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LATE PREHISTORIC TECHNOLOGY, QUARTZITE PROCUREMENT, AND
LAND USE IN THE UPPER GUNNISON BASIN, COLORADO:
VIEW FROM SITE 5GN1.2

by

Jonathan M. Peart

A thesis submitted in partial fulfillment
of the requirements for the degree

of

MASTER OF SCIENCE

in

Anthropology

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2013

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ABSTRACT

Late Prehistoric Technology, Quartzite Procurement, and
Land Use in the Upper Gunnison Basin, Colorado:
View from Site 5GN1.2

by

Jonathan M. Peart, Master of Science

Utah State University, 2013

Major Professor: Dr. Bonnie Pitblado
Department: Sociology, Social Work and Anthropology

This thesis presents the results from archaeological test excavations at site 5GN1.2. The focus of this research is to evaluate Stiger's Late Prehistoric settlement-subsistence hypothesis. According to this hypothesis, post-3000 B.P. occupations of the Upper Gunnison Basin were limited to logistically organized big-game hunting forays originating from residential camps located outside of the basin. Since Stiger's model is based on Binford's forager-collector continuum model, archaeological test implications of his hypothesis include hunter-gatherer settlement mobility, site types, feature types, artifact assemblage characteristics, and the organization of lithic technology.

Test excavations at 5GN1.2 revealed intact archaeological deposits reflecting aboriginal occupation during the Late Prehistoric between about 3000 and 1300 B.P. Late Prehistoric features include four hearths associated with abundant debitage, small-game faunal remains, burnt seeds, and lithic tools. Identified lithic tools include ground stone,

projectile point fragments, cores, and bifaces. Individual flake attribute analysis of the debitage assemblage provides evidence lithic reduction activities were dominated by bifacial reduction of local and non-local raw materials.

Archaeological evidence rules out site 5GN1.2 as a Late Prehistoric logistical big-game hunting site. Site 5GN1.2 contains all the hallmarks of a residential base camp, including constructed hearths, rock art, evidence of plant resource processing, small-game procurement, comparatively high tool diversity, high proportion of locally available tool-stone, late-stage tool manufacture, and tool maintenance debitage. Site 5GN1.2 likely served as a short-term residential base camp occupied by whole family groups during the Late Prehistoric.

The Late Prehistoric occupations of site 5GN1.2 represent a more diverse settlement-subsistence adaptation than envisioned by Stiger's culture history. Some hunter-gatherers may have occupied the UGB on long-range logistical big-game hunting forays, but at 5GN1.2 this is simply not the case. This lithic technology research project represents the first published comprehensive debitage analysis of an archaeological component at 5GN1.2 and 5GN1. These results and data can serve as a database for later archaeological research within the UGB.

PUBLIC ABSTRACT

Late Prehistoric Technology, Quartzite Procurement, and Land Use in the
Upper Gunnison Basin, Colorado: View from Site 5GN1.2

Jonathan M. Peart

This thesis presents the results from archaeological test excavations at site 5GN1.2. The focus of this research is to evaluate Stiger's Late Prehistoric settlement-subsistence hypothesis. According to Stiger, post-3000 B.P. occupations of the Upper Gunnison Basin were limited to big-game hunting forays originating from base camps located outside of the basin. Test excavations at 5GN1.2 documented archaeological deposits reflecting aboriginal occupation during the Late Prehistoric between about 3000 and 1300 years ago. Archaeological features include four hearths associated with abundant small-mammal remains, burnt plant seeds, stone tools and stone tool manufacturing debris.

Archaeological evidence rules out site 5GN1.2 as a focused Late Prehistoric big-game hunting site. Site 5GN1.2 contains all the hallmarks of a residential base camp, including constructed hearths, rock art, both plant and animal resource procurement, comparatively high tool diversity, and evidence of bifacial late-stage stone tool manufacture. Site 5GN1.2 likely served as a short-term residential base camp occupied by whole family groups during the Late Prehistoric.

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Jonathan M. Peart

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CHAPTER 1

INTRODUCTION

This thesis presents the results from archaeological test excavations at site 5GN1.2 and a detailed individual flake attribute analysis of the recovered assemblage. The goal of this research is to evaluate Stiger's (2001) hunter-gatherer settlement-subsistence hypothesis for Upper Gunnison Basin (UGB) occupations post-3000 radiocarbon years before present (B.P.). For the purposes of this thesis, I refer to this period (post-3000 B.P.) as the Late Prehistoric.

