture (Hiller 1948; Mooney 1910:592). On the Plains, this implement historically was made from stone, bone, horn, metal or even wood (Schultz 1992:339). Tlingit and Northwest Coast hide-workers used a mussel shell (Emmons 1991:211; Hodge 1912:593).

Softening. Softening is a critical step in the production of soft, flexible hides. Without manipulation following the tanning process, the hide would again become stiff and inflexible (Edholm and Wilder 2001:137). The softening process prevents the natural glues in the skin

from setting up by realigning the fibers in the fiber core so they do not interlock and can move freely (Richards 2001:36, 109). The exterior fibers in the fiber core are stretched before the interior fibers, and thus the process requires repeated stretching of the same part of the hide as it dries (Richards 2001:109). Stretching also increases the size of the hide, which tends to shrink as it dries. The softening process, one of the most labor-intensive steps in hide-working, was often a cooperative activity on the Great Plains and elsewhere (Table 7.1). This step was best described by early tanner Albert B. Farnham, simply as “work” (1916:121).



Figure 7.12. Softening the hide by stretching (Skinner 1921:228, Plate LI).

Softening, a laborious process, often involved more than one person (Figure 7.12). Once begun, softening had to continue without interruption until the skin was dry or the procedure would have to be repeated (Farnham 1916). In native North America, softening could be accomplished using a number of techniques; the simplest involved pulling with hands or with hands and feet (Ewers 1945:11; Robinson 2003:174; Wallace and Hoebel

1955:94; Wallis and Wallis 1955:40; Wissler 1910:64; 1934:60). This technique is also found outside of native North America. Weedman (2005:185) reported that the Gamo hide-workers stretch the hide with their feet, and an early account of South African natives also described use of this method for softening springbok hides (Stow 1905:73). Another softening technique used in North America was to draw the skin across a rope of sinew stretched between two trees, through a sinew loop, or across a bison scapula, or blunted stick, sapling or tree branch, or an iron hoop to make the hide pliable (Curtis 1928:29; Denig 1928:147; Dorsey 1884:311; Ewers 1945:10-11; Fletcher and La Flesche 1911:345; Grinnell 1972:215; Kroeber 1902:27; Lowie 1910:14; 1954:66; Russell 1898:184; Wallace and Hoebel 1955:94; Weltfish 1965:370; Wissler 1910:64; 1934:60). Figure 7.13 shows a post wooden post used to soften hides by the Algonquin of Canada. Scapulae were often used to soften bison hides, and it is possible that the under-representation of scapulae at Locality 1 at the Jurgens site (Wheat 1979:29) could be explained by their use in the softening stage. Kroeber (1902:26) described Arapaho women using convex tin tools to rub the skin until it was dry, suggesting that bone, horn or stone were probably used prehistorically for this task. Skinner (1911:225) reported that the Menomini (Mamaceqtaw) used a small implement of bone or wood to soften animal hides. In an autobiographical account of his early life among the Kansas and Osage, Hunter (1823:287) described women softening a hide by drawing it over a rounded timber set into the ground. A similar technique was used by the Choctaw (Bushnell 1909:11) and was described by Driver and Massey (1957:343) for processing small hides. For deer skin and other game, an oyster shell was used (Lawson 1967:186). Among Northwest Coast and British Columbia groups (Figure 7.14), softening was often accomplished by a large scraper mounted on a long wooden handle (Emmons 1911:81;

Emmons 1991:211; Pokotylo and Hanks 1989; Sapir and Sapir 1989:404; Teit 1900:185).

Spier (1970:117) discussed chewing as a means of softening hides and suggested that in addition to bending the fibers in a hide, the saliva acted as an emulsifier to allow fats to dissolve more readily into the hide.



Figure 7.13. Algonquin girl standing next to hide stretching post with hides in the background. Outaouais Region, Quebec, Canada. National Museum of the American Indian, Smithsonian Institution. Photo by Frederick Johnson. (Source ID, NMAI_352613; Catalog Number:N15049).



Figure 7.14. Tahltan woman softening hide with a *tagodi* (Albright 1982: Figure 21).

Richards (2001:109) stated that hide abrading is an important step in the softening process. Abrading removes the crust that develops on the surfaces (hair and flesh sides) of the hide, which can prevent the hide from completely stretching. Modern tanners note that coarse pumice can be used on the hair side and finer pumice on the flesh side of the skin (Edholm and Wilder 2001:38). Historic abrading tools typically consist of materials such as pumice, sandstone, gypsum or cancellous bone (Adams 1988; Clark 1958:144; Denig 1928:147; Emmons 1911:83; Ewers 1945:10; Grinnell 1972:213; Howard 1965:52; Merrill et al 1997:122, Figure 37; Mooney 1910:592; Murdoch 1892:300; Russell 1898:186; Wissler 1910:64; 1934:60). Blackfeet women rubbed the bison skins with a rough stone, whereas today a grater-like piece of metal is used (Kehoe 2005:139). Abrasive stones were also used in processing hides among the Namaqua of southern Africa, and have been reported in early accounts of hide-working in South Africa (Gooch 1881:144; Webley 2005:161). Patagonian women also used an abrasive stone for smoothing guanaco skins (Lothrop 1928:11).

A possible Cody pumice hide-abrading stone was reported by Shortt (2001:237, Figure 4) from the Osprey Beach Locality in Yellowstone National Park. Sandstone abraders or slabs were also reported from Brown's Valley (8,700+-110 B.P) (Jenks 1937) and Horn Shelter 2 (ca. 9650 ^{14}C yr. B.P.) (Redder and Fox 1988). The Agate Basin site contains a rough stone that has been interpreted as a hide abrader. Wheat (1979:130) reports abrasive handstones from the Jurgens Site from Areas 2 and 3 and the Fill Area created by the leveling process. These handstones are made from quartzite, granite, and sandstone.

Smoking. Following the tanning, stretching and softening processes, the hide is soft and flexible. However, the hydrogen bonds that bind the oils to the collagen fibers in the fiber network can be broken. Because not all the collagen fibers are coated in oil tanning, if continuously exposed to water, they will become hydrolyzed and vulnerable to decay (Goffer 2007:335-336). A hide wetted repeatedly will become stiff and inflexible (Edholm and Wilder 2001:155). Smoking allows the hide to retain its suppleness even after being exposed to moisture (Catlin 1913:52; Ewers 1945:11). Smoke tannage coats the fibers in the reticular layer such that the natural glues in the skin cannot adhere. In the smoking process, a smudge fire is made from rotten wood, creating smoke. The heat from the smudge fire (30-50° C) oxidizes the oils in the skin and converts them to aldehydes and polymers (Levitt 1979:51). The smoke from the rotten wood also contains aldehydes, such as formaldehyde, acrolein and acetaldehyde, which permanently bond with the collagen fibers in the skin, creating "cross-links" or bridges between the fibers (Edholm and Wilder 2001:156-157; Reed 1972:72; Richards 2001:36). This cross-linking occurs in areas that are normally taken up by water. These strong chemical bonds retain their structure when wet and prevent the fiber structure from collapsing (Edholm and Wilder 2001:156). Unlike commercially tanned leathers,

smoked skins are not broken down by soap products and other alkaline fluids (Richards 2001:37). Historic smoked brain-tanned skins of native North America were noted for their durability and suppleness even after becoming wet (Hunter 1823). It should be noted though, that while smoking allows the skins to remain pliable after wetting, smoked brain-tanned skins are not waterproof. Smoke tanning might have arisen in Northern Asia and diffused into North America, where it was commonly practiced by historic native peoples (Spier 1970:118).

In indigenous North America, the smoking process often entailed draping the hide on a frame place over a smudge fire or in some cases over the smoke aperture in lodges (Binford 1967; Ewers 1945:11; Hunter 1823:287; Lowie 1910:14; Wallace and Hoebel 1955:95). The smudge fire was created by placing rotten vegetation and hot coals together in a pit (Ewers 1945:11). Hides were typically sealed together before being placed over a frame or draped from a tripod, which ensured retention of the smoke (Richards 2001). Additionally, other skins might be placed on top of the skins to be smoked to facilitate the process (Ewers 1945). Catlin (1913:52) summarized this process:

A small hole is dug in the ground and a small fire is built in it with rotten wood, which will produce a great quantity of smoke without much blaze; and several small poles of the proper length stuck in the ground around it, and drawn and fastened together at the top around which the skin is wrapped in form fashion of a tent, and generally sewn together at the edges to secure smoke within it.

Richards (2001:129), a modern brain tanner, points out that smoking is weather-dependent and difficult to conduct on windy or even breezy days. Prehistorically, smoking might have been most often performed during certain seasons. Because the fire can ruin a hide, the smoke tannage process requires constant attention. Blackfeet women carefully watched over the smudge pit (Ewers 1945:11).

In North America, bison hides were sometimes smoked, but in other instances, this step was skipped altogether (Brink 2008:227). It is possible that Paleoindians did not regularly smoke bison hides, and therefore smudge pits might not be expected on habitation sites even when other evidence of hide-working is present. Alternatively, Paleoindians might have smoked bison and other hides when they were also dehaired. Dehairing and smoking of bison skins might be associated. In at least one instance, smoking the bison hide also involved dehairing (Harmon 1903:287-288). Because historically rawhide products were often manufactured in the summer season, the occurrence of smudge pits might be more probable on habitation sites during this season than in fall or winter.

Application of Ocher. Hematite or red ocher (Fe_2O_3) is well known from Upper and Middle Paleolithic contexts in Europe, Africa, Russia, and the Near East (Barham 2004:114; Harrold 1980; Lambert 1998:76; Roper 1991; Schmandt-Besserat 1980:127; Soffer 1985). In Upper Paleolithic sites, there is evidence of grinding red ocher with ground stone and heating ochers to alter colors, in addition to their use in cave paintings, in burials, and on Venus figurines (Schmandt-Besserat 1980:129-131). Use of ocher continued into the European Mesolithic in burials as well as in Near Eastern Natufian and Neolithic contexts (Schmandt-Besserat 1980:140-142). The use of red ocher is also common in prehistoric North and South America. Red ocher in burials was common between 1200 and 500 B.C.E. in the midwestern United States, referred to as the Red Ocher Complex (Birmingham and Eisenberg 2000:79; Walthall 1990:91–92). Red ocher is also associated with burial practices in the Chinchorro mummies. Red ocher was used extensively by Australian aborigines in burials and living contexts (Barham 2004:114; Berndt and Berndt 1964:392; Pretty and Calder 1998:296).

Given its pervasive association with ritual practices, especially in burials, red ocher seems to have universal symbolic appeal.

In addition to its inclusion in ritual and burial contexts, red ocher was known to have been used by a number of groups to add color to animal skins. Several North American groups dyed hides with red ocher (e.g., Paterek 1996; Turner 1888:290-291). Historically, Patagonian women produced garments and tents from guanaco skins (Mason 1924:84). Tents, Mason (1924:84) wrote, were made from “forty to fifty guanaco skins sewn together and smeared with grease and ochre.” Coloring skins with red ocher or other red pigments also occurs in Africa (Wadley et al. 2004; Webley 2005:162; Weedman 2005:193). Endscrapers at Pincevent, France, had traces of red staining, which has been interpreted as the remains of red ocher used in the hide-working process (Keeley 1980:171). Additionally, red ocher-stained floors are interpreted as the remains of ocher-treated hides used as floor coverings (Keeley 1980:171).

In addition to its aesthetic and symbolic qualities, ocher might also have preservative properties (Audouin and Plisson 1982). Velo (1984:674) claimed that iron oxides have an astringent effect and promote healing. Iron oxides might have been applied to the human skin by Australians and others to keep insects in check (Bahn and Vertut 2001:86; Keeley 1980:172). Velo wrote that some Australian groups used hematite and limonite for medicinal purposes; wounds and burns being were treated with red ocher. African and European groups have also been reported to use red ocher in the treatment of wounds either by drying or as an antiseptic (Bahn and Vertut 2001:86). More specifically, the iron ions in red ocher might inhibit the production of collagenase by bacteria, which breaks down the collagen in skins (Keeley 1980:172; Mandl 1961:196). Mandl (1961:196) wrote that with the exception of

calcium, all metal ions inhibited *Costridium. histolyticum* collagenase. The metal ions Mg, Co, and Mn inhibited collagenase at concentrations of 0.5 M, whereas Ag, Cu, Fe²⁺, Fe³⁺, Hg, Ni, Pb, and Zn required concentrations of 10⁻³ M. Thus, the iron ions in red ocher might have assisted in preserving hides. Others argued that red ocher has no preservative or antibacterial qualities, or that staining hides (and other items) with red ocher was primarily symbolic rather than functional (Barham 2004:114; Power and Watts 1996:317-318; Rosenfeld 1971:182; Watts 2002).

Red ocher might also have a drying effect on skins. Audouin and Plisson (1982) conducted an experiment with a moose hide that had begun to decay. They applied red ocher to the hide, which subsequently dried quickly. The tail, which had not been treated, decayed. In an attempt to further substantiate the drying effects of red ocher, Audouin and Plisson treated two halves of an ox hide—one with yellow and the other with red ocher. The red ocher side dried quickly, decreased in thickness by 1mm and became more pliant than the yellow ocher side. Thus, red ocher, and not yellow ocher, may have the beneficial effect of drying the hide and perhaps aiding in its preservation. Colored clays were also used for cleaning animal skin garments (Paterek 1996:433). Turner (1888:295) who reported on the native Naskopie (Nagnagnot) inhabitants of Hudson Bay, stated that if a hide was deemed too oily, it was treated with a powdery substance such as chalk, clay, calcined bone or flour. The Blackfeet approach to cleaning skins involved rubbing them with colored clay-water mixtures using a bone or rock tool (Ewers 1945:13). The addition of red ocher might serve to remove excess oil from the skin.

Red ocher occurs in several Paleoindian contexts, including burial, ritual, cache, habitation contexts, and evidence for red ocher mining occurs at the Paleoindian Powars II

Site at the Sunrise Mine in southeastern Wyoming (Anderson 1966; Bement 1999a:179; Dixon 1999; Frison 1982; Frison and Bradley 1980; Kilby 2008:47, 62, 77, 79, 94, 107, 122, 130, 179-185; Roper 1987; Roper 1991; Stafford et al. 2003; Tankersley et al. 1994). Roper (1991:295) reported that grinding stones with adhering red ocher occur at Lindenmeier (Wilmsen and Roberts 1978:125), Agate Basin (Frison 1982:69), Cattle Guard (Emery and Stanford 1982:12), Red Smoke (Davis 1954:7), and the Niska Site in Saskatchewan (Meyer and Liboiron 1990:299). Roper (1989) found that 10 of 23 Paleoindian sites on the Plains contained both red ocher and ground stone tools, suggesting that the ground stone implements were used in ocher processing. Lumps of red ocher and ocher-stained sandstone abraders were found at Locality B of the Barger Gulch site, which is a single occupation Folsom site (Mayer et al. 2008:83). It is possible that some of these red ocher-stained abraders could have been used in the hide smoothing process following an application of a red ocher mixture.

Time Allocation. Gleaned from the ethnographic literature, estimates of the time required to prepare hides may be useful in gaining insight into Paleoindian settlement duration.

Unfortunately, there are a number of confounding variables in creating these estimates. First, depending on the season, hides can be dried or frozen at certain stages, extending hide preparation over a significant period time. Dried skins can be stored in this manner effectively for up to a year (Edholm and Wilder 2001:17). Hide-working on the Plains was sometimes conducted in stages, with several hides being defleshed before they were scraped or tanned (Denig 1928:147). Different animals, such as bison and deer, would have required different processing times due to skin thickness. Wet-scraping versus dry-scraping would also potentially have required different processing times, due to lengthy soaking and or

drying steps. The type of tool used will affect time allocation estimates. Stone tools might not be as effective as metal tools for some stages of hide work, and the time allocation in many of the ethnohistoric accounts must be considered conservative estimates in comparison to stone tool standards.

The type of hide product desired could also affect time allocation. For example, skins requiring the removal hair would need additional scraping time, and if rawhide products were desired, the lengthy softening process could be skipped. The condition of the skin and the product for which it was intended (rawhide, robe, clothing) is also related to season. In autumn, thick winter bison skins with hair intact might be required for clothing and bedding, making removal of the grain unnecessary, but requiring significant thinning, tanning time, and softening. Thinner spring and summer hides with less hair, and perhaps infested with insect larvae, might more often be made into rawhide, which requires fewer steps. The two related issues of desired hide product and season of manufacture could have resulted in very different strategies of time allocation to hide-working. A number of ethnohistoric sources reveal that cooperative hide-working was common, potentially creating shorter estimates of time allocation in hide preparation (Table 7.1). Most of the ethnohistoric accounts of cooperation in hide-working involve the final step of softening. This step perhaps requires the most time and labor input. Additionally, the hide must not dry out before it has been sufficiently softened, and therefore this step cannot be prolonged once begun.

Table 7.2 summarizes the historic and modern literature on time allocation in the various stages of hide preparation. Not surprisingly, total preparation time varies considerably, from 10 hours to more than two weeks per hide. This, of course, is dependent on a number of factors, including the pace of the work. Most scholars, however, report that a

skilled hide worker could complete a hide robe in a minimum of about two days. This would, of course, eliminate the graining process. It is not always clear, however, if the initial drying time is included in these estimates. Fleshing appears to take several hours for caribou and bison. The drying time again varies depending on weather, climate and species. At a minimum, it appears that drying takes a full day. One reference for sweating time is up to three days. Soaking for deer and caribou before the graining process can take from two days to a week. Once the tanning solution is applied it is allowed to set or soak for a period ranging from overnight to at least three days. In some cases, following the application and setting of tanning solution, the hide is rinsed for one or two days. Scraping and thinning time again is dependent on animal species and the type of implement used. For bison, cattle, and other large animals, this stage appears to have taken half a day or on the order of six hours. The highest estimate for large game is three or four days of intermittent work. In modern and historic accounts, the softening process took up to several hours up to half a day for various species. The smoking estimates vary widely from half an hour to several days.

Table 7.1. Accounts of Cooperation in Hide-working in Ethnohistoric Literature.

Hide-working Step	Author	Culture	Animal Species	Tool or Technique	Description
General	Henriksen (2009:36)	Innu	caribou	Not specified	“Two old women were tanning a caribou hide.”
General	Steinbring (1966:580)	Northern Ojibwa	Not specified	Chisel bone flesher; metal scraper	There are sometimes multiple persons working on a hide
General	Lothrop (1928: 11)	Tehuelche	Guanaco	Hafted stone or glass scraper	“When a man is married, his wife, or wives, of course manufacture his mantles, assisted by their friends, whom they help in their turn”
Framing	(Emmons 1991:210)	Tlingit	Not specified	Frames	Tlingit men built frames upon which women lashed and processed hides
Stretching	Haley 1981:100)	Apache	Larger hides	Not specified	Women did the bulk of the hide work, though men assisted with the stretching of larger hides
Fleshing	Issenman (1997:76)	Inuit	caribou	Dry-scrape; Blunt edged scraper	Women were sometimes aided by men
Fleshing	Mooney (1910:592)	Plains	Not specified	Iron bladed instrument	Two women working together
Scraping with elkhorn scraper	Mooney (1910:592)	Plains	Not specified	Elkhorn scraper with blade of stone or iron	Several women work together
Squeegeeing	Mooney (1910:592)	Plains	Not specified	Broad blade 6 in. long set in a bone handle	“The stripping is done by two women working together.”

Table 7.1. Accounts of Cooperation in Hide-working in Ethnohistoric Literature.

Softening	Weltfish (1965:370)	Pawnee	bison	Sinew rope	cooperating in the softening of a bison hide along a sinew rope
Softening	Wallis and Wallis (1955:41)	Micmac	Deer or moose	Hand kneading	“with the hands, man and wife knead every portion of it.”
Softening	Harmon (1903:288)	Northern Plains	bison	Pulling with hands	Two women pulling on either side of the hide while it dries over a fire
Softening	Skinner (1912:126)	Northern Saulteaux	Not specified	pulling	The skin is pulled by two people to make it pliable
Softening	(Silberbauer 1981:224)	G/wi	Eland, gemsbok, kukdu, hartebeest	Kneading with hands, removal of material with fingernails	Five or six men needed in the softening process
Softening	Frobenius and Keane (1909:98-99).	Barotse	Not specified	Beating with sticks	Among the Barotse (Marutse) of South Africa, two to six men cooperated in this step in the process of making drum skins
Softening	Hoebel (1978:67)	Cheyenne	bison	Rope or blade softening	In lodge making, one hide is given to a friend or relative for the softening process. This is the only step that is cooperative.
Softening/aligning hide	Otak (2005:78)	Igloodik	caribou	Hand pulling	This step is always done with a partner
Softening	Weedman (2005)	Traveler accounts in Ethiopia	Not indicated	Pedipulation	With linseed and milk
Softening	Weedman 2005	Konso	Cattle, goat and sheep	Pedipulation	Castor oil beans and ocher are ground into the hide

Looking solely at the production of bison robes based on these time allocation estimates, it is possible to get a sense of the minimum length of time required to produce these products without smoke tannage (Table 7.3). For estimates of half a day, I chose this to mean at least six hours. For the estimate of several days, the estimate of three days was used. Unfortunately most accounts do not mention skinning time and staking time. It seems unlikely that work would continue non-stop, and the time must have been longer prehistorically. Most of the ethnographic estimates are based on the use of metal tools, thus prehistoric hide-workers using bone and stone tools would have presumably have taken much longer. Paleoindian bison robe hide-workers would have been working much larger hides with thicker skins, again inflating the estimate. Given these problems, a minimum of one week to prepare a bison robe for Paleoindian hide-workers seems reasonable.

Table 7.2. Time Estimates for Bison Robe Manufacture.

Procedure	Time Estimate
Fleshing	Six hours
Drying	Several days (3 days)
Scraping membrane/thinning	6 hours
Softening	6 hours
Total minimum time	4.5 days

Location of Hide-working Activities

Dawson and Judge (1969) suggest that hide-working at the Rio Rancho Folsom site might have been conducted on the periphery of the site, based on subjective observations of endscraper locations. Activities that require standing, such as hide-working, may tend to take place at some distance from a residence or main activity areas (Binford 1980; Carr 1984;

Jodry 1999a:231). Others have suggested that the messiness and odors associated with hide-working necessitates its performance away from living areas (Carr 1984; Rockwell 2011:98). Is hide-working, or certain stages of hide-working, best conducted at some distance from residences or main living areas? Examination of modern-day hide-working locations and historic photos can help begin to answer this question, and suggest the range possibilities of hide-working locations within a Paleoindian camp.

In modern-day Ethiopia, some hide-workers conduct work several meters from their house (Sidama and central Gamo), while the Konso workers process hides just outside the house (Brandt et al. 1996:49). Modern Sámi women, as seen in the video “Ray Mears in Sweden: Life in the Nordic Tipi”, are also known to process reindeer hides in front of the residence (<http://youtube.ng/watch?v=76xIhuJ1MhQ>). Sámi and Naskapi women (Quebec) conduct later-stage softening and tanning inside the tent (<http://youtube.ng/watch?v=4eAnCwd1NYU>). These modern examples suggest that hide-working in general does not necessarily have to be conducted far from residence because of mess or smell associated with the task.

On the American Great Plains, there are many historic photos depicting women processing hides just outside the tipi or some other structure (Figures 7.15–7.17). Evidence from other regions, such as Russia, where reindeer hide-working is an important activity, also suggests that hide-working was conducted near a domestic tent. Figure 2.13., for example, shows a Nenets woman of Russia working on a beam at the opening of a tent. Based on historic photos, activities conducted in the immediate vicinity of a tent, include staking a hide, scraping the interior for tallow, softening, and fleshing/thinning on a beam.



Figure 7.15. Fleshing a hide outside a residence. Hide scraping—Apsaroke, ca. 1908. Photograph by Edward S. Curtis, Curtis (Edward S.) Collection, Library of Congress Prints and Photographs Division Washington, D.C. (<http://it.paperblog.com/north-american-indian-photographs-by-edward-curtis-221228/>).



Figure 7.16. Woman scraping a hide near residence. Southern Tsitsistas/Suhtai (Cheyenne), Colony; Washita County; Oklahoma; USA., ca. 1902-1904, “Red Water's mother-in-law (or Red Water, per Ilene Lieberman, 2001), standing, holding a hide scraper, standing next to staked hide. She wears a long cotton print dress, with a shawl or blanket wrapped around her waist; she stands next to a tipi, with a grassy landscape and low hills in the background. National Museum of the American Indian, Smithsonian Institution (Catalog Number: N13604). Photo by Elizabeth Curtis Grinnell. (<http://www.americanindian.si.edu/searchcollections/item.aspx?catids=0&cultxt=cheyenne&src=1-1&page=4&irn=353758>)



Figure 7.17. Cheyenne Woman scraping and softening hides near residence. “Cheyenne women dressing skins” ca. 1870’s). Dakota Territory. The woman on the left is in the process of softening a bison skin on a post. At right a woman thins a bison skin. Another woman is processing a hide in the background to the right. At the far left a girl or young woman is seated with an animal skin. Smithsonian Institution (Photo Lot 90-1, number 304, National Anthropological Archives, Smithsonian Institution; negative # 90-17238. Photo by Morrow, Stanley J Yankton.

(<http://siris-archives.si.edu/ipac20/ipac.jsp?&profile=all&source=~!siarchives&uri=full=3100001~!88398~!0#focus>).

Prior to the development of photography, several painters attempted to document Native American life through art. Charles Russell (1864–1925) painted western scenes including Native American life, influenced by his time spent with the Blackfeet Tribe (Blood branch) from 1888 to 1889. His famous painting, “The Silk Robe”, depicts two women outside a tipi scraping a bison hide, while men look on from near the entrance (Figure 7.18). A child plays with the bison’s tail. Karl Bodmer (1809–1893), the Swiss-born painter, painted detailed paintings of Native American life from the 1830s. Bodmer depicts Sioux lodgings with a woman directly outside a tipi, scraping a hide on a beam (Figure 7.19).



Figure 7.18. *The Silk Robe*, by Charles M. Russell, ca. 1890, Amon Carter Museum, Fort Worth, Texas. (Accession Number 1961.135). (http://www.cartermuseum.org/custom/acm_display.php?irn=129942&QueryPage=%2Fcustom%2F) (Used with permission from the Amon Carter Museum)



Figure 7.19. Women working on a beam near residence. “Sioux Tipi”. Watercolor on paper by Karl Bodmer from his travel to the U.S. 1832-1834 (<http://en.wikipedia.org/wiki/File:Tipi01.jpg>)

The famous American painter, George Catlin, of Wilkes Barre, Pennsylvania, made five trips visiting different western tribes between 1830 and 1838, creating over 500 paintings of Native American life during this time. Some of his works were created after he returned from his travels from sketches he had made. In the Comanche Village painting, a group of men gather near to the female hide-workers, suggesting separate but adjacent activities of men and women. Between the two areas, a girl is depicted staking a hide and a boy is wielding a weapon. Catlin’s painting of Comanche and Cree villages suggests that hide fleshing of large hides was in some cases conducted some distance from tent (Figure 7.20–7.21). This initial step in hide processing might have been conducted away from the residence as the hide is still wet and contains wet animal tissues. Jodry’s (1999a) suggestion that initial processing occurred at some distance from later hide processing at the Cattle

Guard Site seems to be supported. The paintings suggest that fleshing may have taken place at a different location than others steps in the hide-working process such as scraping and softening.



Figure 7.20. *Comanche Village* by George Catlin, ca. 1834–1835. Smithsonian American Art Museum. Gift of Mrs. Joseph Harrison, Jr. 1985.66.346. The women are depicted fleshing bison skins. (<http://americanart.si.edu/collections/search/artwork/?id=4011>)



Figure 7.21. *Crow Lodge of Twenty-five Buffalo Skin* by George Catlin, ca. 1832–1833. Smithsonian American Art Museum. Gift of Mrs. Joseph Harrison, Jr. 1985.66.491. The woman is fleshing a bison skin. (<http://americanart.si.edu/collections/search/artwork/?id=4019>)

Some photos are suggestive that the intensity of hide-working may also have affected where hide-working activities were organized. In two early photographs (Figures 7.22–7.23), many hides are being processed by several women at some distance from tipis. In Figure 7.23., Jodry (1999a:318) points out that at least 10 hides are being processed. The photo suggests that when many hides are being prepared, perhaps during robe season, hide-working occurred at some distance from residences. When hide-working was conducted on a smaller scale, the activity may have been located closer to a single residence. Binford (1980:172) noticed a similar general pattern writing “When only one or two hides are being worked, they may be staked out just to the side or slightly behind shelters, but if larger quantities are involved, they will be carried out a greater distance from the center of residential activities.” Binford also noticed that rocks are often removed from the often flat area selected for hide-working, and that the resulting ring of stones can be confused as a residential space. This possible hide-working intensity and location of activities would have a significant affect on the archaeological record. As mentioned, the initial fleshing of bison, both large- and small-scale, might have taken place away from other activities. Because fleshing is historically accomplished with only bone tools, such as the chisel-bone flesher, very few archaeological signatures might remain. Large-scale hide scraping might have taken place at the periphery of camps, resulting in many endscrapers and other hide-working tools being deposited at the periphery of a camp. With large-scale hide-working little overlap with other artifacts would be expected. In addition, large-scale hide-working, perhaps conducted during the fall when the bison fur was at its best, might have been conducted communally, in aggregated camps. This raises the possibility that very large camps might also produce endscrapper depositions different from that of smaller-scale sites. This endscrapper deposition might also be affected

by the season of kill, where fall kill/camp sites might produce different patterns of endscraper deposition than kills during other seasons.



Figure 7.22. Women cooperating in fleshing a hide. Northern Cheyenne Women Dressing Buffalo Hide. n.d. Photograph by S. J. Morrow. The women here are fleshing hides. From stereo card by Stanley J. Morrow. National Anthropological Archives (NAA INV 06605900; NAA neg. 3701) (<http://siris-archives.si.edu/ipac20/ipac.jsp?uri=full=3100001~!14731!0#focus>).

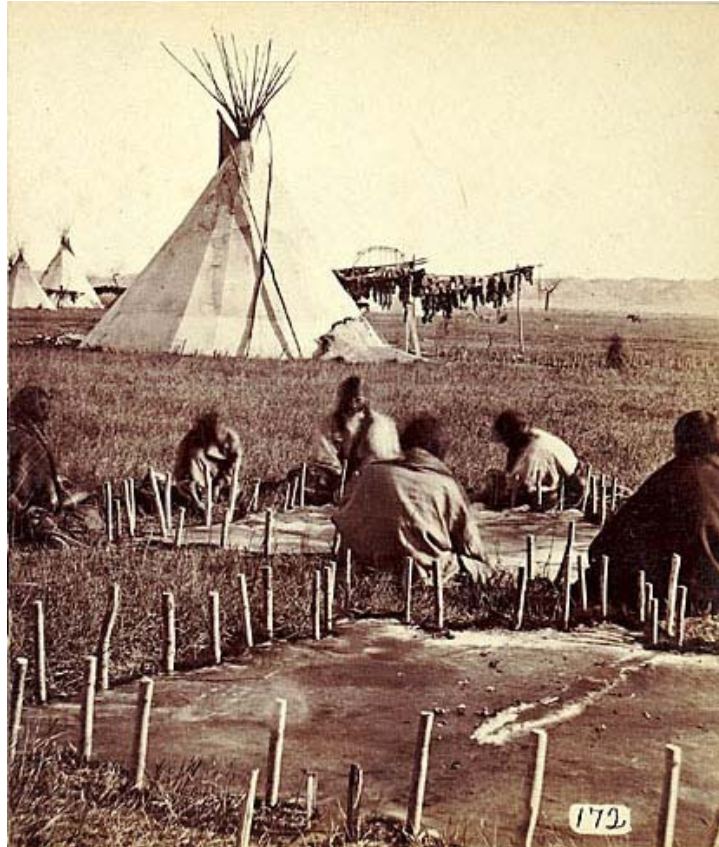


Figure 7.23. Women cooperating processing bison hides. “Women Curing Buffalo Hides”. Dakota Territory. Photo by Morrow, Stanley J Morrow. Smithsonian Institution, National Anthropological Archives, Smithsonian Museum Support Center, Suitland, Maryland (Photo Lot 90-1, number 315; Local Number: NAA MS; OPPS NEG 90-17235) (<http://collections.si.edu/search/results.htm?q=Hide+preparation>).

Implications

Examination of the ethnohistoric and modern literature on hide-working suggests that two main techniques might have been used by Paleoindians—the wet-scrape technique and the dry-scrape technique. These techniques involve different toolkits and tend to be associated with different species and hide products. Wet-scraping can be accomplished with nothing but bone and wood tools, particularly the wooden beam and the bone beamer. This technique is strongly associated with medium-size animals such as deer, and is most

appropriate for processing animals without the fur as use on a beam can damage the fragile hair.

Gramly (1982:37) points out that hide-working can be accomplished with bone tools alone and that endscrapers might have been wood-working tools. While true for the wet-scrape technique, the dry-scrape technique requires a sharper implement. On the historic Plains, bison were most commonly dry-scraped rather than wet-scraped. Unlike deer, thick bison hides required considerable thinning, particularly in the neck area, in order to take up the tanning solution. Numerous endscrapers from Plains Paleoindian sites, some of which are associated with hide-working (e.g., Akoshima and Frison 1996:77-80; Ballenger 1996; Barnes 1932:54; Donahue 1988:363; Jensen 1982; Jodry 1999a:229,235, Figure 74; Judge 1973; Kay and Martens 2004; Keeley 1988; Moss and Newcomer 1982:310; Rosenfeld 1971; Semenov 1964:88; Wilmsen 1970; Yerkes and Gaertner 1997:68-69), suggest a dry-scrape technique. Late prehistoric endscrapers, similar to Paleoindian endscrapers, appear to have been associated with bison hide-working on the Great Plains. Creel (1991) provides evidence for the use of endscrapers in processing bison hides in late prehistoric times. He shows that on the Southern Plains endscrapers, beveled knives and bison co-occur on the post AD 1300 sites, whereas prior to this time, (AD 900 to 1300), there is no bison bone, no endscrapers and no beveled knives, suggesting that endscrapers, however they were hafted onto a handle, were used for processing bison hides. On many late prehistoric Oneota tradition sites on the eastern margins of the Great Plains endscrapers are common, but are relatively scarce at sites closer to the Great Lakes. This pattern in endscraper discard along with use-wear analysis suggest endscrapers were bison hide-working implements (Boszhardt and McCarthy 1999). Given the association with endscrapers and bison hunting, numerous endscrapers from

Plains Paleoindian sites suggest that Plains Paleoindians were practicing a dry-scrape technique on bison. A serrated flesher recovered from redeposited sediments discovered at the Agate Basin site in northeastern Wyoming has been interpreted as a possible Folsom flesher (Frison and Craig 1982:171) and further supports the dry-scrape hypothesis. The dry-scrape technique also implies Plains Paleoindians were using a staking or framing technique to stretch hides. Dry-scraped bison hides would have been particularly suited to production of robes, bedding, and if the hair was removed to very durable rawhide. Historically, bison hides were not often smoked, and smudge pits might not be common in areas on Paleoindian sites that saw heavy bison hide processing.

Paleoindian bison hide processing could have had an impact on Plains Paleoindian settlement strategies. Because of the fast rate at which bison spoil after a kill, removing the skins must have been completed quickly. Small groups might not have been able to effectively remove a large number of bison hides for processing in a single kill event. Group aggregation and cooperation in hide removal might have been a strategy used by Paleoindians, particularly in the fall, when bison wool was at its thickest and the need for robes and warm bedding increased.

In native North America, deer were often processed using a wet-scrape technique and did not require considerable hide-thinning like bison. Paleoindians in these areas might have used a wet-scrape technique on deer, particularly if the hair was to be removed. Dunbar and Webb (1996:340-343) discuss two smooth and slightly polished *Mammuthus columbi* neural spines found near Tampa Florida, which might have been used by Paleoindians as beamers.

Around 10,000 years ago, Paleoindians inhabiting montane regions like the Rockies targeted a wide array of animals, including deer, bighorn sheep, antelope and to a lesser

extent bison (Frison 1991:67). Deer skins that have been wet-scraped have greater flexibility than dry-scraped ones and were likely more suitable to producing clothing such as shirts and pants as opposed to robes. It is expected, that endscraper deposition in foothill-mountain regions would be less prevalent than in open grasslands or that use-wear on endscrapers might exhibit greater incidence of wood-working as opposed to hide-working.

Paleoindians in different environmental settings might also have varied in their use of soaking methods to facilitate hair removal and removal of excess tanning solution. In areas where running water was accessible, the stream soaking method could have been used. In areas with little or no running water, a dry-scrape method could have been used to remove the grain, and excess water and tanning solution could have been removed on a stretched hide with a broad tool.

Summary

A number of different tools and features are potentially associated with Plains Paleoindian hide- working activities (Table 7.3). Driving the skin off bison, especially if the hide was to be preserved for use, likely involved no cutting implements, but could have been accomplished using hand-sized pounding stones. At the Cooper Site in Oklahoma, cobbles associated with the upper bison kill have been interpreted as possible pounding stones for removing the bison hides (Bement 1999a:79, Figure 28). Drying could have been accomplished using a frame, but in the absence of abundant wood resources, hides would easily have been staked to the ground with wood, bone, antler stakes, or large stones.

Table 7.3. Possible Archaeological Residues of Hide-working.

Procedure	Use-life	Archaeological Residue
Skinning	Short-term. Deposited at skinning location	Flakes, bifaces used for initial cuts only. No tools used in removal of skin
Drying	Long-term	Wooden or possibly bone stakes under ideal preservation conditions
Fleshing	Chisel fleshers: Long-term, as much as ten years (Steinbring 1966:581). Abrasive stones for sharpening: unknown	Bone fleshers in ideal preservation conditions; large dulled stones such as slate; abraders for sharpening bone flesher
Graining	Bone beamers: unknown. Stone scrapers: minimum 4 to 5 scrapers deposited per hide. Bone or wooden haft: long-term, several generations (Grinnell 1972:215)	Wet-scrape method: Bone beamers under ideal preservation conditions Dry-scrape method: stone scraper; scraper resharpening flakes, bone or wooden haft under ideal preservation conditions.
Membrane removal/ Thinning	Bone or wooden haft: long-term, several generations (Grinnell 1972:215). Stone scrapers: minimum 4 to 5 scrapers deposited per hide.	Wet-scrape: bone beamer Dry-scrape: stone scraper; bone or wooden haft under ideal preservation conditions
Softening	Possibly long-term	Abrasive stones
Smoking	Short-term	Smudge pits

Fleshing bison could have been accomplished with serrated bone fleshers, perhaps made from bison leg bones. Bone fleshers, such as the possible Folsom flesher from Agate Basin have the potential for preservation. Fleshers likely had a long use life and were likely discarded only periodically. Flesher sharpening was accomplished by modern tanners with a steel file. A rough stone may have served to keep fleshers sharp during Paleoindian times, and serrations might have been rechiseled using a stone flake or perhaps an endscraper spur. Graining and membrane removal could have been accomplished with a hafted stone scrapers. It is clear that Paleoindian endscrapers were continuously resharpened along one working

edge, as evidenced by the discovery of endscraper resharpening flakes, which in some cases contain traces of use-wear (Frison 1968; Hayden 1979a:68; Shott 1995). Endscraper resharpening flakes are usually small and thin with small flat platforms, and Frison and Bradley (1980:30) report that all unifaces at the Hanson site were resharpened using a direct percussion technique. Prehistorically, stone bits could have been refurbished using a simple hammerstone.

Damage to bison crania associated with brain extraction as has been found at historic sites could suggest that Plains Paleoindians were brain tanning hides. Smashed bison skulls from historic Great Plains sites suggest the removal of the brain for tanning (Brink 2008:163, 213). At the Gull Lake site, bison skulls were smashed through the frontal bone or basally, breaking the squamous, temporal and occipital bones after removal of the mandible and tongue (Kehoe 1973:152). One bison skull at the Jurgens site in Colorado might have been smashed to gain access to the brain (Wheat 1979:144). At the Lehner site in southeastern Arizona, mammoth skulls could have been smashed for brains, given the large number of skull fragments and the lack of complete skulls (Haury et al 1959:29).

The brain tan solution and possibly ocher mixtures might have been applied with a smooth stone or the hands alone. Red ocher occurs in Paleoindian burial, ritual, cache, and habitation contexts, and evidence for red ocher mining occurs at the Powers II site and Sunrise Mine (Anderson 1966; Bement 1999a:179; Dixon 1999; Frison 1982; Frison and Bradley 1980; Kilby 2008: 179-185; Roper 1987; 1991; Stafford et al 2003; Tankersley et al 1994). Roper (1991:295) reported that grinding stones with adhering red ocher occur at Lindenmeier (Wilmsen and Roberts 1978:125), Agate Basin (Frison 1982:69), Cattle Guard (Emery and Stanford 1982:12), Red Smoke (Davis 1954:7), and the Niska Site in

Saskatchewan (Meyer and Liboiron 1990:299). Roper (1989) found that 10 of 23 Paleoindian sites on the Plains contain both red ocher and ground stone, suggesting that the ground stone implements were used in ocher processing. Lumps of red ocher and ocher-stained sandstone abraders were found at Locality B of the Barger Gulch site, a single occupation Folsom site (Mayer et al. 2008:83; Surovell et al. 2001:59). It is possible that some of these red-ocher stained abraders could have been used in the hide smoothing process following an application of a red ocher mixture as well.

Softening could have been accomplished with simple bone tools such as scapulae or only the hands and feet. In abrading, porous stones like pumice or cancellous bone could have been used. A possible Cody age pumice hide-abrading stone is reported by Shortt (2001:237, Figure 4). The Agate Basin site contains a rough stone that has been interpreted as a hide abrader (Frison 1980). Sandstone abraders or slabs are also reported from burials, such as from Brown's Valley (8,700+-110 B.P.) (Jenks 1937) and Horn Shelter 2 (male, ca. 9650 ^{14}C yr. B.P.) (Redder and Fox 1988).

On the historic Plains, smoking, as mentioned, was not strongly associated with bison robe manufacture, but more strongly associated with deer skin processing. Smoking then might have been more prevalent in areas occupied by deer. Smoking pits might be difficult to differentiate from general hearths, as skins were often smoked over lodge covers.

In many cases, the tools associated with hide-working might be recoverable in the Paleoindian archaeological record, but might not be recognizable as tools. Pounding, smoothing, and abrading stones might not easily be identified except in association with known hide-working implements such as endscrapers. The presence of red ocher might also signal the potential for hide-working implements. Identification of beamers or fleshers could

help determine whether Paleoindians used a wet- or dry- scrape technique, whether medium or large animals were likely processed, and whether Paleoindians used a beam or staking technique. Excavation of Paleoindian sites with a mind toward hide-working toolkits might help to identify implements used in hide processing.

The location of endscrapper deposition may have been influenced by whether small or large-scale hide-working was being conducted. Fleshing, based on historic photographs and paintings of the Great Plains, was more likely to have taken place at a greater distance from the residence than other hide-working activities. Because fleshing leaves little residue in the archaeological record, the prehistoric location of fleshing may be hard to identify. For small-scale hide-working historic photos and paintings from the Great Plains indicate this activity, especially thinning of hide could be conducted in the immediate vicinity of the tent or tipi. As a result, endscrapers and other hide-working tools would overlap with other tools types, assuming the tent-tipi was a hub of activity. For large-scale hide-working, perhaps associated with the fall season when bison hides were in the best condition, hide-working may have taken place at the periphery of the camp, resulting in clustering of endscrapers at the margin of the site with little overlap with other tool types. The spatial deposition of endscrapers might also pattern with the season of kill and aggregation sites, with large communal fall kills associated with endscrapper deposition on site peripheries with little overlap with other tools.

In the next chapters, I build on the ideas outlined here, especially regarding the location of hide-working on sites as well as the results of the previous chapters, namely that (1) Folsom women could have participated in technological organization, (2) Folsom women likely did the bulk of the hide-working; (3) endscrapers might have been used by women to

work bison hides; (4) difference between endscrapers and weapons in spatial patterning, raw material, reduction, and design may reflect gendered activities. In the next chapter, I examine spatial patterning of endscrapers, weapons assemblages, and other tools at the Rio Rancho Folsom site in the Central Rio Grande Valley in New Mexico to explore whether the patterning in tools is commensurate with endscrapers as part of weapons assemblages, hide-working activities, or both.

CHAPTER 8

Analysis of Artifact Distribution at the Rio Rancho Folsom Site

While her mother is bending over a large buffalo-hide stretched and pinned upon the ground, standing on it and scraping off the fleshy portion as nimbly as a carpenter shaves a board with his plane, Winona at five years of age, stands upon a corner of the great hide and industriously scrapes away with her tiny instrument.

—Charles Alexander Eastman (1907:175)

This chapter examines endscraper and weapons assemblages from the Rio Rancho Folsom site from the central Rio Grande Valley in New Mexico in order to determine if the distribution is compatible with hide-working activities or not and if endscrapers and weapons assemblages are distinct in terms of their spatial patterning. These questions are explored not only to provide information about the technological organization of these tool types, but also to investigate the potential for identifying the gender of the tool users. The results indicate that while the distribution of endscrapers and weapons-related debris overlap in some cases, in other cases they are distinct, with endscrapers occurring away from weapons-related debris. Endscrapers and other unifaces tend to be located in both high-activity/hearth areas as well as away from these areas. Projectile points and preforms, on the other hand, tend to cluster strongly in high-density artifact and tool areas. Given modern and historic evidence that hide-working can take place both near to main activity areas as well as on the periphery of camps (Chapter 7), the results are not inconsistent with endscrapers being used for hide-working, though other scenarios are also possible.

The Rio Rancho Folsom Site

The Rio Rancho Folsom site, one of the largest Folsom sites in the western United States, is located on the Llano de Albuquerque, approximately 40 km northwest of downtown Albuquerque (Figure 8.1). The site is also one of the highest artifact density Folsom sites in the central Rio Grande Valley, and contains a wider array of material types than most Folsom sites in the Great Plains and Southern High Plains regions. Vegetation at the site is mixed grassland-scrubland developed on an eolian surface, and the area receives low annual levels of precipitation. The site, located at 1,814 m elevation, is situated on the crown and southern slope of a 300-m long, low east-west trending ridge and the surrounding landscape is characterized by ridges and valleys (Huckell and Kilby 2002). To the north of the ridge lies the head of a drainage. Dawson and Judge (1969:156) described the prehistoric landscape as “dotted with lake basins and cut by several large drainages, which abruptly terminates about three miles to the west in an escarpment, the rim of the Rio Puerco Valley”. Approximately 19.2 km (twelve miles) east of the site are bluffs that overlook the Rio Grande Valley (Dawson and Judge 1969:156). Dawson and Judge (1969) originally suggested the site was situated on the edge of a large Pleistocene lake, but more recent investigations suggest this basin feature is erosional rather than lacustrine (Huckell et al. 2001:29).

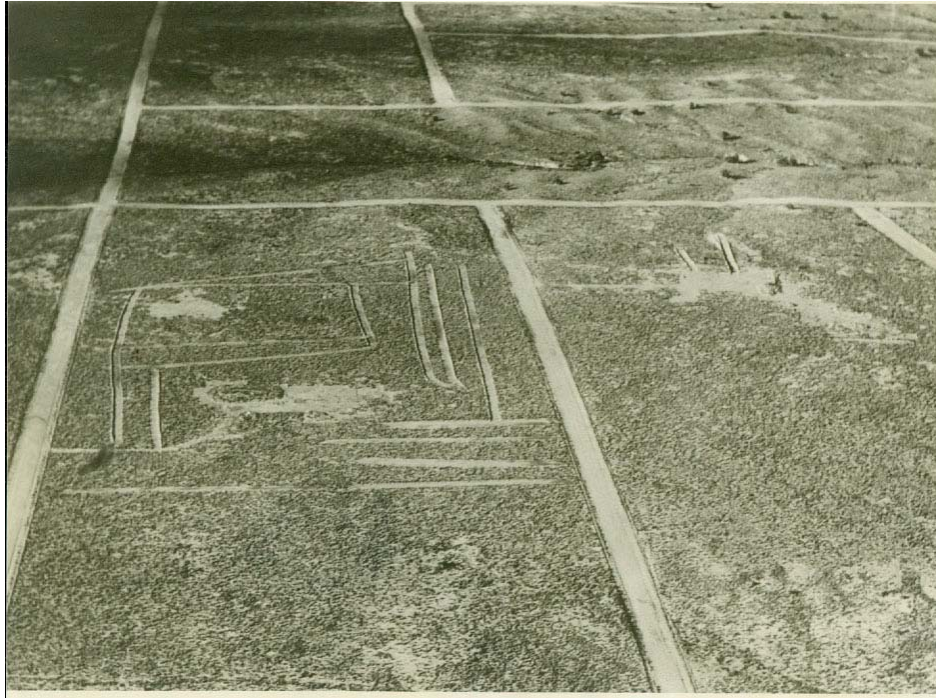


Figure 8.1. Aerial view of the Rio Rancho Folsom Site in 1967, looking north.

The site was one of the first large-scale Folsom camp excavations in North America (Judge 1973:54). The initial site excavation, from 1965 to 1967, was carried out under the direction of Frank Hibben, with the field operations run by then University of New Mexico graduate student Gerald Dawson with the assistance of volunteers. In the fall of 1967, the Albuquerque Archaeological Society assisted in the excavation (Dawson and Judge 1969; Judge and Dawson 1972; Hibben 1966:9, 1968; Hillerman 1973; Huckell and Kilby 2002:11). The site consists of three spatially discrete loci designated 4146, 4147/AS-2, and 4148. Dawson excavated most of Locus 4147 and Locus 4148, and Locus AS-2 was excavated by Dawson and volunteers from the Albuquerque Archaeological Society. Individual loci were preliminarily identified from surface artifacts. Excavation was initiated in the areas of highest artifact density and continued outward until densities of three or fewer were reached (Buchanan and Tyndall n.d.). A system of 10-by-10 foot grids was used.

Sediment was shovel-stripped to a depth of approximately 10 to 15 cm and screened through ¼ inch mesh hardware cloth. Horizontal provenience information is limited to each 10-by-10-foot unit and vertical provenience is lacking altogether.

In the original excavations, Folsom artifacts were concentrated in the upper 20 cm of eolian sand deposits. Based on observations from recent backhoe trenches and geomorphic, pedological, and sedimentological analysis, the site contains well-developed soils “with a moderate to strong argillic Bt horizon and a stage 2 calcic (Btk) horizon in the upper 75 cm of an eolian sand” (Huckell et al. 2001:29). Most of the artifacts appear to have been recovered from a Bw horizon above the Bt horizon. Comparison with soil chronosequences in the region suggests that the developed soils at the Rio Rancho site are tens of thousands of years old, and that the modern topography has not changed significantly since the Paleoindian occupation (Huckell et al. 2001:29).

Approximately 7,400 artifacts were recovered during the 1960s excavations. Following the excavations, the collections were housed at different institutions, including the Maxwell Museum of Anthropology at the University of New Mexico, the Albuquerque Archaeological Society, and the Smithsonian Institution, making it difficult to study the collection in its entirety. Recently, however, most of the collection was reassembled at the Maxwell Museum (Huckell and Kilby 2002:12). In addition to the artifacts, the collection contains 35 mm slides and black-and-white photographs; however, no field notes or complete field maps have survived, and the original excavators never fully published findings from the site (Huckell et al 2001:28). A few brief reports on the site exist (Dawson and Judge 1969; Judge and Dawson 1972; Hibben 1966, 1968; Hillerman 1973).

In part because of the large number of Folsom point bases, preforms, channel flakes, endscrapers, and lithic debitage, the Rio Rancho Folsom site has been interpreted as a camp site. The site has yielded 36 Folsom projectile points, 51 preforms, nearly 200 channel flakes, 101 endscrapers, and over 6,000 pieces of lithic debitage. Folsom point bases, preforms, and channel flakes were recovered, indicating weapons replenishment was an activity carried out at the site, perhaps following one or more successful kills (Huckell and Kilby 2002:12). Thirteen pieces of unidentified bone and four pieces of tooth enamel were recovered from the site. One piece of tooth enamel, identified by Bruce Huckell, compares favorably with bison tooth enamel (Locus 4146, Artifact No. 60, 20E/18S). The presence of bison tooth enamel could indicate that the site was once located near a bison kill, the skeletal remains of which have not preserved.

Dawson and Judge (1969:149) identified five loci or excavation units, as noted above, which subsequently have been collapsed into three loci (Figure 8.2). Dawson's Excavation Units I and II correspond to Locus 4146, Excavation Unit III corresponds to Locus 4147, Excavation Unit IV corresponds to AS-2, and Excavation Unit V corresponds to Locus 4148. Because 4147 and AS-2 are contiguous, they are considered one locus in this analysis. The largest (Locus 4146) also contains later Cody, Archaic, Puebloan, and Historic period artifacts in addition to Folsom material. Locus 4148 and Locus 4147/AS-2 appear to be single-component Folsom occupations.

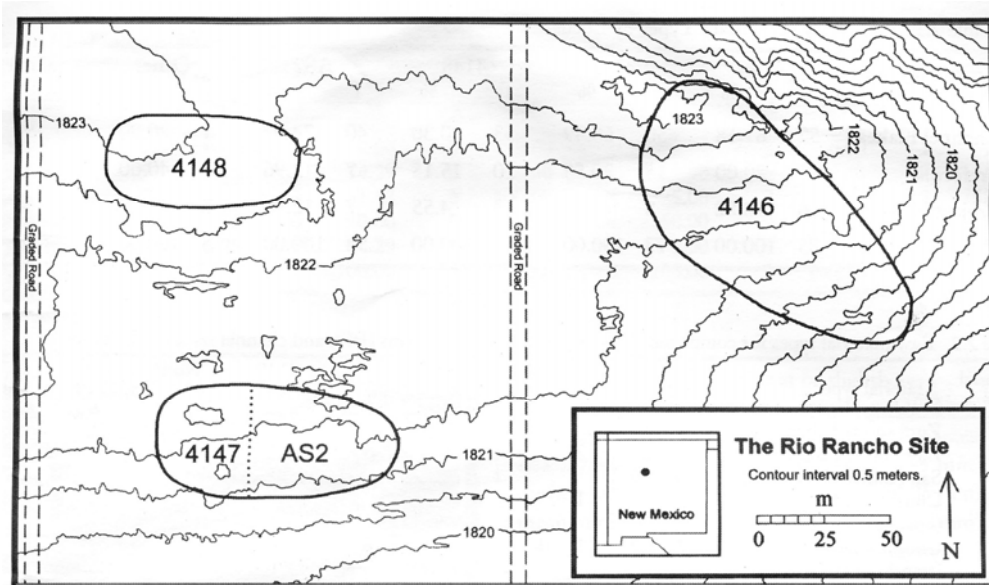


Figure 8.2. Map of the major loci at the Rio Rancho Folsom site (Huckell and Kilby 2002:13, Figure 2.1).

Locus 4146 covers an area of 2583 m² (Huckell and Kilby 2002:12). Locus 4147 and Locus AS-2 are contiguous, and together cover 1812 m² (Huckell and Kilby 2002:12). The smallest locus, 4148, is approximately 845 m², but could be as large as 1800 m² (Huckell et al. 2001; Huckell and Kilby 2002:12). At present, it is unknown whether these loci were occupied simultaneously, whether they were occupied by the same group, and whether they represent similar activities. Recent investigations suggest that additional remains are present at Locus 4146 and Locus 4148 beyond the boundaries of the original excavations (Huckell and Kilby 2002:12).