The UGB covers about 11,000 km² in the southern Rocky Mountains of Colorado and represents a high altitude (elevation ranging from 2200 to 4300 m) mid-continental interior mountainous basin (Johnston et al. 2001). Stiger (2001) suggested that at about 3000 B.P., hunter-gatherer prehistoric occupations shifted to logistically organized big-game hunting forays originating from residential bases located outside of the basin. This hypothesis suggests that environmental degradation led to the end of residential occupations within the basin and a specialized adaptation to short-term and long-range big-game hunting (Stiger 2001).

Stiger's model represents a significant departure from other archaeological interpretations of UGB prehistory (e.g., Black 1991; Reed and Metcalf 1999). Aside from Stiger's hypothesis, archaeological interpretations of the basin's culture history suggest over 10,000 years of diverse, but always mobile, prehistoric hunter-gatherer occupations (e.g., Baker et al. 1981; Black 1991; Jones 1984; Reed and Metcalf 1999). Moreover, nowhere else in the Rocky Mountains do archaeologists argue that an area comparable to

the size of the UGB and time-scale of the Late Prehistoric (nearly three millennia) are limited to simply hunter-gatherer logistical big-game hunting forays (e.g., Benedict 1999; Bender 1983; Bender and Wright 1988; Bettinger 2008; Kornfeld et al. 2009).

If Stiger's model is accurate, then the Late Prehistoric archaeological record within the UGB can provide a relevant data source applicable to a number of archaeological research questions focused on big game hunting in high elevation settings. For example, recent archaeological research focusing on logistical big game hunting prompted a series of lively debates involving economic transport modeling (e.g., Grimstead 2010, 2012; Whitaker and Carpenter 2012), and applications of Costly Signaling Theory (e.g., Broughton and Bayham 2003; Coddling and Jones 2007; Hildebrandt and McGuire 2002; McGuire and Hildebrandt 2005; McGuire et al. 2007). Additionally, UGB archaeological research could provide a test case for Grove's (2010) assertion that long range logistical mobility could reduce subsistence risk in patchy environments.

Although archaeologists have conducted numerous archaeological research programs in the basin, most of this research has focused on Paleoindian and Early Archaic sites (e.g., Andrews 2010; Cooper and Meltzer 2009; Euler and Stiger 1981; Jones 1986a; Meltzer and Cooper 2006; Pitblado and Camp 2003; Pitblado et al. 2001; Stamm et al. 2004; Stiger 2006). On the other hand, archeologists have reported on comparatively few post-3000 B.P. site components (e.g., Dial 1989; Hutchinson 1990; Peart 2011; Rossillon 1984). Contemporary views of the basin's culture history, including Stiger's hypothesis, are almost exclusively based on open-air shallow lithic

scatters (e.g., Black 1991; Reed and Metcalf 1999; Stiger 2001). Archaeological research in the basin is also hampered by the fact that quartzite raw materials often exceed over 90 percent of individual site chipped-stone assemblages (Pitblado et al. 2013). Inferring prehistoric mobility and land use patterns across time and space through an archaeological record dominated by shallow lithic scatters presents a considerable archaeological research challenge (Pitblado et al. 2013; Stiger 2001). As a result, Pitblado et al. (2013:2198) and others (e.g., Moore and Firor 2009; Reed and Metcalf 1999) noted that archaeological reconstructions of basin prehistory can be characterized as rudimentary.

Archaeological research at site 5GN1.2 is well suited to test Stiger's hypothesis. Sheltered archaeological sites are rare in the UGB, especially rockshelter sites with intact hearth features, subsistence remains and components dating to the Late Prehistoric. Furthermore, site 5GN1.2 is located within site 5GN1, a large locally significant multi-occupation quartzite procurement location utilized for thousands of years (Black 2000; Liestman 1985; Stiger 2001). Local quartzitic bedrock exposures of the Junction Creek Formation and alluvial cobbles provide an abundant local source of fine-grained quartzite raw material (Andrews 2010; Black 2000; Liestman 1985; Pitblado et al. 2013; Stiger 2001).