Re-investigations of the site led by Bruce Huckell of the University of New Mexico identified some of the originally excavated units by relocating wooden grid stakes and attempting to align them with old slides and photographs of the excavations. The project produced a complete topographic map covering the 340 m east/west by 170 m north/south area that contained the original excavations (Huckell et al. 2001:28). To determine if in situ

deposits still existed, test pits, 1-by-1 m in size, were excavated in 5-cm levels at all three loci, and sediment was screened through 1/16-in screens. At Locus 4146, two pits were excavated, both producing artifacts in unconsolidated sand. At Locus 4147/AS-2 two test pits did not produce artifacts. East of Locus 4148, researchers found an unexcavated area, and 11 judgmentally placed 1-by-1 m excavated units in this area were excavated, producing 29 artifacts from 5 to 20 cm below the surface above or within the uppermost argillic horizon (Huckell et al. 2001:30). Huckell et al. (2001) concluded that the artifacts had been subject to eolian and fluvial processes before final burial.

Buchanan and Tyndall (n.d.) investigated refitting of channel flakes and preforms at the Rio Rancho site and concluded that some of the artifacts had been transported down slope through sheetwash. At the same time, numerous refits occurred within close proximity indicating that the site retains some spatial integrity, especially within the denser clusters of artifacts.

The original excavation grids were established for each locus independently. Consequently, loci grids do not exactly align. In addition, different coordinate systems were used for each locus. Because of these anomalies, a new numeric coordinate system was created for each locus in order to facilitate analysis of the dataset (Figures 8.3, 8.4, 8.5). These new designations along with the data for this research are housed at the Maxwell Museum of Anthropology at the University of New Mexico.

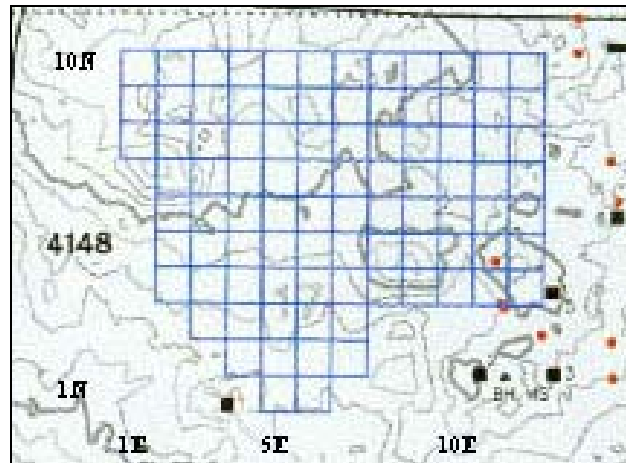


Figure 8.3. Coordinates and grid system for Locus 4148 (map by J. Holmlund).

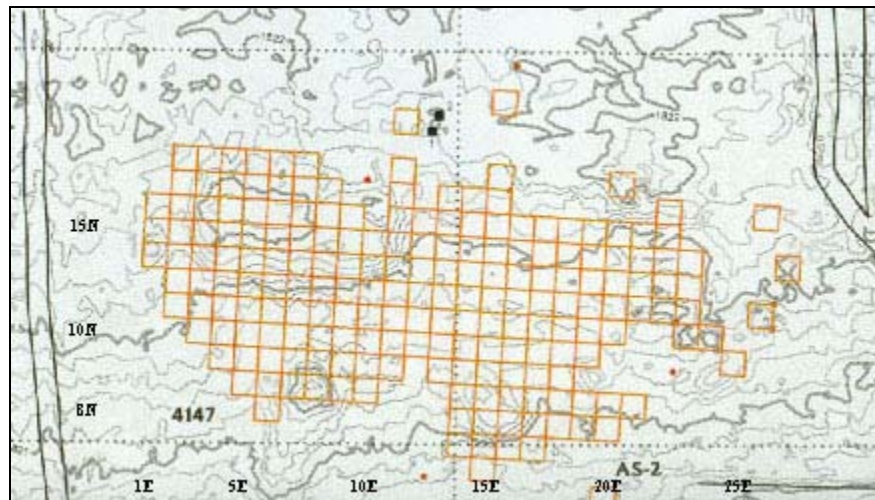


Figure 8.4. Coordinates and grid system for Locus 4147 (map by J. Holmlund).

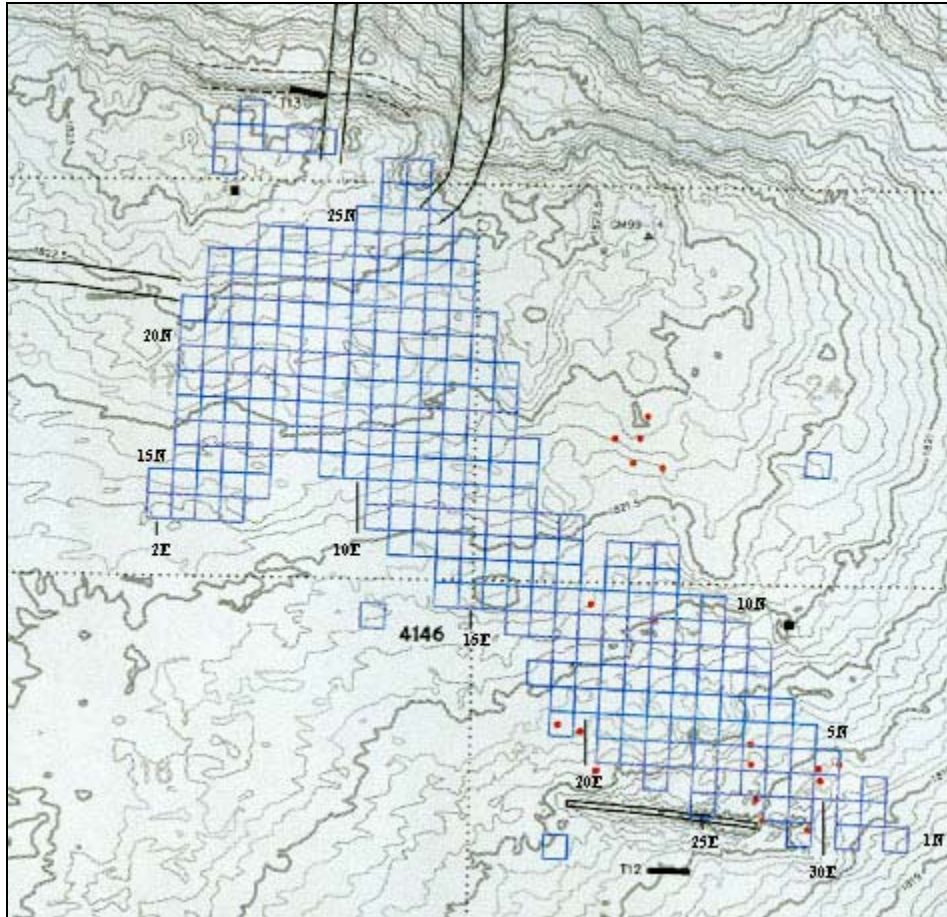


Figure 8.5. Coordinates and grid system for Locus 4146 (map by J. Holmlund).

Artifact Distributions at the Rio Rancho Folsom Site

Several researchers have attempted to infer gendered activity areas from patterns in the archaeological record (e.g., Bird 1993:27; Blackmar 2000; Brose and Scarry 1976; Conkey and Spector 1984; Flannery 1976; Gero 1991; Gilmore 2005:32; Guenther 1991:19-20; Hughes 1991:38; Jodry 1998; 1999a; Judge 1973; Rule and Evans 1985:218). In a classic study, Flannery (1976) found distinct differences in the distribution of male- and female-centered activities in the interior of a Oaxacan residence. Unlike gendered domestic activities conducted within a permanent structure, many tasks conducted by foragers likely occurred

out-of-doors, and distinct, non-overlapping gendered depositional areas, as in the Oaxacan case, are improbable. Additionally, the debris from outdoor activities often can be the remains of discarded or lost tools, rather than those that are being stored within a household, further complicating interpretation of spatial patterns. The issue of re-use of areas for different purposes during a single occupation, and site re-occupation can obscure the signatures of gendered activities as well. While discrete spatial patterning of artifacts would be suggestive of spatial segregation of activities, the lack of such patterning does not necessarily signify that gendered activities did not exist.

Based on subjective observations, Dawson and Judge (1969:157) suggested that the loci on the Rio Rancho site contained debris from male and female activities and artifact clusters represented the residues of family units. They further proposed that camp activities may have been situated around shelters at the site. Endsrapers and small flake tools, they observed, occurred on the peripheries of the loci, leading them to hypothesize that the processing of animal hides occurred away from main activity areas of the camp (Dawson and Judge 1969:157). Other researchers have documented hide-working activities being conducted away from hearth-centered activities in archaeological and ethnographic contexts (Brose and Scarry 1976:201; Carr 1977, Carr 1984:127; Jodry 1999a; Watanabe 1968: Figure 4). In his model of intra-site activity patterns, Carr (1984) proposed that messy tasks or those that produce obnoxious odors or leave residues of animal waste, are more likely conducted at the peripheries of camps. Binford (1983) also observed that hide-working takes place in areas away from main activities areas, particularly for large-scale hide-working. Closer examination of different stages of hide-working suggests that the peripheral location of hide-working might not be the norm for all stages of hide-working (see Chapter 7). Photographs

and early paintings indicate that small-scale dry scraping of hides can take place immediately adjacent to the main living area, potentially overlapping with other activities such as cooking and manufacture of weaponry, without interfering with daily activities (Chapter 7). Children appear in and around the hide-working area in some historic paintings, suggesting that childcare may have been compatible with this stage of hide-working.

Other hide-working activities, such as fleshing or scraping of large hides on frames, appear to be more likely to occur some distance away from the residence, though there is some photographic evidence for small-scale fleshing taking place immediately adjacent to a residence (Chapter 7). The fleshing stage of the hide work, when the hide is wet and animal tissues adhere to the hide, may be more likely to produce unwanted odors, attract vermin, and interfere with daily activities, and therefore may be more likely to occur at greater distances from main activity areas. Based on photographic evidence, medium- to large-scale hide-working, perhaps involving more than 10 hides, might also be more likely to be placed farthest from the main activity area (Chapter 7). Historically, large-scale Great Plains hide processing likely took place during the fall robe season (Chapter 7), when bison hides were at their peak condition, and there may be a relationship between the scale of hide-working and patterns in the spatial distribution of endscrapers on sites. Jodry (1999) has discussed at length the possible effect of seasonality on endscraper use and discard.

Another area of interest is the density of artifacts deposits. At the Crane site, a Middle Woodland base camp in Illinois, Carr (1977) found that tools used to scrape hides had greater nearest-neighbor distances than other classes of artifacts. Carr (1984:126) suggested that hide-working requires more space compared with other activities such as whittling or stone tool manufacture. Similarly, Binford (1983) observed that activities that are performed in a

standing position will take up more space than those conducted in a seated position. The archaeological signature of more peripheral activities, like hide-working, tends to have a more amorphous distribution and contain a lower density of debris (Carr 1984:127). Flint-knapping and fine wood-working are assumed to be centrally located activities, and should produce a denser concentration of artifacts over a smaller area. Unfortunately, the Rio Rancho Folsom site has rather gross spatial data, which are not ideal for this kind of small-scale analysis. While Carr's ideas cannot be tested with any rigor here, the data can point to some possibilities.

Given these observations on central and peripheral activities, along with historical modern-day evidence regarding the location of hide-working, expectations for Paleoindian site spatial relationships can be formed.

- 1) If endscrapers were used as part of weapons refurbishment such as fine wood-working, it is expected that they will be distributed over a relatively small area, being used in a seated position, and overlap in distribution with other debris from weapons manufacture.
- 2) If endscrapers were used for purposes not associated with weapons refurbishment, such as hide-working, they should be located away from debris from weapons manufacture.

To investigate these possibilities, each locus from the Rio Rancho site is examined in terms of the spatial distribution of end scrapers and weapons assemblages.

Locus 4147/AS-2

Locus 4147/AS-2 (combined) contains a total of 2,756 artifacts (Table 8.1). Some artifacts do not have adequate provenience information and cannot be included in this spatial

analysis. One preform from Locus 4147 has an apparent numeric provenience (6M46) that currently cannot be matched to an excavation unit, and was excluded from the analysis. One point midsection from AS-2 lacked provenience information and was excluded. There are two additional preforms from AS-2 with no provenience data. In two cases (69.20.164 and 69.20.372/373) two pieces of a preform refit, and these were treated as two pieces. For consistency, and because no attempt was made to refit endscrapers or other tool types, broken artifacts were treated as the number of fragments of that artifact rather than the complete artifact. Artifacts outside the main excavation block were excluded from the analysis. One projectile point base (69.20.146, 9N, 4W) was outside the main excavation block of Locus 4147 and was excluded. One projectile point (B415-1) located northeast of Locus AS-2 was outside the main excavation block and was excluded. Two endscrapers north of Loci 4147 and AS-2 (414 and D404-1) were beyond the main excavation block and were excluded. One uniface was outside the main block and was also excluded.

Table 8.1. Artifact Frequencies and Percentages for Locus 4147 and AS-2 combined.

Artifact	Frequency	Percentage Non-flake Artifacts	Percentage All Artifacts
endscraper	37	18.59%	1.34
uniface	23	11.56%	.83
point	15	7.54%	.54
preform	24	12.06%	.87
channel flake	75	37.69%	2.72
core	2	1.00%	.07
tested cobble	2	1.00%	.07
other	5	2.51%	.18
biface	16	8.04%	.58
flake	2557	—	92.78
Grand Total	2756	99.99%	99.98%

Hearth-centered Activities. Ethnographic research has shown that hearths, as sources of heat and light, are often the center of camp activities (Binford 1983:149–163; O’Connell et al. 1991; Yellen 1977). A variety of different activities, especially those involving a seated position, are expected to take place around hearths including warming resin (Binford 1983:150), flint-knapping, fine wood-working, and cooking. This situation produces relatively dense clusters of artifacts and bone in the vicinity of the hearth area (Carr 1984:127; Jodry 1999a; Surovell and Waguespack 2007:219). Unfortunately, Folsom hearths are unlikely to preserve because of their surficial nature and exposure to wind and water (Hofman 1995b:421; Jodry and Stanford 1992:155; Surovell and Waguespack 2007:223). At Locality B at the Barger Gulch site, a single-component Folsom-age site in Colorado, Surovell and Waguespack (2007) identified hearth-centered activities based on post-excavation spatial analysis. They anticipated that activities located around hearths would produce artifact densities greater than those in areas surrounding but farther from the hearth (Surovell and Waguespack 2007:228). Surovell and Waguespack (2007:229) identified a possible hearth area using a variant of nearest-neighbor analysis from the proposed center point of the hearth. This research undertakes a similar investigation to determine what types of artifacts are positioned around high-density areas and what types of artifacts are situated away from these areas. High-density areas could represent hearths, or possibly, as Dawson and Judge speculated, shelters. While the Rio Rancho site does not have the spatial resolution available at more recently excavated Folsom sites such as Barger Gulch, it is possible to calculate densities within the 10-by-10 foot units, providing a general, but nonetheless informative, picture of the artifact distribution at the site.

Locus 4147/AS-2 High-density Area 1. Four 10-by-10 foot units in the southwestern portion of Locus 4147 each contain more than 100 artifacts including flakes and formal tools; these high-density units include Units 5E, 12N (n=103), 6E, 13N (n=122), 7E, 11N (n=108), and 7E, 12N (n=192). These units have the highest artifact frequencies on Locus 4147 and AS-2 (Figure 8.6). The mean artifact density for these four units (called “4147/AS2 High-density Area 1”) is 132 artifacts per unit. Artifact density was calculated as distance from the highest density units increased, by including the adjacent horizontal and vertical units (Figure 8.7). Radiating out from this area to adjacent units, the mean artifact density drops steadily (Figure 8.8). The high artifact density coupled with the steady decrease in artifact density radiating out from this area suggests that High-density Area 1 was associated with tool production, perhaps centered around a hearth, hearths, or possibly a shelter.

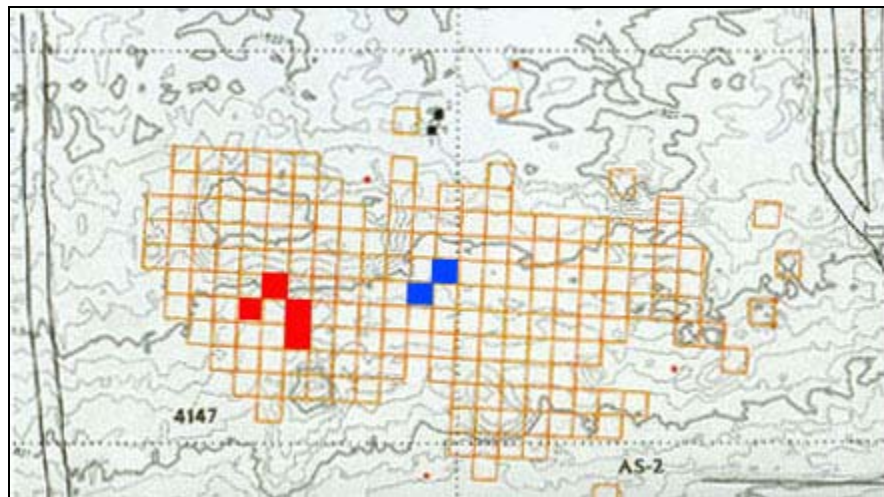


Figure 8.6. High-density Area 1 (red squares) and High-density Area 2 (blue squares) at Locus 4147-AS-2 (topographic map by J. Holmlund).

			20 ft.			
		20 ft.	10 ft.	20 ft.		
	20ft.	10 ft.	HD-1	10 ft.	20 ft.	
20ft.	10 ft.	HD-1	10 ft.	HD-1	10 ft.	20 ft.
	20ft.	10 ft.	20ft.	HD-1	10 ft.	20 ft.
		20ft.	20ft.	10 ft.	20 ft.	
				20 ft.		

Figure 8.7. Increasing Distance from High-Density Area 1 in 10-foot increments.

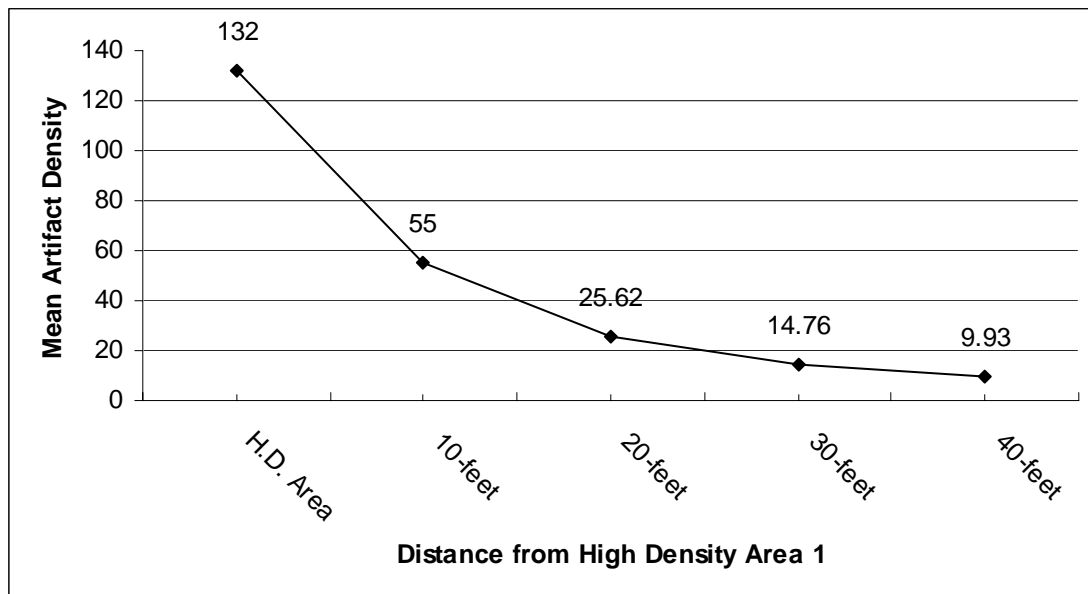


Figure 8.8. Decrease in artifact density with distance from high-density Area 1 at Locus 4147/AS-2.

Next, I looked at the types of formal tools in and around High-density Area 1 at Locus 4147/AS-2. Expected values for the frequencies of tool types were calculated based on the area inside Locus 4147/AS-2 High-density Area 1 versus the expected frequencies for the total area of the main excavation block containing artifacts. The total number of units containing artifacts in Locus 4147 and Locus AS-2 combined is 177, and the number of units inside Locus 4147/AS-2 High-density Area 1 is four. The total number of units in High-density Area 1 and the 40-foot perimeter is 54.

The combined High-density Area 1 and the 40-foot perimeter make up 31 percent of the excavated area for Locus 4147/AS-2. The expected values for tool frequencies were calculated based on these proportions. The observed frequencies for points, preforms, channel flakes, bifaces, and flakes, are all greater than expected within High-density Area 1, while the observed frequencies for endscrapers and unifaces are lower than expected (Table 8.2). There are more than three times as many preforms present in High-density Area 1 than expected (Table 8.2). Of the points in High-density Area 1, three are basal fragments and one is a tip fragment.

Chi-square values were generated to determine whether the frequency of tool types within the High-density Area 1 and the 40-foot perimeter are greater than would be expected by chance. The chi-square values for points, preforms, flakes, and total artifacts in the High-density Area 1 and the 40-foot perimeter are significant at the .05 level or greater, indicating there are more of these artifacts in this area of the locus than would be expected by chance (Table 8.2).

Table. 8.2. Artifact Frequency in High-density Area 1 and 40-foot perimeter at Locus 4147/AS-2.

Artifact	High-density Area 1	10 foot	20 foot	30 foot	40 foot	Total Observed	Expected	Chi-square
Point	3	2	2	1	1	9	4.65	4.07 p=0.0436
Preform	1	7	2	3	2	15	7.44	7.68 p=0.0055
channel flake	5	10	7	3	7	32	23.25	3.29 p=0.0697
biface	0	1	2	1	3	7	4.96	.84 p=0.3593
endscraper	3	4	0	1	1	9	11.47	.53 p=0.4666
uniface	2	1	0	0	1	4	7.13	1.37 p=0.2418
flake	514	523	320	183	124	1664	792.36	958.85 p<.0001
graver	0	1	0	0	0	1	—	
Grand Total	528	550	333	192	139	1742	854.36	922.22 P<.0001
No. of Units	4	10	13	13	14	54	—	—
Mean artifact Density	132	55	25.62	14.76	9.93	32.26	—	—

χ^2 values in bold are significant.

These figures strongly suggest that this area of the site was used for weapons production, perhaps around a hearth or near a shelter as Dawson and Judge suggested. Endscrapers also occur in this area but their frequency is not higher than would be expected by chance. This partially supports Dawson and Judge's proposition that endscrapers tend to be located away from high-density areas. The results also indicate that endscrapers appear both within High-density area 1 and 40-foot perimeter as well as outside of this area. As discussed in previous chapters, hide-working was not necessarily a strictly peripheral activity, and photographic evidence suggests some stages of hide-working were conducted immediately outside residences on the Great Plains in the nineteenth century. Whether High-density Area 1 at Locus 4147/AS-2 was associated with a shelter is more difficult to determine, but remains a possibility.

Locus 4147/AS-2 High-density Area 2. There is a high-artifact density area near the center of combined Locus 4147/AS-2, though artifact density is not as great as High-density Area 1. While not as high as those found in the southwestern portion of Locus 4147 in High-density Area 1, these frequencies are higher than the surrounding units. In addition, two cores and two tested cobbles occur near these units and was possibly an area of small-scale tool production. This area will be referred to as High-density Area 2. This area contains two adjacent units, 12E,14N and 13E,14N which have artifact densities of 36 and 38, respectively.

Looking at mean artifact density for the first 10-foot perimeter of units surrounding units 12E,14N and 13E,14N, the mean artifact density is 17.17 per unit. In the units forming the second and third sets of units radiating out from these higher density units, the mean artifact density drops to 13.3 and 10, respectively (Figure 8.9). I calculated the expected frequencies for tools and flakes based on the area encompassed by High-density Area 2 plus the 20-foot perimeter and the total area of the locus, and compared the expected values to the observed values. The expected and observed values for most tools and flakes is similar, with the exception of unifaces, which are over-represented (Table 8.3).

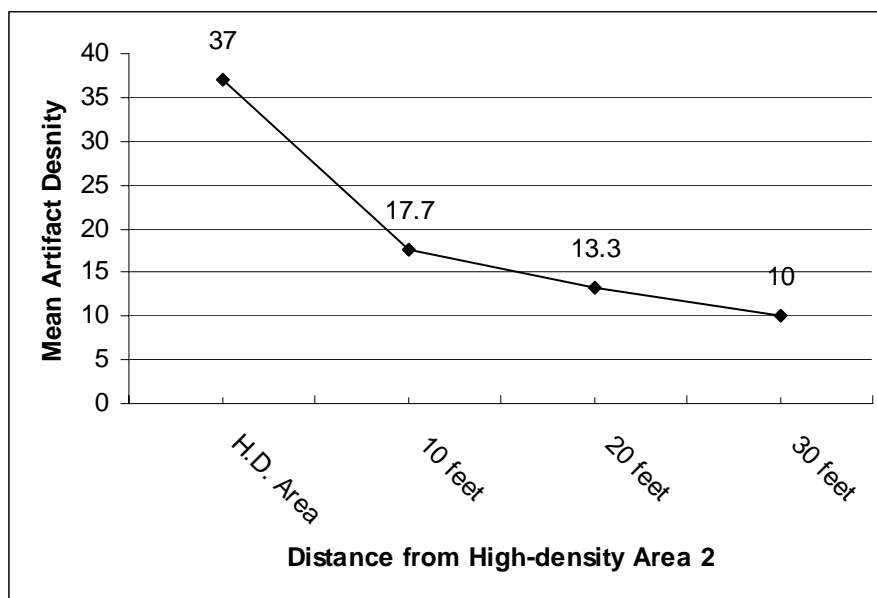


Figure 8.9. Artifact density per unit with distance from Locus 4147/AS-2 High-density Area 2.

Table 8.3 Tools within High-density Area 2 and 20-foot Perimeter.

Artifact	High-Density Area 2	10-foot Perimeter	20-foot Perimeter	Total Observed	Expected	Chi-Square
Point	1	0	0	1	1.5	.16 p= 0.6891
Preform	2	1	1	4	2.4	1.06 p= 0.3032
channel flake	1	4	3	8	7.5	.03 p=0.8624
endscraper	1	1	2	4	3.7	.02 p=0.8875
uniface	2	2	2	6	2.3	5.95 p=0.0147
core	0	1	1	2	—	—
tested cobble	0	1	1	2	—	—
flake	67	91	122	280	255.7	2.31 p= 0.1285
Grand Total	74	103	133	310	275.6	4.29 p=0.0383
No. of Units	2	6	10	18	—	—
Mean artifact Density	37	17.7	13.3	17.2	—	—

χ^2 values in bold are significant

Chi-square values were calculated to determine if tools and flakes occur in greater frequencies in High-density Area 2 and the 20-foot perimeter than would be expected by chance. Only the chi-square value for unifaces was significant at the .05 level of confidence. Combining endscrapers and unifaces, the expected frequency is 6, while the combined observed frequency is 10. The relatively high frequency of unifaces in this area, coupled with the presence of cores and tested cobbles, suggests the possibility that this area was used to produce some flake tools, perhaps blanks for endscrapers, albeit on a small-scale. This contrasts sharply with High-density Area 1, which is oriented toward weapons production. The results suggest that endscrapers are more oriented toward this area than other tools, and secondly the area may have been involved in small-scale production of endscrapers.