In July 2010, Jonathan Peart (author) and Dr. Bonnie Pitblado (principal investigator) conducted limited controlled excavations at 5GN1.2. The 2010 excavations identified four distinct subsurface hearth features containing burnt seeds, faunal remains, and a diverse artifact assemblage. Recovered artifacts include chipped-stone tools (e.g.,

bifaces, projectile point blanks, and scrapers), ground stone, and 3565 pieces of lithic debitage. Site 5GN1.2 contains a sheltered archaeological assemblage encompassing intact hearth features, rock art, ground stone and a diverse chipped-stone assemblage suggestive of prolonged hunter-gatherer residence during the Late Prehistoric (Peart 2011). These initial excavation results are difficult to reconcile with Stiger's view of the basin's culture history (2001). For instance, hunter-gatherer occupations dating to the Late Prehistoric within the UGB are not expected to contain evidence of plant processing (e.g., ground stone and burnt seeds), small-game procurement, large hearth features, or extensive use of locally available quartzite raw material in formal tool production (Stiger 2001).

As previously stated, the focus of this thesis is to evaluate implications of Stiger's model with the archaeological evidence from 5GN1.2. Stiger generated specific archaeological expectations for his hypothesis, including site types, assemblage characteristics, hunter-gatherer organization of technology and land use patterns; and those are tested in this thesis. A selected list of these expectations is included as Table 1-1. Not all of the implications listed in this table can be adequately tested through an analysis of a single site, and fully characterizing hunter-gatherer settlement-subsistence organization for the Late Prehistoric in the UGB is beyond the scope of this thesis. Nevertheless, the research presented here provides a single-site case-study evaluation of Stiger's hypothesis.

Table 1-1. Archaeological test implications of Stiger's post-3000 B.P. hypothesis.

Characteristic	Expectations
Site type	-“later occupations are present, but they are generally smaller” (Stiger 2001:11) -“used by small numbers of people” (Stiger 2001:50) -“after 3000 BP were occupying temporary hunting camps” (Stiger 2001:50)
Mobility organization	-“used by hunters residentially based outside the basin” (Stiger 2001:50) -“winter residential sites outside the Upper Gunnison Basin but continued to exploit game seasonally inside the basin” (Stiger 2001:115)
Technology organization	-“they brought lithic materials and food provisions from outside to maintain themselves until they could acquire needed Basin resources” (Stiger 2001:50) -“relatively high percentages of nonlocal raw materials” (Stiger 2001:115) -“relatively high frequencies of CCS tools” (Stiger 2001:162) -“occupied by people coming into the basin and bringing tools made with raw materials from outside areas” (Stiger 2001:163)
Features	-“They built some ephemeral structures” (Stiger 2001:50) such as “temporary sunshades or windbreaks and small-shallow fire-cracked-rock features” (115) -“amorphous stains and game drives appear only in the last 3000 years” (Stiger 2001:163)
Subsistence	-“they brought ... food provisions from outside to maintain themselves until they could acquire needed Basin resources” (Stiger 2001:50) -“Perhaps while searching for bison, they encountered sheep or deer that they took for use in camp” (Stiger 2001:50)

Stiger's hypothesis, and most recent archaeological research in the UGB and the region (e.g., Metcalf and Black 1997; Pitblado 2003; Reed and Metcalf 1999), are theoretically grounded in the forager-collector continuum developed by Binford (1980). Binford proposed a continuum of hunter-gatherer adaptive mobility strategies for coping with disparities between hunter-gatherer populations and resource distribution in both time and space. At the core of the forager-collector model are two idealized settlement-subsistence systems representing opposite ends on this continuum: foragers (low logistical and high residential mobility) and collectors (low residential and high logistical mobility). Foragers move their residential camps (whole groups) to exploit resource

patches. They collect food on a daily basis near residential camps and generally do not practice food storage (Binford 1980). In short, they bring people to the resources they exploit.

On the other end of the continuum are collectors, who send small, logistically organized, task groups to acquire resources that are brought back to residential base camps (Binford 1980). Essentially, in contrast to foragers, collectors bring resources to people and often practice resource storage. Stiger's hypothesis represents a task-specific, collector-type mobility strategy with high logistical mobility and no residential mobility within the UGB. According to this hypothesis, hunter-gatherer land use during the Late Prehistoric consisted of focused male-dominated big-game hunting long-range forays (Stiger 2001).