Nearest-neighbor Analysis. Nearest-neighbor analysis can be used to measure the degree of dispersion of artifacts (or sites) in an area to identify whether they are clustered or randomly distributed. The nearest-neighbor statistic measures the degree to which artifact distributions deviate from a random distribution. The value R is calculated as a ratio expressed as the mean observed distance between artifacts (r_A) or between artifacts and a point in space, divided by the mean expected distance (r_E).

$$R = r_A/r_E$$

Mean *observed* distance between artifacts is measured by taking each artifact and finding the closest artifact—its nearest-neighbor—and measuring the distance between that pair. This procedure is repeated for every artifact. The mean of all the observations is then calculated, resulting in the observed distance or r_A . This procedure can be carried out within

and between artifact types, or for all artifacts regardless of type. The mean *expected* distance between artifacts is determined by artifact *density* (p) within the site. The *total area* containing the artifacts is measured. The total number of artifacts is divided by the total area, resulting in, p , the artifact density. Then r_E is solved for in the equation:

$$r_E = 1 / 2\sqrt{p}, \text{ where } r_E \text{ is the mean expected distance between artifacts}$$

In the final step r_A (mean observed distance) is divided by r_E (mean expected distance). The nearest-neighbor statistic, denoted as R , ranges from 0.0 to 2.15. Artifacts are randomly distributed when R equals 1. Values less than 1 indicate some degree of clustering, and values greater than 1 indicate some degree of even spacing. The resulting number falls between 0.0 and 2.15. A value of 0.0 would indicate that all of the artifacts are located at the same point. A value of 2.15 would indicate that artifacts are perfectly evenly spaced.

In order to further evaluate which artifacts are clustered around the High-density Area 1 at Locus 4147/AS-2, I performed a nearest-neighbor analysis from the southwest corner of the unit with the highest artifact density (7E, 12N) at the locus 4147/AS-2 (192 artifacts). For this analysis, I looked at points, preforms, channel flakes, endscrapers, unifaces, and bifaces within the main excavation block (195 blocks, including those with no artifacts). Units beyond 24E and 18N, outside the main excavation block, were excluded. Points and preforms have nearest-neighbor coefficients below 1, indicating clustering toward the highest density unit (Table 8.4). Channel flakes, endscrapers, and unifaces have nearest-neighbor coefficients greater than 1, indicating a tendency to be located away from the high density unit. While points and preforms were on average closer to the highest density unit than other tool types, the p value is not statistically significant. The p values for endscrapers, unifaces,

and channel flakes are statistically significant, meaning that these tool distributions are not oriented around High-density Area 1.

Table 8.4. Results of Nearest-neighbor Analysis from Locus 4147/AS-2 High-density Area 1.

Artifact Class	Frequency	Nearest Neighbor Coefficient	C Statistic (z-score)	p value
points	15	0.84	-1.15	0.2501
preforms	24	0.88	-1.13	0.2585
channel flakes	75	1.30	5.01	0.0000
endscrapers	37	1.46	5.26	0.0000
unifaces	16	1.12	4.44	0.0000
bifaces	23	1.48	0.90	0.3681

Significant p values are in bold.

Nearest-neighbor analysis also reveals the relationship *between* artifacts for the combined Locus 4147/AS-2 (Table 8.5). The R value represents the nearest-neighbor statistic. These were converted to z-scores (C values) in order to calculate the significance of the statistic at the .05 level of confidence. Looking first at channel flakes, the results suggest that these are not distributed very near any tool type, but trend in the direction of being located near other channel flakes. Where preforms trend in the direction of clustering near channel flakes, channel flakes do not trend in the direction of being near preforms. This pattern could suggest that some areas were more closely associated with weapons manufacture than others, resulting in greater fluting failure and preform discard in some areas. Alternatively, this pattern could result from channel flakes being more subject to movement through natural processes than larger artifacts as Buchanan and Tyndall (n.d.) have suggested. If so, channel flakes may not be very useful in identifying activity areas. Also, the sample size for channel flakes (n=75) versus preforms (n=13) likely has an effect on the nearest-neighbor values.

Projectile points and preforms have a nearest-neighbor coefficient less than 1, suggesting a tendency to be distributed more closely to each other. Bifaces also tend to group with points and preforms. The nearest-neighbor coefficients for endscrapers/points and points/endscrapers are below 1, suggesting overlap in the distribution of points and endscrapers. In contrast, the nearest-neighbor values for endscrapers/preforms and preforms/endscrapers are all above 1, suggesting a tendency for these tools to be distributed away from each other. Endscrapers tend to be located near other endscrapers, but do not strongly trend toward any other artifact. Other uniface artifacts that could not be classified as endscrapers do not appear to be distributed near any other artifact except endscrapers and other uniface artifacts. The p-value for uniface artifacts to endscrapers is also highly significant. The nearest-neighbor value for endscrapers to uniface artifacts, however, is .95, suggesting that while endscrapers occur where uniface artifacts occur, they also occur in other places across the loci away from other uniface artifacts.

If endscrapers and other uniface artifacts were part of weapons production, we might expect them to be located near points, preforms, and channel flakes. Endscrapers, however, trend strongly only toward other endscrapers, suggesting their deposition is associated with a different activity than points, preforms, and channel flakes. Other uniface artifacts tend to be distributed near endscrapers, but not other tools, suggesting that the areas where these tools are most abundant may not have been associated with weapons production, but rather served other functions. While the use of endscrapers and uniface artifacts for fine wood-working cannot be ruled out, this pattern is compatible with endscrapers and perhaps uniface artifacts being used for non-weapons production tasks, possibly hide-working.

Table 8.5. Nearest-neighbor Coefficients between and within Tool Types at Locus 4147/AS-2.

	Endscraper	Point	Preform	Channel Flake	Biface	Uniface
Endscraper	R=0.66 C=-3.88 p=<0.0001	R=0.80 C=-1.51 p=0.0655	R=1.51 C=4.75 p=<0.0001	R=1.50 C=8.29 p=<0.0001	R=0.96 C=-0.27 p=0.3936	R=0.29 C=-6.55 p=0.0000
Point	R=0.92 C=-0.88 p=0.1894	R=0.69 C=-2.30 p=0.0107	R=0.85 C=-1.45 p=0.0735	R=1.33 C=5.41 p=<0.0001	R=0.80 C=-1.56 p=0.0594	R=0.92 C=-0.74 p=0.2296
Preform	R=1.45 C=5.16 p=<0.0001	R=0.82 C=-1.33 p=0.0918	R=0.87 C=-1.18 p=0.1190	R=1.24 C=4.02 p=<0.0001	R=0.75 C=-1.93 p=0.0268	R=1.19 C=1.78 p=0.0375
Channel flake	R=1.01 C=0.11 p=0.4562	R=0.90 C=-0.78 p=0.2177	R=0.85 C=-1.42 p=0.0778	R=0.68 C=-5.32 p=<0.0001	R=1.21 C=1.63 p=0.0516	R=1.03 C=0.26 p=0.3974
Biface	R=1.08 C=0.97 p=0.1660	R=0.74 C=-1.90 p=0.0287	R=1.01 C=0.07 p=0.4721	R=1.38 C=6.31 p=0.0001	R=0.54 C=-3.53 p=0.0002	R=0.84 C=-1.44 p=0.0749
Uniface	R=0.95 C=-0.52 p=0.3015	R=1.02 C=0.18 p=0.5714	R=1.20 C=1.89 p=0.0294	R=1.33 C=5.39 p=<0.0001	R=0.77 C=-1.78 p=0.0375	R=0.69 C=-2.80 p=0.0026

Significant values are in bold; No. of units=195

K-Means Analysis. In order to identify areas that may have been used for different activities, the non-hierarchical K-means algorithm was used (Kintigh and Ammerman 1982). Jodry (1999a) successfully used K-means at the Folsom-age Stewart's Cattle Guard site to examine intra-site patterning and Buchanan and Tyndall (n.d.) employed K-means to evaluate cultural and natural movement of artifacts at the Rio Rancho Folsom site. The method has been used to correctly identify known activity areas on !Kung sites (Gregg et al. 1991; Yellen 1977). K-means uses the two-dimensional positioning of artifacts, and simultaneously maximizes variation between clusters while minimizing variation within clusters. In this case, the southwest corner of the unit is used for the position of the artifact, because exact provenience is lacking. While this is less ideal than point-provenienced artifacts, the spatial information that is available can provide insight into general spatial patterns at the site. The K-means algorithm requires specification of the number of clusters to be generated. For this analysis, K-means clusters are formed based on coordinates and artifact type using Euclidian distance.

To conduct the K-means operations, unit coordinates for Locus 4147/AS-2 were assigned contiguous numerical X and Y coordinates. An overall site coordinate system encompassing all three loci (4146, 4148, and 4147/AS-2) could not be produced because independent grid systems were used for each locus.

Using K-means clustering on spatial data for points, preforms, endscrapers, channel flakes, bifaces, and unifaces, four clusters were generated for Locus 4147/AS-2 (K-1, K-2, K-3, and K-4; Figure 8.10). Cluster 1 (K-1) encompasses High-density Area 1 in the southwestern portion of the locus, while cluster 2 (K-2) encompasses High-density Area 2. The latter contains tested cobbles and cores, and is possibly an area of small-scale flake tool production as discussed previously. Cluster 3 (K-3) is located in the northeastern portion of the combined loci and Cluster 4 (K-4) is located in the southeastern part of the locus.

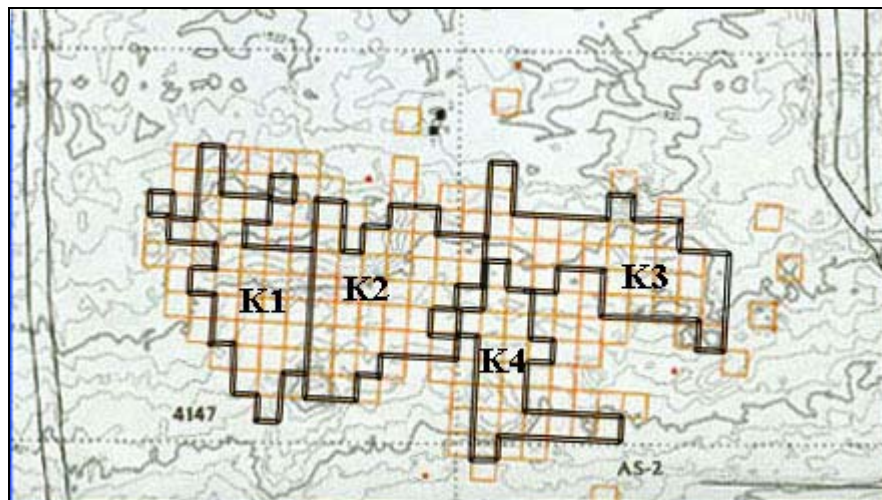


Figure 8.10. K-Means clusters at Locus 4147-AS-2 (topographic map by J. Holmlund).

Table 8.6 presents the quantities of tools within the four clusters. Cluster K-3 contained a similar percentage of the site's endscrapers and other non-endscraper unifaces (43%). Combining endscrapers with other unifaces, Cluster K-3 contains 43 percent of all the

unifacial artifacts within the locus. Several excavated units in this area contained no artifacts, suggesting this cluster represents the periphery of the human activity for the locus. Cluster K-3 is located away from Locus 4147/AS-2 High-density Area 1, the highest density area for the locus. Cluster 1 (K-1) contains more than half of the points and 46 percent of the preforms. Cluster K-1 has the highest percentage of points, preforms and channel flakes, whereas Cluster K-3 has the lowest percentage of points and preforms, containing only 3 of the 39 total points and preforms. Figure (8.11) shows the percentages of combined unifaces from each cluster and combined points and preforms.

Table 8.6. Tool Frequencies and Percentages within Clusters at Locus 4147/AS-2.

	K-1	K-2	K-3	K-4	Total
endscraper	14(37.84%)	7(19%)	16(43%)	0	37
uniface	3(13%)	9(39%)	10(43%)	1(4%)	23
point	8(53%)	4(27%)	2(13%)	1(7%)	15
preform	10(46%)	9(38%)	1(4%)	3(13%)	24
channel flakes	27(36%)	20(27%)	15(20%)	13(17%)	75
biface	5(31%)	7(44%)	3(19%)	1(6%)	16

Significant values are in bold.

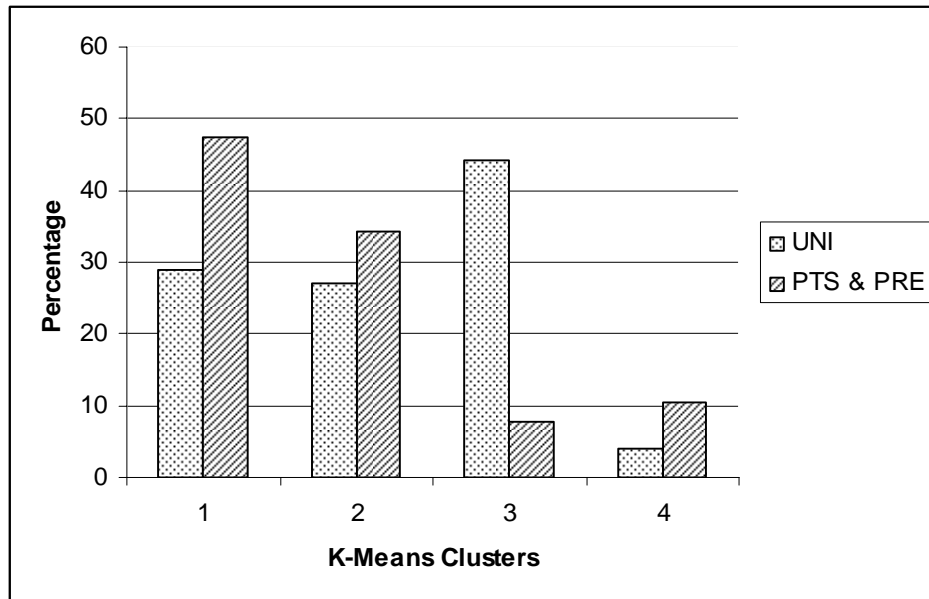


Figure 8.11. Percentages of all uniface (UNI) combined and points (PTS) and preforms (PRE) combined for K-Means clusters at Locus 4147/AS-2.

Given the high percentage of unifaces and low percentage of points and preforms, Cluster K-3 was likely an area of high endscraper/uniface use, but not strongly associated with weapons manufacture. The location of K-3, situated away from the highest-density area on the periphery of the locus, is compatible with the expectation that endscrapers (and other unifaces) were used at the periphery of the camp, possibly for hide-working. In addition, K-3's average artifact density is very low—only 7.76 artifacts per 10-foot unit. This low artifact density is also compatible with a more diffuse scatter of artifacts associated with tasks involving standing such as fleshing and scraping in hide working. While natural processes have certainly acted upon the site, it is expected that all tool types had an equal chance of being transported to this area. If the endscraper and uniface distribution in K-3 was due to natural movement of artifacts, a greater number of lighter artifacts and a greater diversity of artifacts might be expected. The large number and percentage of endscrapers and unifaces, the small number and percentage of points and preforms, and the low density of artifacts in cluster K-3, are all consistent with Dawson and Judge's (1969) hypothesis that endscrapers occur at the known periphery of the locus and were possibly associated with hide-working.

Given the presence of cores and tested cobbles, which are rare for the entire site, in adjacent cluster K-2, it is possible that endscrapers or flake blanks were manufactured in this area on a small scale, and used in cluster K-3, but further investigation is required to address this question. Despite the fact that endscrapers tend to cluster in the northeastern part of Locus 4147/AS-2, they also appear in all four clusters at the locus, suggesting the possibility that not all hide-working activities occurred at the periphery, or that endscrapers were used for multiple activities.

A similar pattern exists on a smaller scale on the western portion of Locus 4147/AS-2. Four endscrapers are situated at the western margin of the locus, but no other tools are present in these units. The mean artifact density is extremely low at 3.3 per unit. This area is adjacent to a High-density Area 1, a probable tool production area. The endscrapers here are unlikely to have been transported by natural processes from the large High-density Area 1, because the direction of movement would run counter to the slope and patterns in artifact movement documented by Buchanan and Tyndall (n.d.). These endscrapers could suggest use of endscrapers immediately adjacent to weapons production. Movement of artifacts at Locus 4147/AS-2 is considered in more detail below.

Movement of Artifacts. In a study of channel flake and preform refitting, Buchanan and Tyndall (n.d.) showed that artifact displacement at Locus 4147/AS-2 occurred in a non-random orientation from northwest to southeast. The average slope within the locus is approximately 3 percent (Buchanan and Tyndall n.d.). No evidence of use-wear was detected in the channel flake assemblage and the artifacts are displaced counter to prevailing winds (Buchanan and Tyndall n.d.). The authors also hypothesized that the displacement was largely due to sheetwash. In one case, the orientation is northeast to southwest and the distance between artifacts is more than 70 feet (21 m); the authors suggest cultural displacement is a possibility in this case. Looking at the distribution of preforms and endscrapers in the northeastern and southeastern portions of the locus, this general displacement from northwest to southeast is consistent with the tool distribution. Three preforms in the southeastern portion of the locus in cluster K-4 are in an area of low artifact density and could possibly have been displaced by sheetwash from cluster K-2.

Comparing Endscrapers between clusters at Locus 4147/AS-2. Endscraper morphometric features were compared between clusters to determine whether scrapers in different clusters may have served different functions. Endscrepers from all clusters are dominated by Zuni Spotted chert, with more than half of all endscrepers from each cluster being made of this material (Table 8.7). All other material types occur in much lower frequencies. China chert occurs only in K-2, but the frequencies are so small the significance of its presence is difficult to interpret. Endscrepers in all clusters are also similar in terms of their metric measurements (Table 8.8). Mean depth of lateral retouch/modification is similar for clusters K-1 (2.55 mm), K-2 (3.02 mm), and K-3 (3.38 mm). Notches occur on two endscrepers in K-2 and two in K-3. Likewise, endscraper spurs occur on two endscrepers in K-2 and two in K-3. Cluster K-1 has no endscrepers with notches or spurs. Cortex on the exterior of endscrepers is rare for all clusters, but occurs in low frequencies at K-1, (n=1), K-2 (n=1), and K-3 (n=2). Rounded endscraper working edges predominate at K-1 (n=4), K-2 (n=16), K-3 (n=11), and K-4 (n=1). There is little difference in the platform type between clusters (Table 8.9). The mean platform length and width of endscrepers from K-3 is greater than the other clusters, but the low frequencies make this patterning difficult to interpret (Table 8.10). In all, endscrepers from all clusters look similar in their raw material, metric measurements, and morphology. This standardization could suggest that endscrepers were being used similarly across all four clusters, and/or were discarded at similar stages in their use history.

Table 8.7. Endscraper Material Type with K-means Clusters at Locus 4147/AS-2.

Material type	Cluster			
Material type	K-1	K-2	K-3	Grand Total
Zuni Spotted	9(61.54%)	4(57.14%)	10(62.55)	23
China	0	0	2(12.5%)	2
Chalcedony	0	1(14.29%)	1(6.25%)	2
Other chert	2(15.58%)	2(28.57%)	2(12.5%)	6
Jasper	2(15.58%)	0	0	2
Petrified wood	1(7.69%)	0	1(6.25%)	2
Grand Total	14	7	16	37

Table 8.8. Metric Measurements for Endscrapers within K-means Clusters at Locus 4147/AS-2.

	Mean (s.d.) central length (mm)	Mean (s.d.) central width (mm)	Mean (s.d.) central thickness (mm)	Mean (s.d.) working length (mm)	Mean (s.d.) Bit thickness (mm)	Mean (s.d.) Weight (g)	Mean (s.d.) WEC (mm)	Mean (s.d.) Edge angle (degrees)
K-1	31.11 (4.67)	30.353 (5.69)	6.25 (.95)	26.65 (4.98)	5.29 (1.27)	8.20 (1.43)	3.94 (.86)	64.89 (8.13)
K-2	30.12 (9.19)	26.58 (5.48)	5.79 (.95)	28.60 (6.68)	5.20 (1.25)	7.71 (4.38)	4.81 (1.40)	64.13 (9.77)
K-3	30.53 (4.87)	23.32 (4.62)	6.14 (1.73)	26.42 (7.86)	4.97 (1.04)	8.37 (4.46)	3.69 (1.26)	70.74 (21.99)

Table 8.9. Frequency of Endscraper Platform Types within K-Means Clusters at Locus 4147/AS-2.

	Cluster			
Platform type	K-1	K-2	K-3	Total
crushed	0	0	1	1
faceted	2	5	7	14
simple	1	2	1	4
n/a	4	9	5	18
Total	7	16	13	37

Table 8.10. Endscraper Mean Platform Length and Width within K-means Clusters at Locus 4147/AS-2.

	K-1	K-2	K-3
mean platform length (mm)	7.45	9.12	7.07
mean platform width (mm)	2.88	3.69	2.59

Locus 4148

As excavated, Locus 4148 is the smallest of the loci at the Rio Rancho Folsom site, containing a total of 829 artifacts in 97 units. Table 8.11 shows the frequencies and percentages of artifacts from this locus. One point labeled as coming from Locus 4146 (4E,1S) was likely mislabeled and probably originated from Locus 4148 given its coordinates. However, because it is impossible to place this artifact with any certainty, it was excluded from this analysis.

Preforms and endscrapers occur in the same frequencies ($n=13$), while points, bifaces, and other unifaces are not as common (Table 8.12). As at Locus 4147/AS-2, the southwestern portion of Locus 4148 contains the units with the highest artifact densities. Units 4E,4N and 5E,3N have artifact densities of 28 and 35, respectively (Figure 8.11). These densities are much lower than the highest artifact densities from Locus 4147/AS-2. The mean artifact density for these two units combined is 31.5. The overall mean artifact density is 10.11 artifacts per unit for all other artifact-bearing units at Locus 4148. If units with only a single artifact at the margins or just outside the main block are excluded, the mean artifact density is still only 11.2.

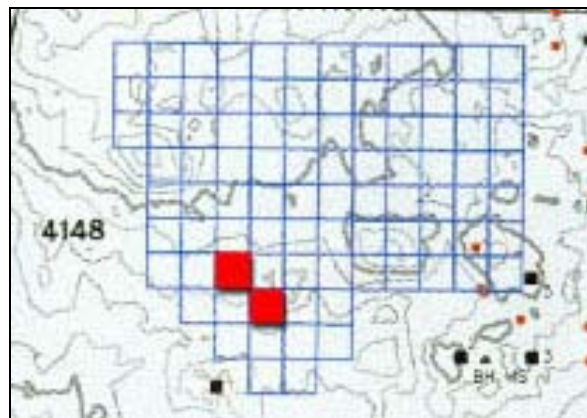


Figure 8.12. High-density area at locus 4148 (topographic map by J. Holmlund).

The high-density units in the southwestern portion of the locus are also associated with formal tools and channel flakes, containing five of these artifacts apiece (Table 8.12). These two units alone contain 13 percent of the total tools and channel flakes from the entire locus. Based on the artifact-bearing units (n=97) within the locus, fewer than two tools would be expected per unit if tools were randomly distributed across the locus. It is hypothesized that this high tool-density area within Locus 4148 was the main focus of activity and possibly associated with a hearth. Nearest-neighbor analysis is used to determine whether and how different tool types cluster around this area.

Table 8.11. Artifact Frequencies and Percentages at Locus 4148.

Artifact	Total	Percentage Non-flake Artifacts	Percentage All Artifacts
biface	1	1.28%	.12%
channel flake	43	55.15	5.2%
endscraper	13	16.67%	1.5%
point	3	3.85%	.36%
preform	13	16.67%	1.6%
uniface	5	6.41%	.60%
flake	751	—	90.6%
Grand Total	829	100	100

Table 8.12. Tools and Channel Flakes Located within High Density Units at Locus 4148.

Artifact	4E/4N	5E/3N
channel flake	3	1
endscraper	0	2
point	1	1
uniface	1	0
biface	0	1
preform	0	0
flake	23	30
Grand Total	28	35

Nearest-neighbor Analysis for Locus 4148. Using the southwest corner of the unit with the highest artifact density (5E,3N), nearest-neighbor analysis was used to determine how tools, including points, preforms, channel flakes, endscrapers, unifaces, and the single biface were distributed in relation to this point. Table 8.13 shows the frequencies of tools, the nearest-neighbor coefficient and the statistical significance. The nearest-neighbor coefficient indicates the direction of closeness, with <1 being nearer, and greater than 1 being farther from the point. Though sample sizes are small, points, preforms, channel flakes, and bifaces have lower nearest-neighbor coefficients, suggesting a tendency to be oriented toward the high-density unit. The p values for points, preforms, and channel flakes are statistically significant at the .05 level of confidence, indicating that weapons manufacture occurred in and around this area of the locus. Endscrapers and non-endscraper unifaces, in contrast, have nearest-neighbor values at or above 1, indicating no tendency to be distributed with respect to the high density unit. The distribution of endscrapers and unifaces is not statistically significant, meaning their distribution is more random with respect to the highest artifact density unit. These values suggest that this high-density area was associated with weapons manufacture, while endscrapers and unifaces were used without respect to weapons manufacture.

Table 8.13. Nearest-neighbor Analysis from Point 5E/3N at Locus 4148.

	Frequency	Nearest Neighbor Coefficient	C Statistic (z-score)	p value (one-tailed) at .05 level
points	3	0.46	-1.79	p=0.0367
preforms	13	0.69	-2.14	p=0.0162
channel flakes	43	0.67	-4.11	p=0.0000
endscrapers	13	1.03	0.22	p=0.4129
unifaces	5	1.31	1.31	p=0.0951
bifaces	1	0.29	-1.36	p=0.0869

Significant p values shown in bold

In order to determine if and how artifacts cluster between groups of artifacts at Locus 4148, I performed a nearest-neighbor analysis for projectile points, preforms, channel flakes, endscrapers, and unifaces within Locus 4148 without respect to a point. Because there is only a single biface on the locus, it was excluded from this analysis. The R values indicate the direction of clustering within and between artifacts, with <1 being more clustered and >1 being less clustered (Table 8.14). All artifact types, with the exception of endscrapers, tend to be located near tools of the same type. Endscrapers do not tend to cluster with other endscrapers or with any other tool type. As at Locus 4147, unifaces tend to be near other endscrapers and unifaces, but not other tools. In other words, while unifaces tend to be near endscrapers, not all endscrapers are near unifaces. Endscrapers also do not tend to be located near points or preforms. Point and preform values suggest clustering both within and between tool types. Points tend to be near endscrapers, but the small sample size ($n=3$) make this difficult to evaluate. As with Locus 4147, channel flakes do not appear to be clustered near other artifacts or near other channel flakes, suggesting that these lighter artifacts might have been displaced through natural processes. The results are similar to those obtained at Locus 4147/AS-2 in that most tool types tend to be located near the same tool type. Endscrapers tend to be more dispersed, and not located near other tool types.

The results suggest that endscrapers and unifaces were affiliated with different activities than were projectile points, preforms, and channel flakes. The results are compatible with Binford's (1983) expectation that activities conducted standing up, such as hide-working, will be more dispersed, as are the endscrapers. They are also compatible with the expectation that hide-working tools will be deposited away from main activity areas.

Table 8.14 Nearest-neighbor Coefficients between Tool Types for Locus 4148.

	Endscraper	Point	Preform	Channel Flake	Uniface
Endscraper	R=1.22 C=1.52 p=0.0643	R=0.73 C=-0.89 p= 0.1867	R=1.28 C=1.93 p= 0.0968	R=0.95 C= -0.63 p= 0.2643	R=0.79 C= -0.89 p= 0.1867
Point	R=1.27 C= 1.86 p=0.0314	R=0.67 C= -1.11 p=0.1335	R=0.81 C= -1.30 p=0.0968	R=0.94 C= -0.76 p=0.2236	R=2.17 C= 5.02 p= 0.0000
Preform	R=1.20 C= 1.35 p=0.0885	R=0.73 C= -0.89 p=0.1867	R=0.88 C= -0.81 p=0.2090	R=0.95 C= -0.59 p= 0.2776	R=1.61 C= 2.61 p=0.0045
Channel flake	R=1.13 C= 0.92 p=0.1788	R=0.44 C=1.84 p=0.0329	R=0.97 C= -0.20 p=0.4207	R=0.91 C= -1.15 p=0.4207	R=2.05 C= 4.50 P=0.0000
Uniface	R=1.36 C= 2.51 p=0.0060	R=1.03 C= 0.10 p=0.4602	R=1.23 C= 1.56 p=0.0594	R=1.06 C= 0.70 p=0.2420	R=0.79 C= -0.90 p=0.1841

Significant values shown in bold

K-Means Analysis for Locus 4148. K-means analysis was conducted for Locus 4148 and resulted in the definition of two clusters. Cluster K-1 is located in the western portion of the locus and K-2 is located in the eastern portion (Figure 8.13). Both areas contain similar frequencies and percentages of endscrapers. Cluster K-2 has more non-endscraper unifaces than K-1. Cluster K-1 has the majority of points, preforms, and channel flakes (Figure 8.14). The units with the highest artifact densities also occur in cluster K-1, similar to High-density Area 1 in Locus 4147/AS-2. Results of the K-means analysis are consistent with those at Locus 4147/AS-2, in which endscrapers and unifaces, while overlapping in their distribution with debris of weapons manufacture, are also located away from areas of weapons production. Huckell and Kilby (2002) have suggested that additional sub-surface artifacts are present to the east of the excavated portion of this locus, and it is possible that additional endscrapers are present farther from the main artifact concentration.

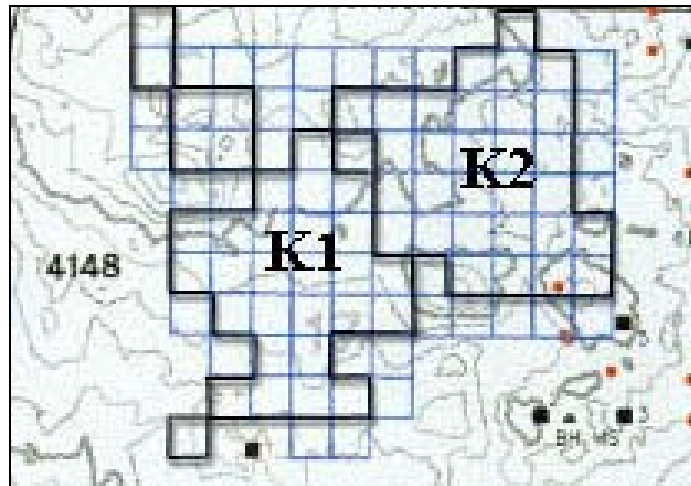


Figure 8.13. K-Means clusters at Locus 4148 (topographic map by J. Holmlund).

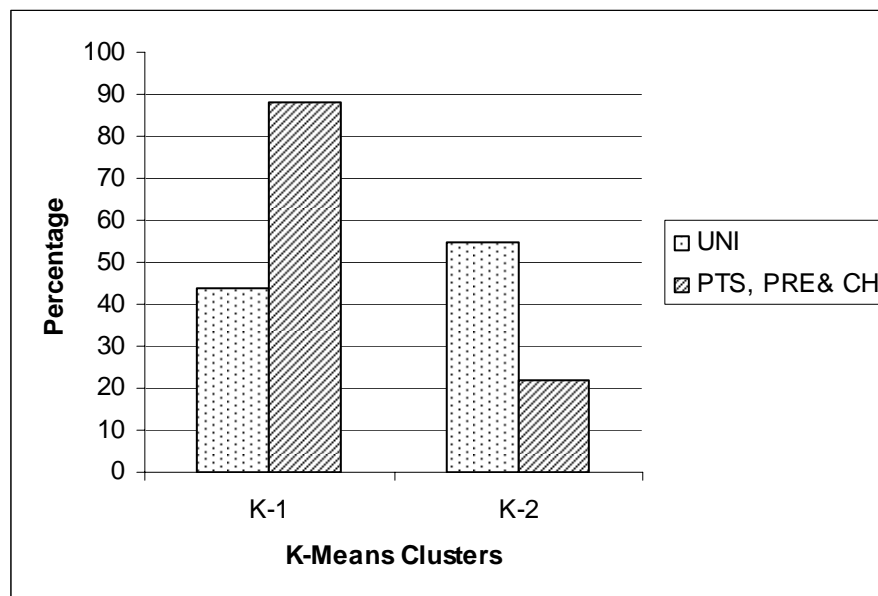


Figure 8.14. Percentages of all uniface combined (UNI) and points (PTS), preforms (PRE) and channel flakes (CH) combined for K-Means clusters at Locus 4148.

In their refitting analysis of channel flakes and preforms at the Rio Rancho site, Buchanan and Tyndall (n.d.) show that there is relatively little evidence of movement of artifacts within this locus. Three of their refits occurred within a single unit. In cases where

refits occurred across units, the direction was east to west, with the greatest refit distance spanning 4 units (approximately 40 feet) and the least spanning 2 units. These data suggest that natural processes are unlikely to account for the spatial patterning revealed in this analysis.

Comparison of Endscrapers between Clusters. Endscrapers were compared between the two K-means clusters at Locus 4148 (Figure 8.15). Both clusters contain overlapping raw materials, with Zuni Spotted and Chuska chert in both clusters (Table 8.15). Metric measurements are similar for both clusters, with endscrapers from K-1 being slightly larger and heavier than endscrapers from K-2. Modifications are more prevalent on endscrapers from K-2, which include two endscrapers with spurs and one with a notch. One example from K-1 has a spur. The mean working length (WL) and working edge convexities (WEC) for endscrapers from K-1 (WL: 26.98 mm; WEC: 5.06 mm) and K-2 (WL: 28.61 mm; WEC=5.20 mm) do not differ significantly, and both have similar frequencies of endscrapers with triangular outline shapes (Table 8.16). The mean depth of lateral retouch/edge damage for endscrapers from cluster K-1 is greater (4.99 mm) than cluster K-2 (2.86 mm) and is statistically significant at the .05 level ($p=.0228$). Most endscrapers from both clusters are non-cortical and have faceted platforms.

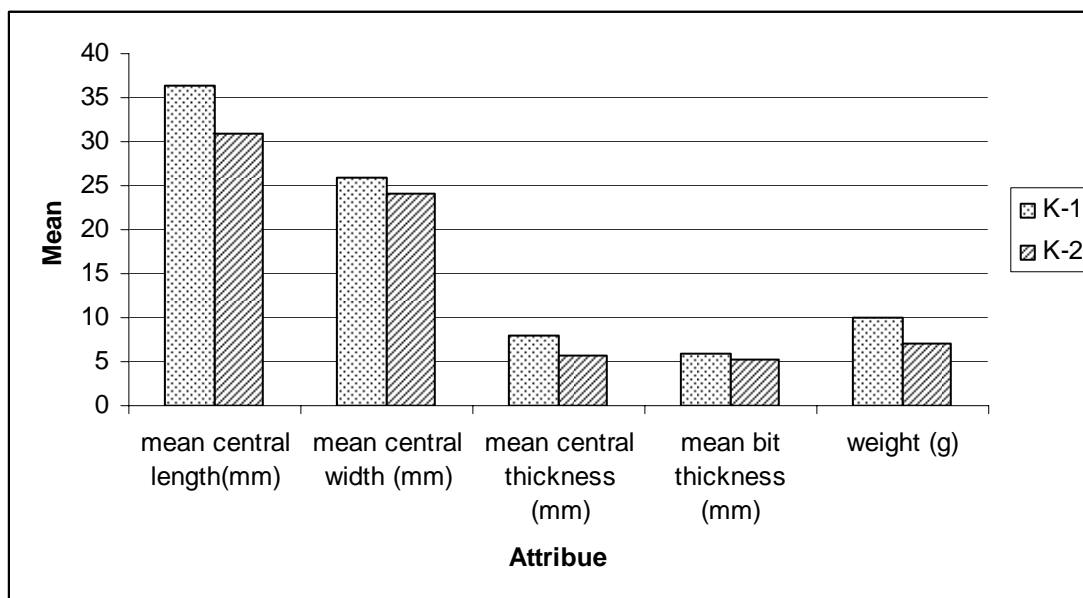


Figure 8.15. Endscraper metric measurements in clusters K-1 and K-2 at Locus 4148.

Table 8.15. Raw Material Frequencies for Endscrapers in Clusters K-1 and K-2 at Locus 4148.

	K-1	K-2
Zuni Spotted	1	5
Chuska	1	0
Local Brown	2	0
unknown chert	2	1
jasper	0	1

Table 8.16. Endscraper Bit Shapes in Clusters K-1 and K-2 at Locus 4148.

	K-1	K-2	Grand Total
Bit Shape	0	1	1
broken	0	1	1
rounded	5	6	11
straight	1	0	0
Grand Total	5	7	13

Locus 4146

Locus 4146 is a multi-component locus, but most of the ceramics occur in the northern portion of the locus, suggesting that debris from very late occupations may be relatively localized. Four preforms (accession numbers 69.20.49, 69.20.137, 69.20.153, and 69.20.219) lacked adequate provenience information and were excluded from the spatial analysis. Five projectile points (69.20.149, 69.20.152, 69.20.155, 69.20.172, and 69.20.180) lacked sufficient provenience data and so were excluded. One refitted point (from original units 22E,19S, 11E,7S and 23E,21S) does not appear to have been part of Huckell and Kilby's analysis of weaponry from the Rio Rancho site, but is included here. Eight endscrapers (69.20.10, 69.20.54, 69.20.71, 69.20.90, 69.20.98, 69.20.112a, and 69.20.119) lacked sufficient provenience information and were excluded. Six channel flakes (69.20.163, 69.20.221, 69.20.241, 69.20.247, 69.20.257, and 69.20.272) had no provenience coordinates and were excluded from the analysis.

Table 8.17 provides the frequencies and percentages of artifacts from Locus 4146, which were recovered from 206 units. The total number of artifacts from the locus is 2,991. Endscrapers are the most common formal tool type in the locus, followed by other unifaces. Units with the highest artifact densities occur in the southeastern portion of the site, the highest being 59 chipped-stone artifacts per unit (Unit 24E,6N) (Figure 8.16). This unit contains 58 flakes along with one piece of possible bison tooth enamel. In neighboring units, artifact densities decrease incrementally, suggesting that this location was an activity area, perhaps involving tool production around a hearth or shelter (Figure 8.17). At the margins of this activity area, artifact densities again increase to more than 50, suggesting this portion of the locus may have contained multiple tool production areas, perhaps around hearths. High

artifact densities also occur in the northwestern portion of the site as well, the highest in this area being 47 artifacts per unit (Unit 14E,17N). This unit also contains a core. Artifact density also decreases from this unit incrementally (Figure 8.18). In the surrounding 20-foot perimeter from unit 14E,17N, there are two endscrapers and another core. It is possible that this area was used to produce endscrapers on a small scale, not unlike High-density Area 2 at Locus 4147/AS-2. The area with the greatest frequency of cores, the far northern portion of the site, also produced several sherds as well an Early Archaic point.

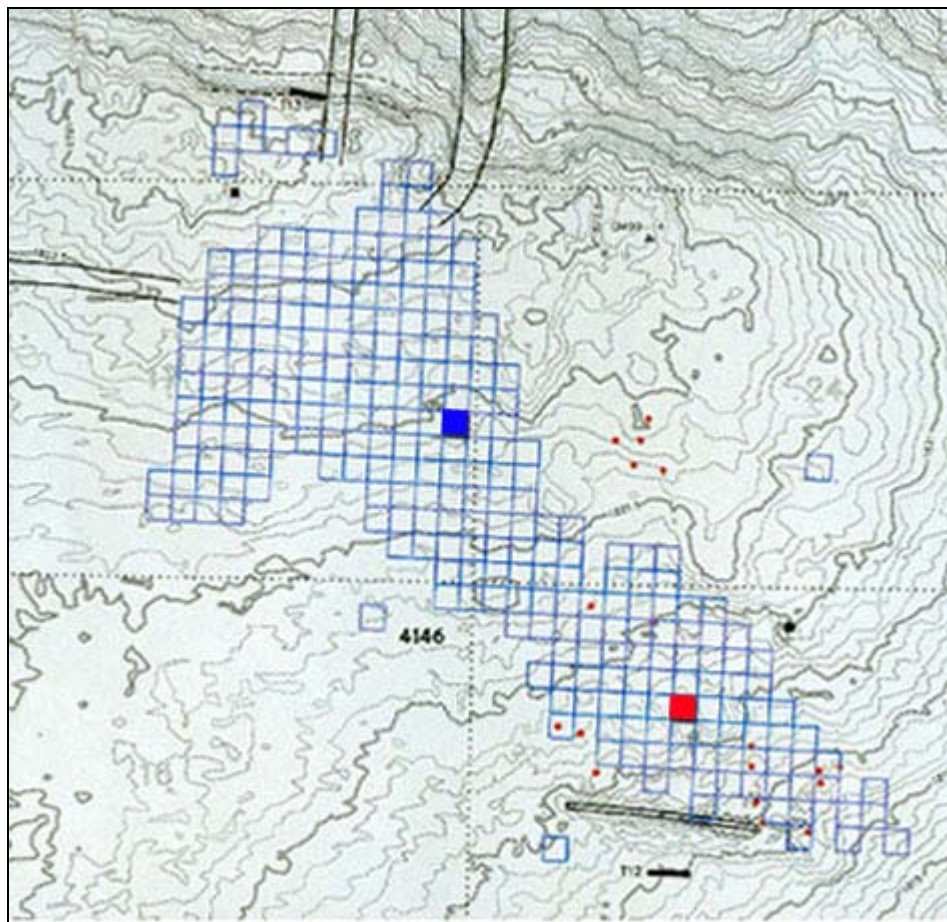


Figure 8.16. High-density areas 1 (red square) and 2 (blue square) at Locus 4146 (topographic map by J. Holmlund).

Table 8.17. Artifact Frequencies and Percentages at Locus 4146.

Artifact	Total	Tool Total
endscraper	30	30(18.18%)
other uniface	17	17(10.3%)
point	10	10(6.06%)
preform	14	14(8.48%)
channel flake	54	10(6.06%)
biface	12	12(7.27%)
core	20	20(12.12%)
spokeshave	1	1(6.06%)
retouched flake	6	6(3.64%)
indeterminate tool	1	1(.61%)
flake	2826 (96%)	—
Grand Total	2991	165(100%)

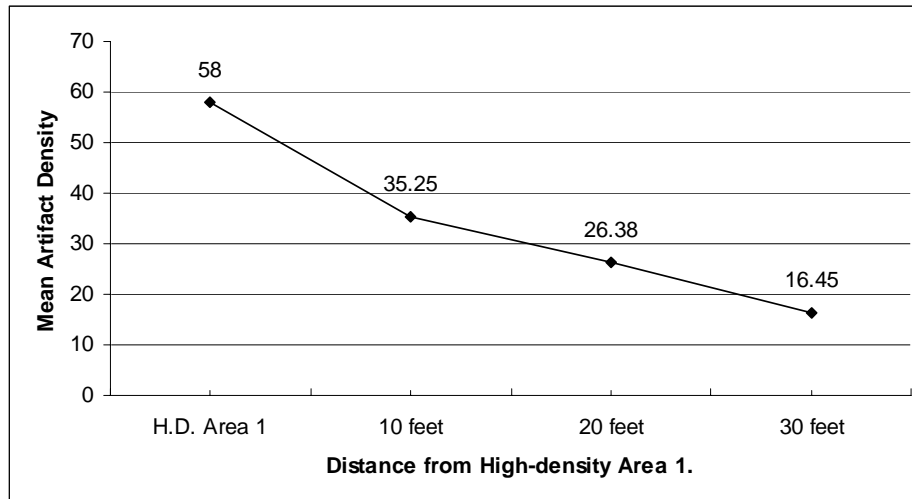


Figure 8.17. Artifact Density per unit with distance from High-density Area 1 (southeast portion of locus) at Locus 4146.

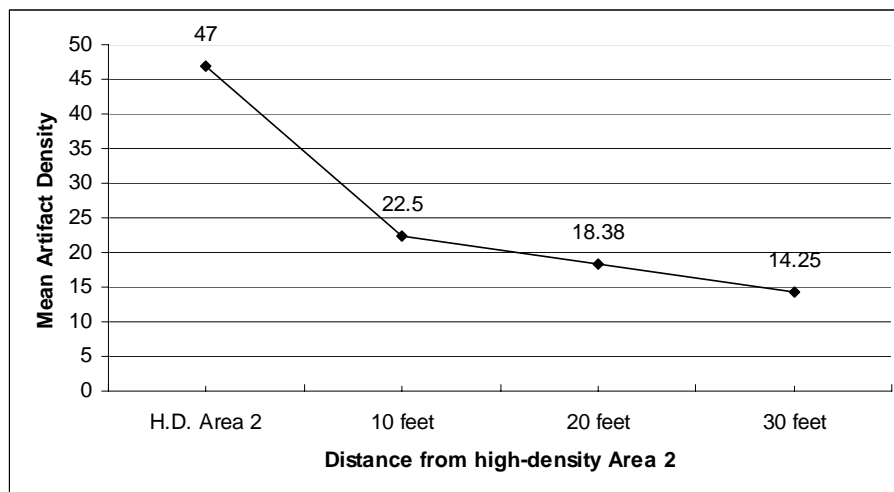


Figure 8.18. Artifact density per unit with distance from High-density Area 2 (northwest portion of locus) at Locus 4146.

K-Means Cluster Analysis for Locus 4146. K-Means analysis was run for Locus 4146, generating three clusters designated, K-1, K-2, and K-3 (Figure 8.18). Table 8.18 shows the percentages and frequencies of artifacts from these clusters. Cluster K-1 contains the majority of both points and preforms, while cluster K-2 contains most of the endscrapers (Figure 8.19). Cluster K-3, the northernmost cluster, contained the fewest formal tools, but the most cores. Unlike Locus 4147/AS-2 and Locus 4148, other non-endscraper unifaces are more abundant in the cluster with the majority of the weapons-associated remain (K-1). Like Locus 4148 and Locus 4147/AS-2, some clusters contain both endscrapers and weaponry debris, while other clusters are dominated strongly by endscrapers with little debris from weapons manufacture. One prominent pattern is that points and preforms are most abundant in K-1, and become increasingly less abundant in K-2 and K-3. No points and only a single preform is located in cluster K-3. Cores show the opposite pattern, becoming increasingly abundant with distance from cluster K-1, though it is not clear if these cores are related to the Paleoindian occupation. Given the differences in distribution of weapons-related artifacts,

endscrapers, and cores, Cluster K-1 was likely an area of weapons production and scraping activities, K-2 may have been an area associated mainly with scraping activities, perhaps hide-working, and K-3 an area of core reduction with an unknown cultural affiliation.

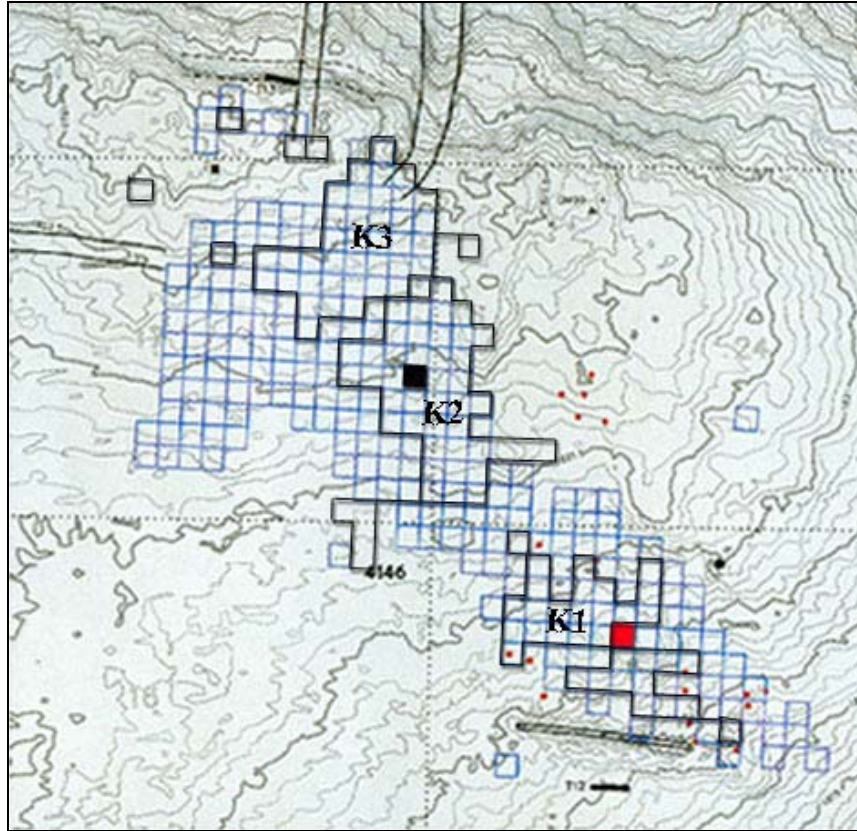


Figure 8.19. K-Means Clusters and High-density area 1 (red square) and 2 (blue square) at Locus 4146 (topographic map by J. Holmlund).

Table 8.18. Tool Frequencies and Percentages for K-Means Clusters at Locus 4146.

	K-1	K-2	K-3	Total
endscraper	9 (30%)	13(43.33%)	8(27.67%)	30
point	7(70%)	3(30%)	0	10
preform	11(79%)	2(14%)	1(7%)	14
channel flake	27(50%)	22(40.74%)	5(9.26%)	54
biface	6(50%)	5(42%)	1(8%)	12
uniface	13(76%)	3(18%)	1(6%)	17
core	3(15%)	3(15%)	14(70%)	20

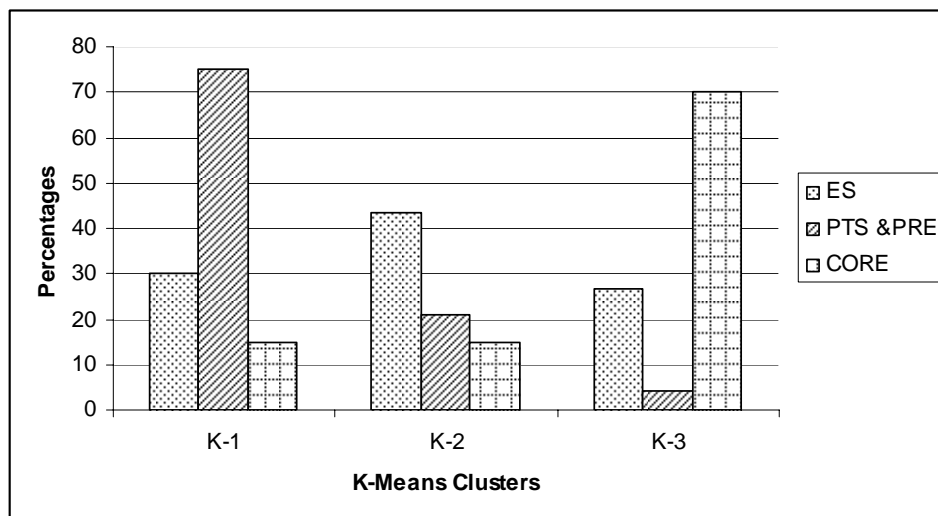


Figure 8.20. Percentages of endscrapers (ES), points (PTS) and preforms (PRE) combined, and cores for K-Means clusters at Locus 4146.

Nearest-neighbor Analysis for Locus 4146. Nearest-neighbor analysis was conducted for Locus 4146 from the unit with the highest artifact density (24E,6N), which has 58 artifacts. This unit and the series of adjacent units within 20 feet of it yielded a high frequency of tools: one endscrapper, one uniface, one preform, one channel flake, two points, and three bifaces. The relatively high density of artifacts and tools in this area suggests it might have been a tool production area, perhaps centered around a hearth or possibly a shelter. Table 8.19 provides the nearest-neighbor coefficients for artifacts from the highest density unit. The nearest neighbor coefficients (measured from point 24E,5N) for points, preforms, and non-endscrapper unifaces are less than 1, in the direction of the high-density unit, while the nearest-neighbor coefficients for endscrapers and cores are in directions away from the highest density unit. Bifaces show no directionality with respect to the highest density unit. The p values for the distribution of endscrapers, preforms, channel flakes, and cores are statistically significant at the .05 level, indicating endscrapers and cores are distributed away from this point while points and preforms are oriented toward the point. These results suggest

that this area was associated with weapons production. As with Locus 4147/AS-2 and Locus 4148, endscrapers are not strongly associated with weapons production areas.

Looking at the overall relationship between artifacts at Locus 4146, none of the nearest-neighbor coefficients indicates that tool types tend to be clustered within types with the exception of unifaces to endscrapers and bifaces to other bifaces (Table 8.20). The nearest-neighbor coefficients are likely being affected by multiple areas containing tools, thereby raising the nearest-neighbor coefficient. While the vast majority of preforms and points occur in the southeastern portion of the locus, a few are thinly scattered in other portions of the site, far from the unit of highest artifact density, lowering the nearest-neighbor coefficients.

Table 8.19. Nearest-neighbor Analysis from Point 24E/6N at Locus 4146.

	Frequency	Nearest Neighbor Coefficient	C Statistic (z-score)	p value (one-tailed) at .05 level
point	10	0.82	-1.06	0.1446
preform	14	0.75	-1.78	p=0.0375
channel flake	10	1.15	2.10	p=0.0001
endscraper	30	1.60	6.32	p<0.0001
uniface	17	0.85	-1.20	0.8849
biface	12	1.08	0.55	0.2912
core	20	2.12	9.54	p<0.0001

Significant p values are shown in bold

Table 8.20 Nearest-Neighbor Coefficients between Tool Types for Locus 4146.

	Endscraper	Point	Preform	Channel Flake	Biface	Uniface	Core
Endscraper	R=0.97 C=-0.36 p=0.3594	R=1.25 C=1.53 p=0.0630	R=1.03 C=0.23 p=0.4090	R=1.25 C=3.58 p=0.0002	R=0.85 C=-1.02 p=0.1539	R=0.77 C=-1.81 p=0.0351	R=1.30 C=2.56 p=0.0052
Point	R=1.55 C=5.74 p=0.0606	R=1.25 C=1.50 p=0.0668	R=0.94 C=-0.43 p=0.3336	R=0.95 C=-0.66 p=0.2546	R=0.78 C=-1.45 p=0.0735	R=0.99 C=-0.09 p=0.4641	R=2.46 C=12.52 p<0.0001
Preform	R=1.62 C=6.53 p<0.0001	R=1.55 C=3.33 p=0.0004	R=1.26 C=1.89 p=0.0294	R=1.31 C=4.30 p<0.0001	R=1.33 C=2.20 p=0.0139	R=0.88 C=-0.98 p=0.1635	R=2.32 C=11.32 p<0.0001
Channel flake	R=1.40 C=4.24 p<0.0001	R=1.02 C= 0.15 p=0.4404	R=1.06 C=0.41 p=0.3409	R=0.89 C=-1.59 p=0.0559	R=0.83 C=-1.10 p=0.1357	R=1.46 C=3.64 p=0.0001	R=1.21 C=1.82 p=0.0344
Biface	R=1.15 C=1.59 p=0.0559	R=0.95 C=-0.30 p=0.3821	R=0.94 C=-0.45 p=0.3264	R=1.12 C=1.69 p=0.0455	R=0.70 C=-1.96 p=0.0250	R=0.96 C=-0.28 p=0.3897	R=1.31 C=2.62 p=0.0044
Uniface	R=1.08 C=0.83 p=0.2033	R=1.25 C=1.50 p=0.0668	R=0.93 C=-0.49 p=0.3121	R=1.31 C=4.41 p<0.0001	R=0.96 C=-0.25 p=0.4013	R=1.03 C=0.26 p=0.3974	R=1.16 C=1.34 p=0.0901
Core	R=1.41 C=4.26 p<0.0001	R=2.01 C=6.11 p<0.0001	R=1.72 C=5.18 p<0.0001	R=1.15 C=2.16 p=0.0154	R=1.39 C=2.58 p=0.0049	R=1.55 C=4.34 p<0.0001	R=0.97 C=-0.26 p=0.3974

Significant p values shown in bold

Nearest-neighbor Analysis within Clusters at Locus 4146. Examining nearest-neighbor coefficients within clusters, endscrapers are the only tool type to be significantly clustered within tool types at cluster K-1 (Table 8.21). Endscrapers tend to be near other endscrapers, preforms, bifaces, and other uniface. Points tend to be nearest to channel flakes. Preforms tend to be near points, but channel flakes are not associated with any other artifacts. Bifaces tend to be near endscrapers and preforms. Unifaces tend to be near endscrapers, and cores are not associated with any tool type. At cluster K-1, tools in general and endscrapers in particular tend to be near different tool types, possibility suggesting an overlap in several different activities.

In cluster K-2, artifacts tend not to be as near to other artifacts as in cluster K-1, especially endscrapers (Table 8.22). Endscrapers in cluster K-2 tend to be more diffusely

dispersed and are not significantly associated with any artifact type. This pattern contrasts with cluster K-1 in which endscrapers are nearer to endscrapers, preforms, bifaces, and uniface than expected. Cluster K-2, having a relatively high frequency and percentage of endscrapers, a low percentage of preforms and points, coupled with a dispersed distribution of endscrapers, is consistent with the spatial expectations for hide-working.

Table 8.21 Nearest-neighbor Coefficients between Tool Types at Cluster K-1 at Locus 4146.

	Endscraper	Point	Preform	Channel Flake	Biface	Uniface	Core
Endscraper	R=0.66 C=-1.94 p=0.0262	R=1.19 C=0.95 p=0.1711	R=1.01 C=0.08 p=0.4681	R=1.73 C=7.23 p<.0001	R=0.60 C=-1.86 p=0.0314	R=0.76 C=-1.67 p=0.0475	R=1.57 C=1.90 p=0.02871
Point	R=0.75 C=-1.43 p=0.0764	R=1.31 C=1.57 p=0.0582	R=0.74 C= -1.67 p=0.0475	R=1.01 C= 0.12 p=0.4522	R=0.64 C= -.68 p=0.2483	R=1.19 C= 1.31 p=0.0951	R=1.74 C=2.46 p=0.0069
Preform	R=0.71 C=-1.65 p=0.0495	R=1.16 C= 0.80 p=0.2119	R=1.08 C=0.52 p=0.3015	R=1.06 C= 0.59 p=0.2776	R=0.57 C= -2.02 p=0.0217	R=0.77 C= -1.62 p=0.0526	R=1.43 C= 1.42 p=0.0778
Channel flake	R=1.38 C= 2.19 p=0.0143	R=0.61 C= -1.99 p=0.0233	R=0.89 C= -0.70 p=0.2420	R=0.95 C= -0.47 p=0.3192	R=1.18 C= 0.86 p=0.1949	R=1.80 C= 5.51 p<0.0001	R=1.89 C= 2.96 p=0.0015
Biface	R=0.60 C= -2.27 p=0.0116	R=0.93 C= -0.35 p=0.3632	R=0.88 C= -0.79 p=0.2148	R=1.53 C= 5.24 p<.0001	R=0.86 C= -0.66 p=0.2546	R=1.02 C= 0.16 p=0.4364	R=1.84 C= 2.77 p=0.0028
Uniface	R=0.36 C= -3.66 p<0.0001	R=1.55 C= 2.79 p=0.0026	R=1.06 C= 0.41 p=0.3409	R=2.00 C= 10.50 p<.0001	R=0.69 C= -1.44 p=0.0749	R=0.96 C= -0.28 p=0.3897	R=2.08 C= 3.58 p=0.0002
Core	R=1.17 C= 0.99 p=0.1611	R=1.30 C= 1.50 p=0.0668	R=1.18 C= 1.17 p=0.1210	R=0.96 C= -0.38 p=0.3520	R=1.21 C= 0.99 p=0.1611	R=1.16 C= 1.10 p=0.1357	R=2.07 C= 3.56 p=0.0002

Top value is nearest-neighbor coefficient. Significant p values shown in bold

Table 8.22 Nearest-neighbor Coefficients between Tool Types at Cluster K-2 at Locus 4146.

	Endscraper	Point	Preform	Channel Flake	Biface	Uniface	Core
Endscraper	R=0.98 -0.14 p=0.4443	R=1.54 1.45 p=0.0735	R=0.77 -0.63 p=0.2643	R=0.79 -1.91 p=0.0281	R=1.09 0.37 p=0.6443	R=0.72 -0.91 p=0.1814	R=0.77 -0.77 p=0.7794
Point	R=1.01 0.04 p=0.4840	R=1.24 0.66 p=0.2546	R=1.45 1.22 p=0.1112	R=0.76 -2.14 p=0.0162	R=0.66 -1.45 p=0.0735	R=0.83 -0.57 p=0.2843	R=0.61 -1.29 p=0.0985
Preform	R=1.33 2.28 p=0.0113	R=1.93 2.51 p=0.0060	R=1.15 0.40 p=0.3446	R=1.18 1.59 p=0.0559	R=1.48 2.05 p=0.0202	R=1.58 1.92 p=0.2843	R=0.89 -0.37 p=0.3557
Channel flake	R=1.16 1.09 p=0.1379	R=1.50 1.35 p=0.0885	R=1.21 0.56 p=0.2877	R=0.98 -0.20 p=0.4207	R=0.60 -1.71 p=0.0436	R=2.14 3.77 p<0.0001	R=0.80 -0.65 p=0.2578
Biface	R=1.14 0.99 p=0.1611	R=1.55 1.49 p=0.0681	R=1.61 1.66 0.0485	R=1.15 1.35 p=0.0885	R=0.50 -2.13 0.0166	R=1.89 2.94 p=0.0016	R=0.94 -0.21 P=0.4168
Uniface	R=1.01 0.06 p=0.4761	R=0.94 -0.18 p=0.4286	R=1.55 1.49 p=0.0681	R=1.10 0.91 p=0.1814	R=1.14 0.59 p=0.7224	R=1.54 1.79 p=0.0367	R=1.03 0.09 p=0.5359
Core	R=0.97 -0.18 p=0.4286	R=1.26 0.71 p=0.2389	R=0.97 -0.09 p=0.4641	R=0.66 -3.06 p=0.0011	R=0.82 -0.78 p=0.2177	R=1.19 0.62 p=0.2676	R=0.65 -1.17 p=0.1210

Significant p values shown in bold

The results of the K-means and nearest-neighbor analyses at Locus 4146 indicate that debris from weapons manufacture overlaps with debris from scraping activities in some areas (K-1) and are located away from debris from weapons manufacture activities in other areas (K-2 and K-3). Cluster K-2 contains the highest percentage of endscrapers and also includes a number of cores, which may have been used in endscraper production, but there cultural affiliation is currently unknown. Cluster K-3 is strongly dominated by cores and could have been an area of endscraper production, though its temporal affiliation is also unclear given its proximity to later material. Although endscrapers as fine wood-working tools cannot be ruled out, the spatial patterning here is consistent with hide-working being conducted in and around main activity areas as well as peripheral to them, perhaps associated with larger-scale hide-working.

Comparison of Endscrapers between Clusters at Locus 4146. Endscrapers within clusters K-2 and K-3 are predominantly of Zuni Spotted chert (Table 8.23). Cluster K-1 endscrapers are mainly made from Zuni Spotted or local brown chert. Cluster K-3 is the only cluster to have endscrapers made of Chuska chert. Other material types including chalcedony, jasper, and rhyolite occur in small numbers. Three endscrapers from K-1 have cortex, whereas there is only one cortical endscraper from K-2 and one from K-3. Endscrapers at all three loci do not differ dramatically in their metric measurements (Table 8.24). Endscrapers from K-1, which is dominated by weaponry manufacture debris, tend to be smaller on average with a smaller working edge length. Endscrapers from K-3 are the largest, with a mean working edge length a centimeter larger than endscrapers from K-1. These differences in size may relate to a difference in function or perhaps degree of use, though this cannot be established with certainty without use-wear analysis.

Table 8.23. Distribution of Endscraper Raw Material among K-Means Clusters at Locus 4146.

Raw Material	Clusters			Total
	K-1	K-2	K-3	
Zuni Spotted	3(33.33%)	6(46.15%)	4(50%)	13(43.33%)
Chuska	0	0	2(25%)	2(6.67%)
chert	2(22.22%)	2(15.38%)	0	4(13.33%)
Local brown chert	3(33.33%)	2(15.38%)	1(16.67%)	6(20%)
chalcedony	0	2(15.38%)	1(12.5%)	3(10%)
jasper	1(11.11%)	0	0	1(3.33%)
rhyolite	0	1(7.69%)	0	1(3.33%)
Total	9	13	8	30

Table 8.24. Metric Measurements for Endscrapers within K-means Clusters at Locus 4146.

	Mean (s.d.) central length (mm)	Mean (s.d.) central width (mm)	Mean (s.d.) central thickness (mm)	Mean (s.d.) working length (mm)	Mean (s.d.) Bit thickness (mm)	Mean (s.d.) Weight (g)	Mean (s.d.) WEC (mm)	Mean (s.d.) Edge Angle (degrees)
K-1	27.69 (15.99)	24.71 (5.83)	6.57 (3.29)	21.19 (2.39)	5.96 (2.13)	7.11 (6.63)	5.17 (3.06)	67.36 (13.83)
K-2	31.61 (8.78)	29.21 (4.52)	6.68 (1.41)	28.65 (4.52)	5.51 (1.28)	8.57 (4.29)	4.68 (1.44)	66.22 (17.10)
K-3	34.75 (9.00)	28.33 (4.43)	7.27 (1.77)	31.86 (7.66)	6.25 (1.76)	10.43 (3.33)	4.49 (1.50)	83 (8.46)

Summary

The results of the density, nearest-neighbor, and K-means analyses suggest that different areas within each locus at the Rio Rancho Folsom Site were associated with different activities. High-density artifact and tool areas have been identified at each of the three loci, and are strongly associated with weapons manufacture and some scraping activities. These may be the same areas suggested by Dawson and Judge to have been associated with shelters, but they could also represent hearth-centered activities. Endscrapers and other non-endscraper unifaces do occur in these areas, but unlike preforms and projectile points, are also likely to occur outside of these high-density areas. While endscrapers occur at the peripheries of loci in diffuse clusters, weapons debris tends to be concentrated in high artifact-dense areas. This patterning suggests that endscrapers are spatially independent of weapons production. The distribution of endscrapers is compatible with that expected for both small-and large-scale hide-working, being located both away from and overlapping with high-activity areas. While the use of endscrapers as fine wood-working tools or possibly tools of other functions cannot be ruled out, the patterns revealed here, coupled with modern and historic evidence for the location of hide-working activities within camps, indicate the

possibility that endscrapers were used for processing animal hides, and were potentially part of women's toolkits.

In addition, another pattern emerges at the Rio Rancho Folsom site relevant to hide-working activities. At all three loci, there appears to be a tendency for projectile points and preforms to cluster in the southern portion of the loci, whereas endscrapers are more prevalent in the northern portions of the loci and also tend to be more broadly distributed in the northern areas. This general tendency could reflect a consistency in the spatial organization of activities within the Folsom camps relative to the prevailing winds. Jodry (1999a:297) found a similar pattern at Stewart's Cattle Guard site in Colorado in lithic cluster K-1, identified through K-means analysis. She discovered that endscrapers associated with hide-work clustered in the northern portion of the area, while tools associated with weapons replacement clustered in the southern portion of the area. She explained, "It is postulated that the northern and central parts of K-1 (N28 to 36) consist of an outdoor area where hide-working and other maintenance tasks were carried out by women. At the southernmost end of K-1 channel flakes and two preforms were recovered suggesting that men were working on weapons replacement in this area" (Jodry 1999a:297). This similarity in the location of potential hide-working tools and weapons refurbishment could suggest a consistency in the organization of camp activities at Folsom sites. Further spatial investigation at other sites is needed to explore this question.

Another line of inquiry begun by Jodry at the Stewart's Cattle Guard is to examine the distribution of endscrapers, weapons manufacture, and high-density areas in light of hide-working intensity and seasonality. Jodry observed that cluster K-1 at Stewart's Cattle Guard was dominated by hide-working debris and was situated at some distance from the rest of the

camp. The Stewart's Cattle Guard kill occurred in late summer/early fall, when Folsom groups may have been taking advantage of the prime condition of bison wool to process hides. Stewart's Cattle Guard site, then, might represent relatively intense processing of bison hides, at least in terms of the numbers of hides dressed. Though the spatial data from Rio Rancho are not ideal, the same may be true for this site as well. Stewart's Cattle Guard represents similar activities in that endscrapers are found in all the clusters identified and roughly the same number of endscrapers was recovered as at the Rio Rancho Folsom site. Smaller campsites with no evidence of associated kills, might be expected to have endscrapers intermixed with debris from weapons production if hide working was not a frequent activity.

The spatial relationships at the Rio Rancho Folsom site indicate that not all tool types are distributed in the same way, and that endscrapers, points, and preforms differ in their distribution. The results suggest that endscrapers were being used both in areas of high activity as well as in areas peripheral to the main camp area or possible hearths. As discussed in previous chapters, this distribution is not incompatible with expectations for hide-working. In the next chapter, I examine the raw material of endscrapers and weapons at the Rio Rancho Folsom site, along with strategies of production to further investigate whether these tools are similar or distinct in terms of technological organization.

CHAPTER 9

Comparison of Endscrapers and Weapons Raw Material and Morphometrics

The granite around the falls had many uses. Women gathered the slabs on the east to make knives, scrapers, and other tools for turning deer hide into buckskin.

—Mourning Dove (Mourning Dove and Miller 1994:103)

This chapter compares the toolstone selection and reduction techniques for endscrapers and weapons in order to determine if these toolkits were separate or linked. This research evaluates Amick's (1999) proposal that high demand for weapons could impact the allocation of raw material to endscrapers. This research also seeks to shed light on the question whether women might have been involved in stone tool procurement and manufacture. Women's procurement of endscraper raw material might be suggested by more local sources being used for endscrapers. Differing reduction strategies for these tool types could provide evidence toward regarding whether the production of gendered technologies were linked or separate.

Analysis of Raw Material

The Rio Rancho Folsom site has yielded 36 Folsom projectile points, 51 preforms, nearly 200 channel flakes, more than 101 endscrapers, and over 6,000 pieces of lithic debitage. Numerous measurements were taken on the Rio Rancho Folsom site endscrapers (Table 9.1), though not all measurements were used in this analysis. Tables 9.2 and 9.3 show the frequencies of endscrapers by locus and the frequency and raw material of projectile points, endscrapers, preforms, and uniface resharpening flakes for the entire site. Data used

in this analysis are housed at the Maxwell Museum of Anthropology at the University of New Mexico.

Table 9.1. Endscraper Attributes Recorded.

Attribute	Description
<i>Material:</i>	
Material color	Description of color using rock color chart
Material texture	Fine-grained, medium-grained, coarse-grained, very coarse-grained
Material type (when known)	Identification of material type based, color inclusions, and fracture characteristics
Inclusions	Presence or absence, color, patterning (e.g., dendritic) and location of inclusions
Size of inclusions	<5mm, 6mm-1mm, 2-3mm, 4-5mm, >5mm
Distribution of inclusions	Percentage of the matrix as follows: 0%, 1-25%, 26-50%, 51-75%, 76-100%.
Material color	Description of color using rock color chart
<i>Continuous variables:</i>	
Maximum axis length (MAL)	Length along the centerline of the tool from the proximal end to the most distal point of the distal or working edge
Medial length (ML)	Length from the impact point on the platform to the distal edge along the medial axis
Maximum width (MW)	Maximum width of the tool, perpendicular to maximum length
Medial axis width (MAW)	Width measured at the midpoint and perpendicular to the medial axis length
Maximum thickness (MT)	Maximum thickness and location of the tool wherever it occurs
Medial axis thickness (MAT)	Thickness at the intersection of medial axis length and medial axis width
Working edge convexity (WEC)	Length between the corners of the working edge and the most distal part of the tool. Judge's (1973:Figure 19) "working factor"
Working edge angle (EA)	Average of three angle measurements of the working edge. This measurement corresponds to the angle formed between the unretouched ventral face of the endscraper and the retouched dorsal working edge. Two measurements: one at edge and one taken two mm from edge.
Width of platform (PW)	Maximum lateral dimension of the striking platform
Thickness of platform (PT)	Transverse dimension of the striking platform taken at the centerline of the platform width
Mean working edge depth (TBR)	Average of three thickness measurements of the flake scars along the main working edge
Thickness of lateral edge retouch (TLR)	Average of three measurements along lateral retouch edge(s)
Length lateral retouch (LLR)	Length of modified portions of the lateral edges (Judge 1973:151)
Working length (WL)	Length between the chord of the arc prescribed by the convex working edge
Exterior facet angle (EFA)	Measure of the angle at the convergence of the facets on the exterior flake surface. With a multi-faceted exterior surface, the measurement cannot be taken (Judge 1973:148)

Table 9.1 (continued). Endscraper Attributes Recorded.

Attribute	Description
Divergence angle (DA)	The angle measured between the main axis of the flake and the lateral edge taken from the proximal end of the flake (Judge 1973)
<i>Discrete variables:</i>	
Outline morphology	One of the five arbitrary morphological categories which define the outline shape of the endscraper.
Striking platform morphology	Simple, faceted, crushed, ground
Eraillure	Presence or absence of eraillure associated with flake platform
Presence of spur	Presence and location of intentional spur
Presence of spokeshave	Presence or absence and location of concave retouch along lateral margin
Lateral graver	Presence of a graver on the lateral margin (Judge 1973:151)
Cortex	presence/absence of exterior cortex
Cortex type	Designated as smooth, medium, or rough
Platform cortex	Presence/absence of cortex on striking platform of original flake blank from which the endscraper was made
Breakage	Presence/absence of break; classified as transverse or longitudinal
Recycling	Presence or absence of evidence for recycling into other tool forms
Lateral breakage	Indication of breakage on left or right lateral edges
Other damage, such as spalling	Present or absence and location of spalling

Table 9.2. Frequencies of Endscrapers by Locus at the Rio Rancho Site.

Locus	4146	4147/AS-2	4148	Unknown	Total
Endscraper Frequency	38(38%)	40(40%)	13(13%)	10(10%)	101
Weapons (PP, PF, CH)	85(30%)	127(45%)	66(23%)	5(2%)	283
Projectile Points	16(44%)	15(42%)	3(7%)	2(6%)	36
Preforms	17(33%)	22(43%)	10(20%)	2(4%)	51
Channel Flakes	52(27%)	90(46%)	53(27%)	1(<1%)	196
Ratio Endscrapers to Points	2.3	2.7	4.3	5	
Ratio Endscrapers to Preforms	2.2	1.8	1.3	5	
Ratio Endscrapers to Channel Flakes	.73	.44	.25	10	

Table 9.3. Frequencies of Projectile Points, Preforms, Channels Flakes, and Endscrapers for the Entire Rio Rancho Site.

	Projectile Points	Preforms	Channel Flakes	Endscrapers	Uniface Resharpener Flakes
Zuni Spotted	8 (22%)	13 (25%)	62 (32%)	48 (48%)	22 (58%)
Light brown, Grayish Brown or Moderate Brown chert	6 (17%)	11 (22%)	35 (18%)	16 (16%)	2(5%)
China Chert	2 (6%)	3(6%)	8 (4%)	3 (3%)	0
Chuska chert	4 (11%)	5 (10%)	25 (13%)	4 (4%)	3(8%)
Red (Zuni Spotted?) chert	0	0	1(<1%)	0	1(3%)
Misc. chert	3 (8%)	2 (4%)	3 (2%)	15 (15%)	5(13%)
Pedernal chert	2 (8%)	2 (4%)	17 (9%)	0	0
Waxy white chalcedony	0	0	1(1%)	0	0
Gray/Grayish brown chalcedony	1(3%)	0	2(1%)	5 (5%)	0
Other chalcedony	0	0	0	1 (1%)	4(11%)
Valle Grande Obsidian (reddish)	6(17%)	6(12%)	12(6%)	0	0
Valle Grande Obsidian (black)	0	2(4%)	3(2%)	0	0
Obsidian (pitted)	1(3%)	2(4%)	1(1%)	0	0
Yellow Petrified Wood	1(3%)	1(2%)	11 (6%)	1(1%)	0
Brown Petrified Wood	0	3(6%)	3(2%)	0	0
Brown Banded Petrified Wood	1(3%)	0	2(2%)	1(1%)	0
Red jasper	1(3%)	0	5(3%)	3(3%)	1(3%)
Brown Jasper	0	0	0	1(1%)	0
Rhyolite	0	0	0	1(1%)	0
Gray Petrified Wood	0	0	0	2(1%)	0
Quartzite	0	1(2%)	5(3%)	0	0
Total	36	51	196	101	38

The data suggest that yellow Zuni Spotted chert was used preferentially for both weapons and endscraper manufacture (Figure 9.1). Together, 29 percent (n=83) of projectile points, channel flakes, and preforms are made from Zuni Spotted chert, and 48 percent (n=48) of the endscrapers are made from this material. Thirty-two percent (n=62) of the

channel flakes, and 25 percent (n=13) of the preforms, 22 percent (n=8) of the points, are made from Zuni Spotted chert. Because the material is strongly represented in both the endscraper and weapons assemblages, Folsom groups likely quarried in the Zuni Mountains area for both weapons and endscraper needs. Channel flakes and preforms are useful to examine because they represent materials that were likely worked at the site in the manufacture of projectile points, and suggest the last raw material source that was targeted. The predominance of Zuni Spotted in the point and preform/channel flake assemblages suggests that this material might have been brought in as preforms or flake blanks. The high frequency of preforms and channel flakes made from Zuni Spotted chert also suggests that finished projectile points manufactured of Zuni Spotted chert may have been transported away from the site.

As with Zuni Spotted chert, a similar percentage of channel flakes (18%, n=35), preforms (22%, n=11), projectile points (17%, n=6) and endscrapers (16%, n=16) at the Rio Rancho Site were manufactured from a light brown chert that might have a local origin, based on observations by Bruce Huckell. Macroscopically similar material occurs as nodules in Quaternary alluvium along the Rio Puerco escarpment west of the Llano de Albuquerque (LeTourneau 2000). This suggests that both weapons and endscraper assemblages were targeting similar materials, some of which were local while others were nonlocal in origin.

While Zuni Spotted and possible local brown chert are used for both endscrapers and weapons, the weapons assemblage was made from a wider variety of raw materials than endscrapers at the Rio Rancho Folsom site. Thirty-four projectile points, channel flakes, and preforms (12% of the weapons assemblage) were made from several varieties of obsidian, some of which derives from the Valle Grande member in the Jemez Mountains some 50 to 70

km north of the site. Because no obsidian occurs in the endscraper assemblage, I conclude that this material was allocated preferentially to the weapons assemblage. While there are cases of obsidian endscrapers from modern contexts in Ethiopia, obsidian was rarely used for endscrapers during the Paleoindian period, which could represent a bias against the material for functional reasons (see Chapter 6).

Of the weapons assemblage, 21(13% of the weapons assemblage) were made from Pedernal chert (Table 9.3). Pedernal chert channel flakes were particularly prevalent in the channel flake assemblage (n=17). None of the endscrapers or endscraper resharpening flakes were identified as being made from Pedernal chert. Huckell and Kilby (2002:21) suggested that at least some of the Pedernal chert at the Rio Rancho site derives from the primary source in the Jemez Mountains approximately 50 to 70 km north of Rio Rancho, rather than from the local gravels in the late Tertiary Santa Fe formation and Quaternary alluvium. They hypothesized that certain Pedernal color variants are not found in the local gravels. They also point to the absence of Valle Grande obsidian in the local gravels, despite its presence on the site. The absence of Pedernal chert in the endscraper assemblage suggests the material might have been preferentially allocated to the weapons assemblage, or the raw material might have circulated out of the endscraper toolkit before arrival at the site. Other types of chalcedony do occur in the endscraper assemblage, and therefore the absence of this material in the endscraper assemblage does not appear to be related to raw material suitability.

Like Pedernal chert, Chuska chert is also represented in greater numbers in the weapons assemblage (n=34; 12% of the weapons assemblage) than in the endscraper assemblage (n=4; 4% of the endscraper assemblage). Chuska chert was brought into the site from the Chuska Mountains source area west of the site, and based on the channel flake and

preform assemblages, was used at the site in the manufacture of projectile points. While Chuska chert is present in the endscraper assemblage, it is far more prevalent in the weapons assemblage, especially in the form of channel flakes (n=25; 13% of the channel flakes). China Chert (San Andres chert) is also found in both the endscraper and weapons assemblages, but in low numbers. This material, though transported to the site like Pederal, Valle Grande obsidian, and Chuska chert, does not appear to have been preferentially allocated to the production of weapons or endscrapers. Figure 9.1 and Table 9.4 shows the distribution of non-local materials by tool class.

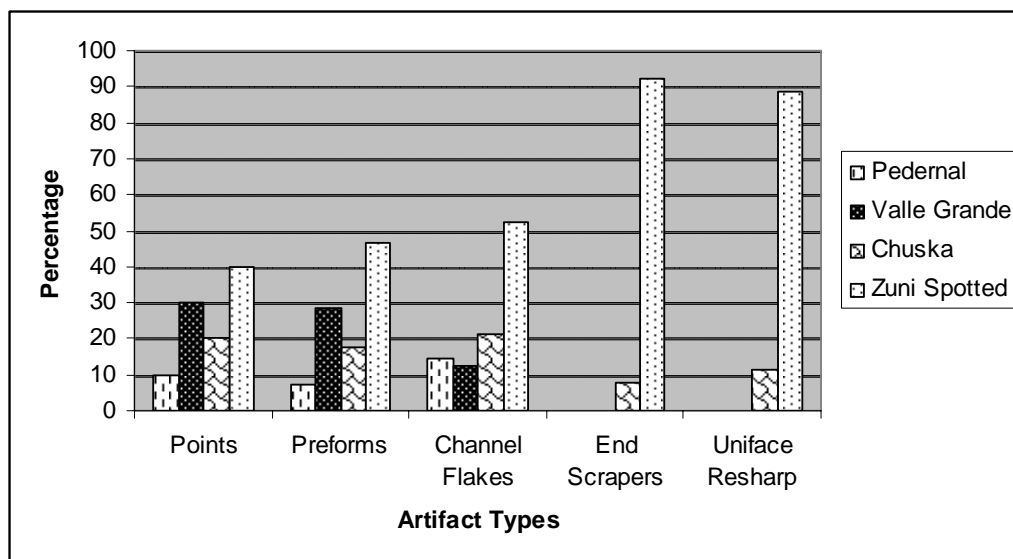


Figure 9.1. Nonlocal raw material distribution in the endscraper and weapons assemblages.

Table 9.4. Frequencies of Nonlocal Sources in the Weapons and Endscraper Assemblages at the Rio Rancho Site.

	Pedernal	Valle Grande obsidian	Chuska	Zuni Spotted
Frequency of Raw Material in Weapons Assemblage (Points, Preforms, and Channel Flakes Combined)	22	24	34	83
Frequency of Raw Material in Projectile Point Assemblage	2	6	4	8
Frequency of Raw Material in Preform Assemblage	2	8	5	13
Frequency of Raw Material in Channel Flake Assemblage	17	15	25	62
Frequency of Raw Material in Endscraper Assemblage	0	0	4	48
Frequency of Raw Material in Uniface Resharpener Flake Assemblage	0	0	3	23

The local brown material was a particularly important shared resource for both the weapons and endscraper assemblages. Miscellaneous varieties of chert, which could not be identified to source, or easily classified into a single group, occur more often in the endscraper and uniface resharpener assemblage (n=20) than in the weapons assemblage (n=8). These materials are not easily categorized, and could potentially derive from local gravels around the site, which, if true, could suggest that material for endscrapers was more often procured locally than materials for weapons at the site. Different varieties of petrified wood were used in relatively low numbers for the both weapons and endscraper manufacture, though they occur somewhat more frequently among the channel flakes (n=11; 6%). Petrified wood can be found in the local Santa Fe Formation gravels and might have been used to supplement both the endscraper and weapons assemblage with raw material, though not to any great degree. Red jasper and gray chalcedony are also found in low numbers in both the weapons and endscraper assemblages. Gray chalcedony occurs in the local gravels of the Santa Fe formation and may have been procured locally to supplement the raw material needs for both tool classes. Other materials, like quartzite and rhyolite occur in very low

numbers overall. If the known nonlocal materials are excluded and the remaining raw materials assumed to be local, then 115 (40.64%) weapons artifacts were made from local materials, and 61 (43.88%) of the endscraper assemblage is comprised of local materials. This would suggest, again, similar strategies for supplying weapons and endscrapers with raw material. Further analysis of the Rio Rancho Folsom site materials and local gravels is necessary to evaluate this hypothesis.

The allocation of raw material to endscraper and weapons manufacture is nuanced. In some cases overlaps in raw material use occur, while in other cases there is no overlap. Two nonlocal materials, including Chuska and Pedernal, do not appear to be equally represented in both the weapons and endscraper assemblages; both are more common in the weapons assemblage. Chuska chert, which is also nonlocal, occurs only in low numbers in the endscraper assemblage compared to the weapons assemblage. Valle Grande obsidian and Pedernal chert both derive from the Jemez Mountains, and occur only in the weapons assemblage. The absence of obsidian in the endscraper assemblage could relate to the unsuitability of the material to endscraper tasks. Other nonlocal sources, such as Zuni Spotted chert, however, are more equally represented in both the weapons and endscraper assemblages. Both assemblages are dominated by Zuni spotted chert. Both Zuni Spotted and China chert, which occurs infrequently, are presumably derived from primary or secondary sources in the Zuni Mountains (Huckell and Kilby 2002:21). The low frequencies of Chuska and Pedernal in the endscraper assemblage may be due to preferential allocation to weapons as Amick (1999) suggests, but could also easily be explained by faster rates of discard and attrition of the endscrapers assemblage. The overall similarity in allocation of Zuni Spotted chert suggests similar strategies of raw material allocation for both tools.

Folsom tool users at the Rio Rancho Folsom site appear to have utilized local materials from the Santa Fe Formation to supplement raw material supply for both the endscraper and weapons assemblages. If the assumption that most unidentifiable raw materials in the two assemblages are local, then both weapon and endscraper assemblages have a similar percentage of nonlocal materials represented. In all, the two assemblages differ in subtle ways, but appear similar in their overall representation of local and nonlocal sources.

Endscraper Size: Implications for Transport

Endscraper metric proportions were examined to explore whether some endscrapers may have served different functions, experienced greater use, and whether endscrapers made from nonlocal material exhibit a greater degree of use than those of more local material. These in turn, might have implications production as well as for the gendered use of the tools. Endscraper measurements were taken using Mitutoyo digital calipers with statistical processing control output. Metric measurements were taken in millimeters and carried out to one hundredth of a millimeter.

Endscraper length (measured along the central axis of the flake) varies between 10.56 mm and 60.27 mm, but is normally distributed for complete, broken, and complete and broken endscrapers combined. Most endscrapers, including complete and incomplete specimens, ranged between 25 and 40 mm (Table 9.5) along their central axis, the mean central length being 34.46 mm. For complete endscrapers, the central axis length of most endscrapers (62%) ranged between 30 and 40 mm (Table 9.6).

Table 9.5. Length Measured along the Central Axis of Complete and Incomplete Endscrapers at the Rio Rancho Site.

	Frequency of Complete Endscrapers	Frequency of Broken Endscrapers	Frequency of Complete and Incomplete Endscrapers
1.00–10.00 mm	0	0	0
10.01–15.00 mm	0	3	3
15.01–20.00 mm	0	2	2
20.01–25.00 mm	2	6	8
25.00–30.00 mm	9	13	22
30.01–35.00 mm	19	7	26
35.01–40.00 mm	14	6	20
40.01–45.00 mm	5	4	9
45.01–50.00 mm	3	0	3
50.01–55.00 mm	0	0	0
>55.00 mm	1	2	3
Total	53	43	96

Width measured along the central axis (the midpoint of the length axis) of complete endscrapers ranges between 14.27 mm and 43.29 mm, with most (68%) falling between 20.00 and 30.00 mm, with a mean central width of 26.47 mm (Table 9.6). Central thickness (measured at the intersection of central length and width measurements) of complete endscrapers range between 2.73 mm and 11.38 mm, with most (91%) falling between 4.00 mm and 8.00 mm (Table 9.7). The mean central thickness of complete endscrapers is 6.75 mm. The measurements of the Rio Rancho endscrapers suggest that there is a consistency in endscraper size in terms of length, width, and thickness, suggesting that if endscrapers were being used for multiple purposes, this is not reflected in their metric proportions. The consistency in central axis width could suggest standardization in size as a means of accommodating the stone tool to a socket or other hafting mechanism. When comparing the Rio Rancho endscraper assemblage to Stewart's Cattle Guard endscraper assemblage, there is a remarkable consistency in all measurements (Table 9.8), suggesting the possibility that uniformity in endscraper dimensions might be widespread during the Folsom period.

Table 9.6. Central Width of Complete Endscrapers at the Rio Rancho Site.

Central Width (mm)	Frequency of Complete Endscrapers
10.00-15.00 mm	1
15.01-20.00 mm	4
20.01-25.00 mm	17
25.01-30.00	19
30.01-35.00	7
35.01-40.00	4
>40.01	1
Total	53

Table 9.7. Central Thickness of Complete Endscrapers at the Rio Rancho Site.

Central Thickness (mm)	Frequency of Complete Endscrapers
2.00-4.00 mm	2
4.01-6.00 mm	19
6.01-8.00 mm	19
8.01-10.00	10
>10.00 mm	3
Total	53

Table 9.8. Stewart's Cattle Guard and Rio Rancho Site Endscraper Dimensions Compared.

	Number	Range	Mean	Stan. Dev.	Sample Variance
Length (mm)	CG:54 RR:96	CG:19.2-68.7 RR:1.56-62.7	CG:33.2 RR:32.4	CG:9.1 RR:8.6	CG:83.8 RR:74.3
Width (mm)	CG:50 RR:96	CG:28.8-43.2 RR:14.3-43.3	CG:29.9 RR:26.3	CG:5.2 RR:5.5	CG:26.8 RR:30.2
Thickness (mm)	CG:59 RR:96	CG: 4.3-11.2 RR: 2.7-13.4	CG:7.3 RR:6.5	CG: 1.7 RR:1.8	CG:2.9 RR:3.3
Distal thickness (mm)	CG:60 RR:101	CG:1.8-10.2 RR: 2.6-10.3	CG: 5.7 RR:5.5	CG:1.6 RR:1.4	CG:2.4 RR:2.1
Weight (grams)	CG:56 RR:101	CG:2.8-27 RR: .9-37.9	CG:8.1 RR:8.5	CG:4.9 RR:5.0	CG:24.4 RR:25

Central length, width and thickness measured for the Rio Rancho specimens; includes broken and complete endscrapers. Adapted from Jodry 1998:225.

Looking at mean length along the central axis and raw material of the Rio Rancho endscrapers, Chuska chert (26.91 mm) and China chert (25.62 mm) had the lowest mean

central length. Chuska endscrapers were expected to have a shorter central length based on the frequency of that material in the endscrapers and weapons assemblages given the distance of the source from the site. The Chuska source is located approximately 220 km west of the Rio Rancho site, and only four endscrapers are made from Chuska. The China chert source is located approximately 115 km west of the site, and China endscrapers occur in small numbers (n=3). Chuska and China chert endscrapers also have the smallest mean central width of the major material types at the site, commensurate with being the most reduced endscraper forms. Thus, there appears to be a correspondence between frequency of nonlocal material and size of endscrapers (length and width). However, t-tests revealed no significant difference between the mean central length, central width, and central thickness of the local and non-local endscrapers. As no Pedernal endscrapers are present in the assemblage, the expectations regarding length and timing of raw material access cannot be tested with this material.

Table 9.9. Sizes of Rio Rancho Endscrapers of Different Raw Material Types.

	Mean Central Length (mm)	Mean Central Width (mm)	Mean Central Thickness (mm)	Number of Endscrapers
Nonlocal:				
China	25.62	24.19	6.80	3
Chuska	26.91	25.83	6.87	4
Zuni Spotted	33.43	27.08	6.39	48
Local:				
Light Brown Chert	28.56	27.93	6.76	16
Local Chalcedony	31.10	30.96	6.61	5
Jasper	40.66	22.57	6.07	4
Petrified Wood	41.2	24.02	6.73	2

The largest nonlocal endscrapers are made of Zuni Spotted chert, which occurs in much larger quantities than Chuska or China. Again, there appears to be a relationship between frequency of the nonlocal endscrapers and size of endscrapers. The nonlocal Chuska might have been procured earlier than the Zuni material, and experienced a greater incidence of use and discard. Zuni Spotted endscrapers or flake blanks might have been brought to the site largely unused and discarded there once they had served their purpose. They might have some use-life left in them, therefore producing the patterns of greater length and width seen in the local materials (Table 9.9).

For endscrapers made on local materials, the pattern is opposite of that of the nonlocal materials. That is, the greater the frequency of specimens of a raw material type, the smaller the mean central length of the endscraper. Of the presumed local materials, jasper (40.66 mm) and petrified wood (41.2 mm) endscrapers, though fewer in number, are considerably larger on average. Chalcedony (31.10 mm mean central length) also occurs in the local gravels of the Santa Fe Formation, but chalcedony endscrapers are smaller on average than their jasper and petrified wood counterparts (Table 9.9). The yellowish brown chert originates from an unknown source. LeTourneau (2000:483-484) has described a similar raw material as “Abiquiu” chert found in cobble form in Miocene alluvium southwest of the town of Abiquiu and redeposited in the Santa Fe Formation. Yellow brown chert endscrapers have the third smallest central mean length (28.56 mm), closer to the length of nonlocal Chuska chert. This pattern in nonlocal material might suggest endscrapers of certain local material types were used more extensively than others, perhaps due to better quality. Chalcedony and the finer-grained local brown chert might have been better suited to endscraper tasks than jaspers and petrified woods, which might have been used less

extensively. Also, the average length of jasper and petrified wood endscrapers is nearly twice the width, suggesting that these raw materials might not represent the most suitable piece sizes or quality for the manufacture of endscrapers, and/or they were discarded with considerable utility remaining.

While the central length of endscrapers varies by as much as 1.5 cm between raw material types, the central thickness of all endscrapers of major material types differs by less than a millimeter. This suggests that while some endscrapers of certain raw material types experienced greater use before discard, the thickness requirements for endscrapers were more tightly controlled. It also suggests that endscrapers of all raw material types may have originally been of a similar length, and therefore mean central length at the time of discard represents actual degree of use rather than original blank size.

Core Reduction and Flake Blank Selection

Dawson and Judge (1969:159) suggested that flake blank production technology at the site consisted of creating a ground platform surface that was struck by a soft hammer or punch. This technology, they argue, produces flake blades with evenly expanding edges. Scrapers from Unit IV (locus AS-2), they argue, were made on blanks detached by indirect percussion using an unground and unprepared surface as a platform, produced a relatively short, wide scraper. From this, they argue a different band occupied the AS-2 area than the other areas.

Differences in platform type for those endscrapers that retain a platform or remnant platform can be informative as to manufacturing technique. Platform type could be identified on 53 endscrapers at the site (Table 9.10), with most (70%) having faceted platforms. Faceted platforms were also the most common identifiable platform type across all four loci

(Table 9.11). This suggests a similar approach to endscraper blank production technology across all four loci, including the endscrapers in Locus AS-2.

Table 9.10. Frequency of Endscraper Platform Types at the Rio Rancho Site.

	simple	faceted	crushed	indeterminate
Endscraper Frequency	13	37	3	48

Table 9.11. Frequency of Endscraper Platform Types by Locus at the Rio Rancho Site.

	4146	4147	4148	4147/AS-2	AS-2
Simple	6 (16%)	2 (11%)	1 (8%)	1 (10%)	2 (15%)
Faceted	11 (29%)	7 (41%)	7 (54%)	3 (30%)	5 (38%)
Crushed	2 (5%)	1 (6%)	0	0	0
no platform or indeterminate	19 (50%)	7 (41%)	5 (38%)	6 (60%)	6 (46%)
Total	38	17	13	10	13

Platform length varies from 3.93 mm to 22.26 mm (Table 9.12). Mean endscraper platform length is 9.32 mm. Mean faceted platform length is 9.02 mm, and mean simple platform length is 10.10 mm. There are three very large platforms (>17 mm), two of which are simple and one of which is faceted. The faceted platform length mode is between 6 and 7 mm. Simple platform length is bimodal between 6 and 7 mm and 12 and 13 mm. Table 9.13 shows the platform type by material type. For both nonlocal and probable local materials, the vast majority have faceted platforms. The uniformity of platform type suggests that production technique used in the manufacture of endscraper blanks was largely uniform, without regard to material type.

While endscraper platforms are faceted, they do not appear to be made from biface thinning flakes, based on the thickness of the flakes. The same is true for Stewart's Cattle Guard endscrapers (Jodry 1998:227). In their discussion of Clovis blades, Collins and Lohse (2004:160-165) describe Clovis blades as being produced by percussion on conical or wedge

cores. They observe that platforms on Clovis blade cores were often rejuvenated just after removal of the blade, leaving no trace of the negative bulb scar on the core. This rejuvenation produced a multi-faceted platform (Collins and Lohse 2004:163–164). Collins and Lohse also describe two variants of blades, “corner” and “center”, produced on wedge-shaped cores. The exterior of center blades consists of prior flake scars. Corner blades “detach from the ridge along the juncture of the core face and one of the lateral sides of the core. Since the sides of the core often retain cortex, the lateral exterior facet of the blade is commonly cortical or partially so” (Collins and Lohse 2003:164). At the Rio Rancho site, there are examples of endscrapers with lateral cortex. While the Folsom Rio Rancho endscrapers are not made on long, thin blades, they do have many of the features that Collins and Lohse describe, and might be produced from a variant of the technique used to produce Clovis blades. Figure 9.2. shows two endscrapers made on “corner” and “center” blanks from the Rio Rancho site. The incidence of faceted platforms and tightly controlled flake thickness suggests that endscrapers were produced using a uniform technique, rather than being produced using a variety of reduction techniques. Unlike modern-day Konso women flint knappers, who use a variety of reduction techniques and where hide-working is a craft specialty, Folsom flint knappers at the Rio Rancho site, whether they were men or women, appear to have used a standardized reduction technique in producing endscraper blanks, which was separate from the technology used to produce weaponry.

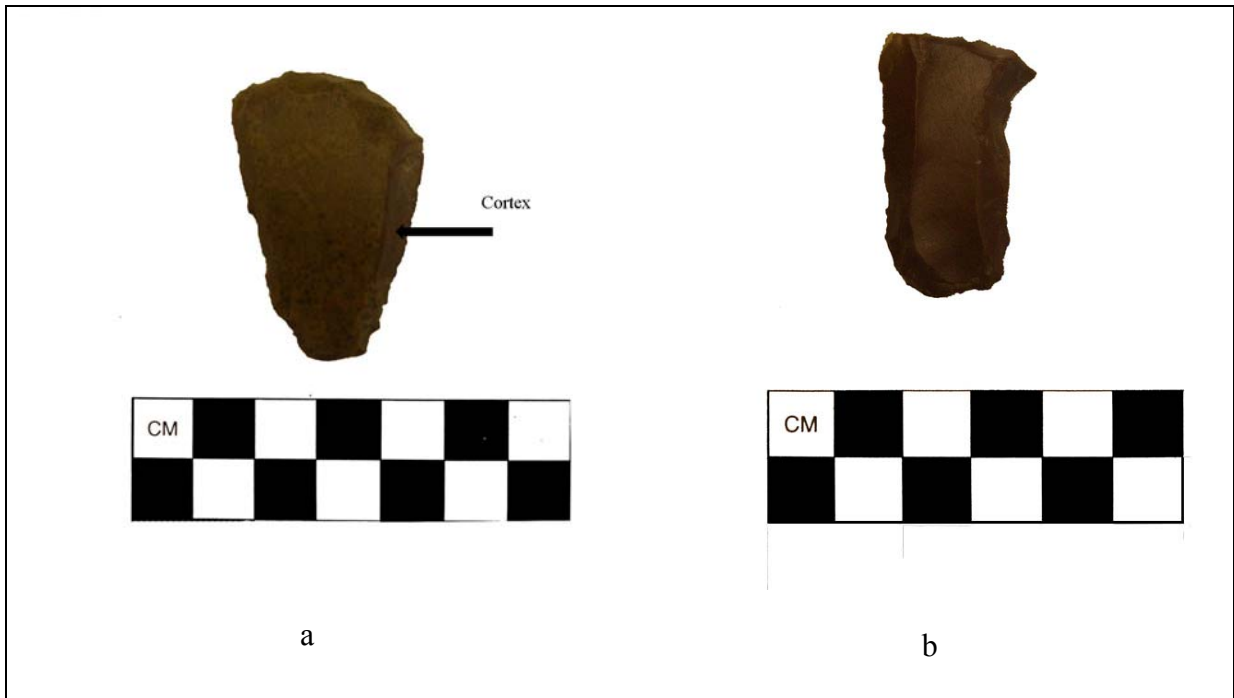


Figure 9.2. Examples of endscrapers made on “corner” and “center” flake blanks from the Rio Rancho site (a, Catalog No. 69.20.57; b, Catalog No: 69.20.183).

Table 9.12. Endscraper Platform Length at the Rio Rancho Site.

Platform Length (mm)	Frequency
3.00-4.00 mm	1
4.01-5.00 mm	1
5.01-6.00 mm	6
6.01-7.00 mm	9
7.01-8.00 mm	5
8.01-9.00 mm	6
9.01-10.00 mm	5
10.01-11.00 mm	5
11.01-12.00 mm	0
12.01-13.00 mm	3
13.01-14.00 mm	3
14.01-15.00 mm	0
>15.00 mm	5

Table 9.13. Endscraper Platform Type by Raw Material Type at the Rio Rancho Site.

	Platform Type			
	Simple	Faceted	Crushed	No Platform
Zuni Spotted	7	20	1	20
China	0	2	0	1
Chuska	1	1	1	1
Gray Chalcedony	1	0	0	5
Jasper	0	2	1	1
Petrified Wood	1	1	0	2
Misc. Chert	3	11	0	0
Total	13	37	3	48

In evaluating Dawson and Judge's conjecture that Locus AS-2 endscraper blanks were produced using a different reduction technique yielding a shorter and wider scraper, I looked at endscraper length and width by Locus (Table 9.14). AS-2 scrapers are shorter than other endscrapers on other loci on average. AS-2 scrapers were not wider, however, than other endscrapers, and are similar to Locus 4146 endscrapers in this respect. AS-2 endscrapers are only slightly thinner than endscrapers at the other loci. Comparing the mean length of endscrapers from Loci 4146, 4147, 4148 to AS-2 using a two-sample t-test of means reveals no significant difference between the two groups ($p=.27$, two-tailed t-test).

Table 9.14. Sizes of Endscrapers across Loci on the Rio Rancho Site.

	Locus 4146	Locus 4147	Locus AS-2	Locus 4148	Locus 4147/AS-2
Mean Central Length (mm)	32.12	32.75	29.31	34.63	33.79
Mean Central Width (mm)	27.43	25.28	27.38	24.68	27.65
Mean Central Thickness (mm)	7.09	6.41	6.00	6.65	6.10

Given the similar width and thickness measurements, a more likely explanation to the difference in endscraper length might be slightly greater endscraper reduction at Locus AS-2.

Endscraper Cortex: Implications for Transport and Manufacture

Another variable that can assist in determining how endscrapers were produced and whether they originated from local or nonlocal sources is the presence of exterior cortex (Table 9.15). Most endscrapers in the Rio Rancho assemblage (n=82; 82%) have no exterior cortex. The 19 endscrapers with exterior cortex were made from Zuni Spotted chert (n=7), pale brown cherts (n=5), other unidentified cherts (n=4), jasper (n=1), yellowish brown chalcedony (n=1), and rhyolite (n=1). The presence of cortex on material such as chalcedony, jasper, and pale brown chert provides further support that these materials were local in origin, perhaps originating in the alluvial gravels around the site.

Fourteen percent of the Zuni Spotted endscrapers have some cortex. Zuni Spotted is the only nonlocal material that has examples of endscrapers with exterior cortex. As with the central axis length, Zuni Spotted endscrapers mirror the cortical frequencies of the local materials rather than the other nonlocal materials. The frequency of Zuni Spotted chert and the relatively long length of Zuni Spotted endscrapers suggest that the Zuni source was the last one accessed by Folsom groups before arrival at the site. The presence of cortex on Zuni Spotted endscrapers, suggests the possibility that the flank blanks might have been made specifically for endscraper production, and were not simply a byproduct of weapons production.

Table 9.15. Frequency of Endscrapers with Exterior Cortex at the Rio Rancho Site.

	Cortex	No Cortex	Total
Nonlocal:			
Chuska	0	4	4
China chert	0	3	3
Zuni Spotted	7	42	49
Local:			
Unidentified Chert	4	11	15
Jasper	1	3	4
Chalcedony	1	4	5
Brown chert	5	11	16
Petrified Wood	0	4	4
Rhyolite	1	0	1
Total	19	82	101

Breakage and Discard Processes

Transverse breakage of endscrapers can provide insight into processes of endscraper discard, function, and potentially individual knappers. Breakage could relate to a number of technological strategies such as economizing of toolstone by taking advantage of the fresh break for other purposes. Breakage can also potentially suggest whether endscrapers were hafted or used in the hand, as researchers have suggested that endscrapers are prone to break at the hafting element. In her study of modern-day Konso hide-workers, Weedman (2010) finds that endscraper breakage is most common among younger, less skilled hide-workers and very old hide-workers.

Incidence of transverse breakage was recorded by determining the main working edge of the endscraper and observing whether breakage occurred along the horizontal plane of the tool. Fifty-three endscrapers are complete and 43 are broken transversely. An additional five are indeterminate in terms of completeness because of their unusual form (such as having two working edges). In five cases, the broken proximal portion could be refitted to the distal portion of the specimen, but in one case, the endscraper was difficult to orient in terms of

proximal and distal ends. The length of the proximal portion (non-working end) of four transversely broken endscrapers varies from 11.98 mm to 30.79 mm (Table 9.16). The distal end (working edge length), however, is more similar for these refitted pieces, all falling within the range of approximately 20 mm to 30 mm. If breakage is related to hafting element, the length of the proximal portion might be expected to be more standardized, representing the length of the hafting element. Instead, the length of the distal end is more similar. No clear pattern emerges with these refitted specimens (Table 9.16).

Table 9.16. Transversely Broken and Refitted Endscrapers from the Rio Rancho Site.

Locus	Accession Number	Length of proximal fragment (mm)	Length of distal portion of endscraper (mm)	Maximum length of endscraper (mm)	Ratio of proximal portion to maximum endscraper length
4146	69.20.103	11.98	20.73	32.71	.37
4146	69.20.09	30.79	27.67	58.46	.53
4146	unknown	28.94	31.35	60.29	.48
4147	69.20.111	13.08	29.97	43.05	.30

Transversely broken endscraper fragments all contain the distal end (working edge) of the endscraper. The mean central length of these fragments is 29.51 mm, whereas the mean central length of complete endscrapers is 34.45 mm. The majority (44%) of transversely broken endscrapers fall between 20 and 30 mm in central axis length. Most complete endscrapers (62%) fall between 30 and 40 mm in length. Clark and Kurashina report unused Ethiopian endscrapers at 65 mm, and Shott (1995: Table 5) reports unused endscraper length at the Leavitt Site at 68.3 mm. At Stewart's Cattle Guard, Jodry (1998:225) reports a maximum endscraper length of 68.7 mm. The maximum endscraper lengths at the Rio Rancho Folsom Site are 58.46 mm (69.20.09), 60.29 mm (no accession),

and 65.71 mm (69.20.119), suggesting the initial endscraper blank size might be comparable to the Ethiopian and Leavitt site examples. All of these very large endscrapers are from Locus 4146. If endscrapers were on average 40 to 60 mm in length prior to use, transverse breakage might be most likely to occur near the midpoint, between 20 and 40 mm along the central axis of the endscraper, perhaps at the point where the hafting element ended. It is possible that the four refitted endscrapers might not accurately reflect the breakage point for the entire assemblage.

Looking at the incidence of transverse breakage with regard to raw material, there appears to be no clear pattern (Table 9.17). For all material types, with the exception of miscellaneous chert, there are roughly equal numbers of complete and transversely broken endscrapers. The breakage does not then appear to be associated with increased recycling or reuse of any particular material type.

For most raw material types, the frequencies of transversely broken and complete endscrapers are roughly equal (Table 9.17). In some cases, sample sizes are small and it is difficult to discern whether these differences are randomly produced. The exception is unidentified cherts, which consist of cherts of a variety of colors, and other inclusion properties. These data indicate that raw material has a minimal affect on breakage.

Looking at the spatial distribution of transversely broken endscrapers in Locus 4146, there is no very obvious spatial patterning, although for transversely broken endscrapers tend to cluster in the lower elevation eastern portion of the locus. This portion of the locus also contains the greatest concentration of preforms and projectile points. It is possible that these endscrapers were associated with refurbishing the hunting toolkit, though no other characteristics of these endscrapers distinguish them from others in the locus. The broken

endscrapers do not appear to cluster so tightly to suggest their deposition by individual workers as in the Konso case. Post-depositional processes might have moved the artifacts from their original locations. In their refitting analysis of Rio Rancho site channel flakes, Buchanan and Tyndall (n.d.) conclude that there is a “non-random pattern of refit line orientation from the northwest to the southeast” for Locus 4147/AS-2 as a result of slopewash. This refit orientation corresponds with the general slope across the site. It is possible that the association of transversely broken endscrapers and projectile points and preforms is a product of slopewash from the northwest (the area of greatest endscraper concentration) to the southeast (the area of greatest preform and projectile point concentration).

Table 9.17. Frequency of Endscraper Transverse Fracture by Raw Material Type at the Rio Rancho Site.

	Complete	Transverse Break	Indeterminate	Total
Nonlocal:				
Chuska	3	1	0	4
China chert	2	1	0	3
Zuni Spotted	22	25	1	48
Local:				
Unidentified Chert	10	5	1	16
Jasper	2	2	0	4
Chalcedony	2	4	0	6
Brown chert	5	7	3	15
Petrified wood	2	2	0	4
Rhyolite	0	1	0	1
Total	48	48	5	101

Design Considerations

A number of endscraper design considerations were examined to determine if they shed light on function and gendering of toolkits. Design considerations examined here

include outline morphology, hafting considerations, size, weight, resharpening, edge angle, and features such as spurs, notches, spokeshaves, and gravers.

Endscraper outline morphology was classified into one of five categories similar to Morrow's designations (1997:73): triangular, tapered, oval, convergent, parallel-sided, and irregular. These categories were judged based on visual appearance of each endscraper.

Outline morphology was recorded in an attempt to understand the design requirements of endscrapers, and what factors, such as raw material, reduction technique, and hafting requirements, influenced their ultimate form.

More than 50 percent of the endscrapers exhibit a triangular outline morphology, with parallel-sided being the second most identifiable form (Table 9.18). As with a standardized central axis width, the triangular shape might have been preferred as a means to accommodate a socket or hafting mechanism. The triangular outline shape could reflect a similar reduction method used to produce the endscraper blank. Of the 29 non-triangular endscrapers that have an identifiable outline shape, most did not retain a platform (Table 9.19). Most (83%) of the triangular endscrapers did retain a platform, the majority of these being faceted (Table 9.19). Almost all raw materials were associated with a triangular outline shape, with the exception of the one rhyolite specimen (Table 9.20). Of the three endscrapers made from jasper, two were parallel-sided in outline, suggesting a possible link between this raw material and outline form. These results suggest that a specialized core with faceted platform preparation might have been used to produce triangular-shaped flake blanks. Local material of various shapes and piece sizes, might not have been suited to producing triangular-shaped blanks or were not easily modified to this shape.

Table 9.18. Endscraper Outline Morphology at the Rio Rancho Site.

	triangular	parallel-sided	ovoid	tapered	irregular	indet.
Endscraper Frequency	53	15	1	4	9	19

Table 9.19. Frequency of Endscraper Outline Morphology and Platform Type and at the Rio Rancho Site.

	triangular	parallel-sided	ovoid	tapered	irregular
simple	11	0	0	0	2
faceted	30	4	1	1	1
crushed	3	0	0	0	0
indeterminate	9	9	0	3	6

Table 9.20. Outline Morphology of Rio Rancho Endscrapers by Raw Material Type.

	triangular	parallel- sided	ovoid	tapered	irregular
Zuni Spotted	29	5	1	2	5
China	2	0	0	0	0
Chuska	3				
Chalcedony	2	2	0	0	0
Other chert	14	4	0	2	4
Jasper	1	4	0	0	0
Petrified Wood	2	0	0	0	0
Other Material	0	1	0	0	0
	53	16	1	4	9

As with endscraper thickness and platform characteristics, there is a clear pattern in the outline morphology of the Rio Rancho endscrapers, suggesting that a particular form was intended. The triangular outline morphology might have been a function of a hafting requirement, implying that endscrapers at the Rio Rancho site were fitted into a similar haft assemblage. Though the sample sizes are small, deviations from the triangular outline morphology occur mainly in the assemblage of local raw materials, such as gray chalcedony and jasper. This might suggest that local materials were not ideally suited to producing endscrapers to their usual specifications.

Bit shape or working edge shape was recorded using the following designations: rounded, irregular, straight, and indeterminate (as a result of bit breakage) based on visual observations. Working edge length was measured following Morrow (1997) as the chord of the arc described by the convex working edge. Working edge convexity was measured following Morrow (1997) as the length between the corners of the working edge and the most distal part of the tool, which is equivalent to Judge's (1973:Figure 19) "working factor". Height of working edge retouch was measured in three places along the main working edge along the retouch scars using digital calipers. These measurements were then averaged to produce the mean working edge height. Step fractures along the main working edge of the endscrapers were recorded as present or absent based on visual inspection. These features of the working edge of endscrapers were recorded in an effort to understand whether endscrapers might have had different functions, or whether other factors such as raw material type might have affected the form of the working edge. Consistency in working edge features could suggest similar function.

The vast majority of Rio Rancho endscrapers (75%) have rounded bits (Table 9.21); the number of non-rounded endscrapers is small. There is also a lack of correspondence between length and working edge shape, which could suggest that degree of use does not affect the shape of the bit (Table 9.22). There is also little correspondence between endscraper working edge shape and the length of the working edge. The mean working edge length for rounded endscrapers is 29.17 mm. For straight working edges the mean working edge length is 27.57; for irregular working edges, the mean working edge length is 30.01 mm.

Working edge convexity was measured on 94 specimens and ranged between 1.67 and 28.79 mm, with most (74%) ranging between 3 and 5 mm (Table 9.21). The average working edge convexity is 4.88 mm. The frequency of rounded bits (n=40) corresponds well with the frequency of working edge convexities between 3 and 5 mm (n=45). Working length of endscrapers was measured on 95 endscrapers and ranged between 18.19 mm and 45.57 mm, with most (88%) falling between 20 and 40 mm (Table 9.23). Mean working length of endscrapers is 29 mm. Like working edge shape and working edge convexity, working edge is unimodal, suggesting a somewhat standardized endscraper edge morphology. Mean working edge thickness is 5.28 mm and is normally distributed (Table 9.24). Most endscrapers (85%) fall between 4.00 and 6.00 mm in working edge thickness. All but ten endscrapers (81%) displayed step fractures on the working edges. This consistency in bit size, shape, and wear suggests that Rio Rancho endscrapers may have served similar purposes across all three loci (Table 9.25).

Table 9.21. Frequencies of Endscraper Working Edge Shapes at the Rio Rancho Site.

	Rounded	Straight	Irregular	Indeterminate
Frequency	40	5	3	5
Mean Central Axis Length (mm)	32.00	31.98	29.60	18.60

Table 9.22. Endscraper Working Edge Convexity at the Rio Rancho Site.

Working Edge Convexity (mm)	Frequency
1.00-20.00 mm	3
2.01-3.00 mm	10
3.01-4.00 mm	25
4.01-5.00 mm	20
5.01-6.00 mm	15
6.01-7.00 mm	14
7.01-8.00 mm	5
>8.00 mm	2
Total	94

Table 9.23. Working Length of Endscrapers from the Rio Rancho Site.

Working Length Interval (mm)	Frequency
15.00-20.00 mm	3
20.01-25.00 mm	25
25.01-30.00 mm	29
30.01-35.00 mm	20
35.01-40.00 mm	14
40.01-45.00 mm	3
>45.01-50.00 mm	1
Total	95

Table 9.24. Endscraper Working Edge Thickness (Flake Scar Height) at the Rio Rancho Site.

Interval Working Edge Thickness (mm)	Frequency
2.00-3.00 mm	1
3.01-4.00 mm	14
4.01-5.00 mm	28
5.01-6.00 mm	27
6.01-7.00 mm	17
7.01-8.00 mm	7
8.01-9.00 mm	5
>9.01 mm	2
Total	101

Table 9.25. Mean Endscraper Working Edge Convexity, Length and Thickness across Loci at the Rio Rancho Site.

	Locus 4146	Locus 4147	Locus AS-2	Locus 4148	Locus 4147/AS-2
Mean Working Edge Convexity (mm)	4.72	3.94	4.48	5.27	4.42
Mean Working Length (cm)	30.41	27.56	28.84	27.36	28.85
Mean Working Edge Thickness (cm)	5.92	4.99	5.41	5.50	5.13

Looking at edges across all loci, there is a significant difference between the working length of endscrapers at Locus 4146 and Locus 4147 and Locus 4147/AS-2, though the mean thickness at both loci is similar (see Table 9.26). Locus 4146 contains endscrapers with somewhat thicker working edges. This could be a result of a functional difference in

endscrapers at Locus 4146. Looking at edge thickness across material type, the means are similar and there is no statistical difference between them (Table 9.26). On the whole there are few statistical differences between the working edges of endscrapers among the loci at the Rio Rancho site, and there seems to be no obvious pattern in these differences.

Table 9.26. T-test Outcomes (p values; one-tailed test) for Endscraper Edge Properties across Loci.

		Locus 4146	Locus 4147	Locus AS-2	Locus 4147/AS-2 combined	Locus 4148
Locus 4146	WL		p=0.046407	p=0.20931	p=0.131137	p= 0.049909
	WEC		p=0.070778	p=0.341926	p=0.221944	p=0.206187
	WET		0.249968	p=0.123994	0.005467	p=0.205302
Locus 4147	WL	p=0.046407		0.272506	p=0.224594	p=0.460134
	WEC	p=0.070778		p=0.084513	p=0.097644	p=0.014663
	WET	0.249968			p=0.340016	p=0.188168
Locus AS-2	WL	p=0.20931	p=0.272506		p=0.498668	p=0.24436
	WEC	p=0.341926	p=0.084513		p=0.440011	p=0.042509
		p=0.123994			p=0.347495	p=0.164967
Locus 4147/AS-2 combined	WL	p=0.131137	p=0.224594	p=0.498668		p=0.216245
	WEC	p=0.221944	p=0.097644	p=0.440011		p=0.042509
	WET	p=0.005467	p=0.340016	p=0.347495		p=0.188168
Locus 4148	WL	p= 0.049909	p=0.460134	p=0.24436	p=0.216245	
	WEC	p=0.206187	p=0.014663	p=0.042509	p=0.042509	
	WET	p=0.205302	p=0.188168	p=0.164967	p=0.188168	

WL=Working Length; WEC=Working Edge Convexity; WET=Working Edge thickness

Spurs, notches, spokeshaves, and gravers and other modifications occur rarely on end scrapers (Table 9.27). Eighteen endscrapers (18%) have spurs, seven of which occur at the right junction of the working and lateral edges (viewed from exterior, working edge oriented down), six on the left, and four endscrapers have spurs at both junctions. One spur occurs on the working edge of the scraper. The near equal occurrence of spurs on the left and right margins of endscrapers suggests that handedness likely did not contribute to the formation of these features. Mean central length of endscrapers with spurs is 30 mm, similar to the overall mean central length of 34.46 mm, suggesting that spurs are not product of increased resharpening. Eight (44%) of the 18 spurred endscrapers are transversely broken. The equal numbers of complete and broken endscrapers with spurs suggests that breakage did not determine whether a spur was added to an endscraper. This is similar to the frequency of transversely broken endscrapers in the overall assemblage (46.2%). If spurs are intentional attempts to recycle endscrapers into other tools, it might be expected that higher-quality material would be recycled to produce them. Eight (44%) of the spurred endscrapers are made on Zuni Spotted chert, seven (38.9%) are made on other cherts, two (11%) are made on chalcedony, and one (5.56%) is on Chuska chert, again closely mirroring the overall assemblage. The data do not support spurs as a byproduct of resharpening or as intentional attempts to recycle endscrapers into other tools.

Spurred endscrapers occurred on all four loci. Most spurred endscrapers were located in Locus 4146, with five left- and five right-margin spurs. Two left-margin spurs were located in Locus 4147, and one left-margin spur occurred in Locus 4147/AS-2. Locus 4148 contained one left- and one right-margin spur. AS-2 contained one right-margin spur, and one right-margin spur had no provenience. The smallest distance between two spurred

endscrapers is at least 30 feet, suggesting that either there is no spatial correspondence between spurred endscrapers, or that post-depositional processes have compromised any spatial association. In Locus 4147/AS-2 two spurred endscrapers are located in the same unit (2E, 3N Locus 4147). A total of three endscrapers occur in this unit, suggesting that its spatial integrity might be intact. Another spurred endscraper occurs in Locus AS-2 (404-A), also in a unit with three endscrapers. In Locus 4148, two spurred endscrapers occur in the same unit (3E, 2S). The other spurred endscraper in Locus 4148 occurs in unit 11E, 1S. The evidence for spurred endscrapers being used by a single worker is not clear from these data, though it remains a possibility.

Table 9.27. Frequencies of Notches, Spurs, and Spokeshaves on Endscrapers at the Rio Rancho Site

	Notches	Spurs	Spokeshaves	Gravers
left	5	6	1	1
right	2	7	0	0
left and right	0	4	0	0
other	0	1	0	0
Total	7	18	1	1

Discussion

The results of these analyses suggest there are slight differences in raw material for endscrapers and weaponry at the Rio Rancho Folsom site in that weapons are more often made from obsidian and non-local Pedernal chert. These differences are not great, however, and might be attributable to functional suitability and different use-lives of weapons and endscrapers. Both assemblages are dominated by Zuni Spotted chert and have similar frequencies of local materials. In a general sense, both assemblages appear to have been allocated with raw material using similar, but not exactly equivalent, strategies. the results do

not support Amick's hypothesis that higher quality nonlocal material was preferentially allocated to the weapons assemblage as a result of high demand for weaponry.

Little difference in endscraper morphology was discerned, suggesting that if functional differences in endscrapers did exist, there are not apparent in their form. The results also suggest that endscraper and weapon blanks were likely produced using different reduction techniques. The manufacture of endscraper blanks seems similar to the Collins and Lohse's (2004) "center" and "corner" endscraper blanks produced on specialized cores. Endscraper blank production appears not to have been affiliated with weapons production, but rather a specific strategy designed to produce a particular form. Whoever was making and using endscrapers, it is clear that these tools were important enough that their production was not left to chance, and scavenging byproducts of weapons manufacture was not the ideal strategy.

Chapter 10

CONCLUSIONS

*My mother showed me how to make buckskin.
She-e dry the hide,
And when it's nice and smoo-o-th,
she scrape it—says, "Come on you take this [scraper] and
do it—don't just hit it down.
Just do it this way, scrape [pull it toward you],
and you're going to learn how to make buckskin.*

—Lillian Bullshow Hogan (Loeb and Plainfeather 2012:153)

This research used multiple lines of evidence to investigate women's use of stone tools during the Folsom period in North America, more than 10,000 years ago. Knowledge of this time period centers around production of weaponry, mobility, and large-game hunting, activities often attributed to men. Less well known are women's activities during this period, especially their participation in the procurement, production, and use of stone tools. Understanding of Paleoindian women's activities not only advances the picture of Pleistocene adaptation, but also helps remedy a long-standing male bias in Paleoindian studies.

Almost all the material remains on Folsom sites consist of stone tools or the debris from their manufacture. Little else, other than faunal material, is typically preserved in these mainly open-air sites. As a result, archaeological interpretations rest largely on these remains, especially weapons and byproducts of weapons production. Because of the assumption that men are largely responsible for stone tool manufacture, the Folsom record is unevenly understood. This research investigates whether women were likely to have participated in stone technologies and if so, in what capacity.

Reviewing the historical and ethnographic literature on women's participation in stone technologies, there are examples of women not only using stone tools, but also quarrying material, selecting, transporting, and maintaining stone tools for their own use. In essence, women have participated in all aspects of stone tool technologies. There is no reason to assume that Folsom women are invisible in the archaeological record, and it may be possible to recognize the archaeological signatures of their activities. Though the ethnographic record is incomplete, women tend to use relatively simple reduction techniques, and tend not to produce highly complex forms like those outlined by Bamforth and Finlay (2008). While this question cannot be fully addressed in this research, this pattern may be related to men's specialization in complex forms of stone tool production, which can take years of apprenticeship to master.

In particular, the ethnographic and historic literature reveals that women often produce, use, and maintain stone scrapers for working large hides. Folsom endscrapers, not unlike the hide scrapers in the ethnographic and historic records, are one of the most common tools on Folsom sites. Additionally, use-wear analysis has shown that many of these tools were used in hide production. The review suggests that not only are women's activities potentially identifiable in the Folsom record, but that endscrapers are one possible avenue for identifying these activities.

To investigate this possibility further, I examined data in the 2002 *Revised Ethnographic Atlas*, and found that there are strong associations among general subsistence strategies, latitude, and sexual division of labor. In societies that rely mostly on terrestrial hunting, women perform the bulk of the hide-working tasks. In societies where there was 46 percent or more reliance on hunting, women did the bulk of the hide-work in 100 percent of

the cases. Waguespack (2005) has found similar associations in her work on Clovis division of labor. While Paleoindians likely relied on a variety of plant and animal sources to some degree, large kill sites are suggestive that much of their diet derived from meat, especially on the Plains, where primary productivity is bound up mainly in animals. These ethnographic patterns are highly suggestive that Folsom women performed most of the hide-working activities. Hide-working activities, far from being peripheral, would have been crucial for making clothes, tools, and perhaps shelter, and thus necessary for survival.

Though there are a number of complex issues involved in sexual division of labor, including seasonally flexible gender roles and third genders, the cross-cultural data are suggestive of a broader-scale pattern. Based on embodied capital theory, I argue that critical, complex tasks and their associated toolkits are more likely to be gendered than more generalized less skill-intensive tasks. Complex tasks such as hunting, highly skilled flint-knapping, and pottery manufacture, have been shown to take up to ten years or more to master. I argue that hide-working, especially working of large hides, is also a complex task that requires years of practice to achieve proficiency. Women's activities, I argue, are not entirely unskilled, but rather some activities, like hide-working are complex and require years of practice and education in order to master. Further, the automatic motor skills that subsequently develop with years of apprenticeship make it difficult for unskilled individuals to use tools adeptly. It is these motor skills and in-depth knowledge associated with complex tasks, I argue, that contribute to the gendering of toolkits.

I use embodied capital theory (Kaplan et al. 2000) to help shed light on the underlying reasons for gendering of complex activities and their associated toolkits. Embodied capital theory states that investments in childhood result in higher productivity in

adulthood. Kaplan et al. (2000) argue that hunting is the most skill-intensive activity. This observation is borne out in qualitative and quantitative studies of hunting. Other non-subsistence activities may also be examined from an embodied capital theory perspective. Adze-making (Stout 2002) and ceramic manufacture (Crown 2001) have both been shown to be highly skilled activities and apprenticeship begins in childhood. Proficiency in these arts can take as many as ten years to master. Hide-working may also be a complex skill requiring years to master, especially larger hides that require greater processing. Historically on the Great Plains, girls begin to learn hide-work at a young age and are given miniature versions of hide-working implements. In particular, skill was required to thin bison hides so that they would be flexible, while not piercing the hide in the process. Weedman (2005) has shown that among the modern-day Konso, novice hide-workers are not as adept, producing spurred scrapers that are more likely to tear the hide. In addition, older daughters are sometimes not able to master hide-working because they are occupied with other tasks, again suggesting that hide-work is not an unskilled task that requires little practice or education.

In Folsom societies, hunting and flint-knapping would also have been highly complex tasks that would not have been easily acquired. I suggest that if weapons manufacture and hunting with projectile weapons were male-dominated tasks in Folsom times, then the time required to master those tasks would preclude men from learning other complex skill-intensive tasks like hide-working and sewing. Sexual division of labor solves the problem of educating and training individuals in critical, complex tasks that require great lengths of time and practice to become proficient. This of course does not argue for a strict sexual division of labor, but is rather a general pattern that allowed Folsom groups to adapt to a particular environment and subsistence strategy.

It is clear that women may have left archaeological residues on Folsom sites, potentially in the form of endscrapers. The challenge is then to investigate this possibility using archeological data. Binford (1983) and Carr (1984) argued that hide-working activities are often far removed from main camp activities, due to odors and unwanted debris. Endscraper distributions that overlap with weapons manufacture debris would then be considered affiliated with tool replenishment and male activities. Historic photos and paintings of Plains tribes, however, indicate that not all hide-working was conducted far from main activity areas. Hide-thinning, especially if it involved small numbers of hides, appears not to be uncommon in close proximity to shelters and main activity areas. For forager societies, where many activities could be conducted outdoors, we might expect some degree of overlapping discard of gendered tools. Processing a large number of hides, especially during the fleshing stage of bison hide processing, may have been more likely to take place at a distance from main activity areas. However, smaller scale hide-work, especially the thinning phase, which requires a stone scraper, may be more likely to occur in and around main activity areas. While the nature of discard and the stages and intensity of hide-working remain speculative, it is clear that overlapping distributions of endscrapers and debris from point manufacture do not necessarily indicate purely male activities and could represent a palimpsest of gendered activities.

The Rio Rancho Folsom site located in the Central Rio Grande Valley northwest of Albuquerque was used as a test case to determine whether endscrapers are distributed differently than other tools, especially weapons and debris from weapons manufacture. The site was one of the first large-scale excavations of a Folsom camp in North America (Judge 1973:54). First excavated from 1965 to 1967 under the direction of Frank Hibben and Gerald

Dawson, the site has been the subject of only a few reports. Three Folsom-age loci have been identified at the site: 4146, 4147/AS-2, and 4148. Locus 4146 also contains remains from later occupations. Dawson and Judge (1969) suggested that endscrapers were removed from denser areas of the loci, and hide-working may have been conducted at the peripheries of these areas. Though the site is not ideal for spatial analysis, having been excavated in 10-by-10 foot units, there is nonetheless some data that provide spatial information.

First, I identified high-density artifact areas on each of the three loci. Following Surovell and Waguespack (2007), these areas may have been associated with hearths and possible shelters as Dawson and Judge (1969) proposed. At all loci, points and preforms tended to occur near these high-density areas. While overlapping with the weapons assemblages, endscrapers and other unifaces tended to occur away from these artifact-dense areas. Nearest-neighbor and K-means analyses further confirm that weapons debris and endscrapers tend to be distributed differently. The results of the spatial analysis indicate that endscrapers were used at the peripheries of each of the loci away from the artifact-dense areas of the site, which is not incompatible with expectations for the spatial location of hide-working activities. Endscrapers also, however, occur in artifact-dense areas, which may be associated with hearths. This distribution of endscrapers near possible hearth areas is not incompatible with the photographic and historic evidence for the spatial distribution of hide-working activities. While it is possible endscrapers were for tasks other than hide-working, their spatial distribution on the Rio Rancho Folsom site is compatible with expectations for hide-working. It is possible that other factors could affect the discard pattern of endscrapers, including the stage of hide-working and the number of hides being prepared, the later potentially influences by the season of site occupation (Jodry 1999).

The raw material and morphometric examination of endscrapers and weapons from the Rio Rancho Folsom site suggests that the raw material procurement strategies differed only slightly, with both assemblages dominated by the non-local Zuni-spotted chert. Endscrapers were somewhat more likely to be made from Zuni Spotted chert than weapons, but the weapons assemblage contains higher frequencies of Valle Grande member obsidian, Chuska and Perdernal chert. Though there are differences in the make-up of the weapons and endscraper assemblages in terms of non-local raw material, the difference is not great, and could be a result of a faster rate of attrition of endscrapers. The absence of obsidian endscrapers is not remarkable for Paleoindian sites in general, and is likely related to functional suitability. In addition, both assemblages show similar proportions of non-local materials. Overall, the results suggest similar strategies of allocating raw material for both toolkits. This contradicts Amick's (1999) hypothesis that high-quality non-local materials might preferentially be allocated to weaponry in the face of high demand for hunting tools. It appears that the Folsom occupants anticipated equally the need for both hunting and scraping implements.

Reduction techniques, however, differ for the two tool types. Several endscrapers from the Rio Rancho Folsom site were made using a technique described by Collins and Lohse (2004) as "center" and "corner" endscrapers made on specialized cores. It is clear that the production of endscrapers reflects a desire for a specific form that could not be found in the byproducts of weapons manufacture. While raw material is similar for endscrapers and weapons, reduction techniques diverge. This divergence suggests the possibility that endscrapers could have been produced by women using a different reduction technique than men, though this question is difficult to answer with the data at hand. Because flakes or

finished endscrapers appear to have been transported to the site, there are few cores, precluding any identification of endscraper production areas. Future studies at other Folsom camps regarding spatial patterning of uniface retouch flakes, endscraper or core reduction could throw light on this difficult question.

One possible avenue for further understanding Folsom women's activities would be to examine other tools that women might have used, such as ultrathin bifaces. These, as Jody suggests, might have been used by women to thinly slice meat for jerking. While these tools are rare, their spatial distribution could potentially reveal information about meat processing activities in relation to hide working. In several historic Plains photos, drying meat is clearly visible in the background of the hide working scenes, often close to residences. Other tools such as graters may also have been associated with hide-working in some cases. The Kouba site included more than 300 graters and five scrapers, suggesting that graters may have been associated with scraping tasks. Spatial distribution of these tools might have cast light on the function of these tools and possibly men's and women's toolkits. Investigation of gender might also be possible at later Paleoindian sites. Blackmar (2000a) argues that Cody knives were associated with "the domestic arena" and were likely women's tools (Blackmar 2000a). She notes that while these implements are documented from Canada to Texas, few Cody sites have produced these items, and most sites only produced a single knife. Blackmar points out that most Cody sites are kill sites, which could explain the scarcity of these tools. Blackmar likens Cody knives to Folsom ultrathin bifaces, which Jodry (1998) has argued to have been women's implements. Investigation of the spatial patterning of Cody knives and their relationship to endscrapers, along with Folsom ultrathin bifaces and their relationship to

endscrapers has the potential for revealing not only intra-site patterning, perhaps around residences, but also could further understand of women's toolkits.

The incidence of needles on Paleoindian sites and Upper Paleolithic sites might also be used to investigate women's activities. Clothing manufacture, especially those made from animal hides, is often a women's task. The spatial location of sewing activities might also help in locating women on Pleistocene sites. The relationship between endscrapers, uniface retouch flakes, ultrathin bifaces, Cody knives, gravers, and needles could provide a fuller picture of women's activities possibly inside and outside of residences.

While some questions remain unanswered, it is clear there is no reason to assume that women are invisible in the Paleoindian record. The question of gendered tools and activities is significant because it is the primary means by which foragers organize activities, and helps explain how people were able to survive and adapt to social and environmental conditions. In addition, inquiry into gendered activities helps widen the archaeological lens to produce a more accurate image of the past.

APPENDIX A

Raw Materials

The following describes the geologic context of materials locally available to inhabitants of the Rio Rancho site in addition to the known non-local materials.

The Santa Fe Group refers to the Tertiary and Quaternary alluvium deposits in the Albuquerque and Chama/Espanola Basins and are today exposed throughout the Rio Grande drainages (LeTourneau 2000:481). The gravels within the Santa Group could then have been locally available to occupants of the Rio Rancho site. The gravels within the Santa Fe Group on the Llano del Albuquerque derive mainly from the west and northwest (LeTourneau 2000:490). LeTourneau suggested that a local gravel may derive from the Abiquiu Formation, which he designates Abiquiui chert. Because of the current uncertainty about the origin of this material and the difficulty in identifying it at the Rio Rancho site, Huckell and Kilby (2002:22) do not include this designation in their analysis of the Rio Rancho weaponry. Pedernal chert also occurs throughout the Rio Grande gravels south of the Jemez (LeTourneau 2000:486). In the Ceja Formation of the Santa Fe Group, obsidian, rhyolite, basalt, chert, petrified wood, quartzite, chert, and agate are available (Letourneau 2000). A bluish-gray chalcedony occurring in the gravels is locally referred to as “Rio Grande” chalcedony, which has its origins in the Pedernal chert Member of the Abiquiu Formation (Letourneau 2000:489).

Pedernal Chalcedony

Pedernal Chalcedony is an isotropic material of varying colors originating from all exposures of the Abiquiu Formation in the Jemez Mountains within four beds of white chert and white siliceous limestone (Le Tourneau 2000:484). The material is well known from

Cerro Pedernal quarries, but is extensively distributed across northern New Mexico in the Chama Basin and perhaps the San Juan Basin (Le Tourneau 2000:485). Pedernal occurs within the Santa Fe Formation as gravels (Letourneau 2000:485) and would have been locally available for the Rio Rancho inhabitants.

Chuska Chalcedony

Chuska chert, also referred to as Narbona Pass or Washington Pass chert is a distinctive transparent to translucent pinkish-orange highly lustrous isotropic material (Banks 1990). In the Albuquerque Basin, the material was called “Paleo Pink” because of its prevalence on Paleoindian sites (LeTourneau 2000:459). Chuska formed within igneous rock and occurs as “irregular nodules and veins with a Tertiary vesicular porphyritic trachybasalt” which overlies the Chuska Sandstone (LeTourneau 2000:45). Nodule size for Chuska is large (up to 30 cm). The material fluoresces green in ultra-violet light.

China Chert

China chert (Correo China, Fingerprint Chert, or China Correo Chert) has been described by Amick (1994a:129) as porcellenous white to white with black marbelled black laminations. Letourneau (2000:431) distinguished between the opaque white variety and the fingerprint variety, calling the former “San Andres Correo” and has recorded this variety of chert in the Zuni Canyon and Lookout Mountain Rim and the LeVega locality southwest of San Raphael in lenticular nodules of pieces up to several centimeters.

Zuni Spotted Chert

Zuni Spotted chert (also sometimes called Chinle Chert) derives from the Shinarump member of the Chinle Formation or the Moenkopi Formation, both Triassic in age. The material is yellowish brown with small dark inclusions. LeTourneau suggested this material

might be the same as Warren's type #1072 (1967:116, in LeTourneau 2000:442), which she proposed as deriving from the Triassic Chinle Formation. Green argued for the material deriving from an older source within the Zuni Mountains (Green 1985:73-74), and Vierra (1993:163) suggested the material comes from the Permian San Andres Formation.

Whatever, the precise location, LeTourneau (2000:442) finds that most researchers place the material within the vicinity of the Zuni Mountains, especially around Lookout Mountain, both in situ and as secondary deposits in sandstone conglomerate. In some cases, small nodules of this material are found in the Santa Fe Group gravels, west of Las Lunas and Belen and near Socorro.

Valle Grande Obsidian

No endscrapers are made of obsidian, though several projectile points, preforms, and channel flakes were identified as Valle Grande obsidian. LeTourneau (2000:501) describes this obsidian source, located in the Jemez Mountains, as the most economically important obsidian source in New Mexico. The obsidian occurs as ovate or irregular cobbles in alluvium rather than in situ contexts (LeTourneau 2000:501). The obsidian should not occur in the Santa Fe Group dated to 27 to 1.2 mya (million years ago) as the eruption of the Valle Grande (1.5 to .5 mya) occurred after the deposition of the Santa Fe Group (Le Tourneau 2000:483, 501). LeTourneau (2000:501) suggested that "limited stream power of rivers draining the Valles Caldera likely further restricted the possibility of the obsidian becoming incorporated in secondary deposits outside the caldera." Valle Grande obsidian would therefore not be locally available to Rio Rancho site inhabitants. Huckell and Kilby (2002:21) indicate that no Valle Grande member obsidian has eroded into the Rio Grande based on work by Steven Shackley.

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