The basic premises and archaeological consequences of the forager-collector model are straightforward; however, hunter-gatherer behavior rarely reflects the precise definition of either the forager or collector strategy. Rather, actual behaviors reflect a combination of both strategies that vary in response to environment, season and other conditions (Binford 1980, 1990; Kelly 1983, 1992, 1995). Binford (1980) and others (e.g., Bleed 1986; Cowan 1999; Kelly 1988; Metcalf and Black 1997) generated a host of test implications based on the forager-collector continuum, including site types, archaeological site assemblages and the organization of technology.

The organization of technology generally refers to how the procurement, manufacture, maintenance and discard of stone tools were structured within the lives and adaptive choices made by hunter-gatherers (Andresfky 2008:4). In this theoretical

framework, hunter-gatherers select between alternative technological strategies to meet tool-stone needs within different environmental and settlement-subsistence contexts (Hayden et al. 1996). Archaeologists have shown that debitage analysis can effectively be used to infer the organization of technology represented within archaeological assemblages and to interpret settlement-subsistence structuring (e.g., Andrefsky 2005; Cowan 1999; Hayden et al. 1996; Patterson 1990; Prentiss 1998, 2001; Sullivan and Rozen 1985).

Individual flake attribute analysis provides the principle analytical strategy for this thesis research, although other pertinent sources of archaeological data receive consideration, including features, subsistence remains and lithic tools. This research employs multiple analytical strategies to interpret the debitage and understand the organization of technology. These include flake completeness (Prentiss 1998; Sullivan and Rozen 1985), size grades (Patterson 1990), application load typology (Andrefsky 2005), flake platforms, and dorsal scar counts (e.g., Magne 1985; Magne and Pokotylo 1981), and others. Different analytical methods provide different kinds of information about site assemblages. Archaeologists continue to improve on a host of diverse techniques, although no one particular approach is considered standard (Andrefsky 2005; Carr and Bradbury 2001). Multiple analysis methods also provide a check and balance approach to the interpretation of lithic data. For the purposes of this research project, I followed the excavation and debitage analysis methods employed by Dr. Pitblado's continuing archaeological research program in the UGB (e.g., Merriman et al. 2008; Pitblado and Camp 2003; Pitblado et al. 2001). By following these established and

thorough methods the results presented in this thesis become directly comparable with other analyzed site assemblages from the basin.

This thesis contains seven chapters. Following the introduction, Chapter 2 provides a more in-depth theoretical orientation for this thesis project including discussions of hunter-gather mobility, mountain adaptations, organization of technology and debitage analysis to provide the necessary methodological and theoretical justification for the work. Chapter 3 presents a general environmental context for the UGB and, more specifically, a context for site 5GN1.2. This context summarizes geography, modern/past climate, lithic raw materials and subsistence resources to highlight environmental constraints influencing hunter-gather land use.

Chapter 4 discusses important foundational archaeological research in the UGB followed by a summary of current views of the basin's culture history. Chapter 5 introduces site 5GN1.2, focusing on the 2010 test excavations and summarizing the project's initial findings. Debitage analysis methods and results are found within Chapter 6. The final chapter, Chapter 7, provides an evaluation of Stiger's hypothesis and research implications in light of the excavation and debitage analysis results. The last chapter also contains project conclusions and suggestions for future research.

CHAPTER 2

THEORETICAL BACKGROUND

The research presented here links archaeological excavation data, including debitage analysis results, with prehistoric hunter-gatherer land use and mobility strategies. Similar contemporary studies employ a host of related theoretical perspectives. However, Stiger's Late Prehistoric hypothesis, and nearly all of the archaeological research in the UGB, is theoretically framed within the forager-collector continuum developed by Binford (1980). As such, the forager-collector model provides the primary theoretical framework for this thesis project. This chapter discusses three essential and interrelated theoretical research domains relevant for this research: hunter-gatherer mobility, mountain adaptations and the organization of technology. This chapter introduces major trends within these theoretical perspectives as they pertain to the research goals of this thesis.

Hunter-gatherer Mobility

Archaeologists consider mobility, the structure and form of settlement movement, as one of the distinguishing characteristics of hunter-gatherers (e.g., Bettinger and Baumhoff 1982; Binford 1980; Brantingham 2006; Kelly 1983, 1992, 1995). Ethnographic research shows considerable variation in how far and how often hunter-gatherers move (Kelly 1983, 1995). As is the case with most aspects of human behavior, developing meaningful typologies for mobility remains an important anthropological

research issue (e.g., Brantingham 2006; Kelly 1995; Marlowe 2005; Perreault and Brantingham 2011).

Early mobility models employed typologies based on an ordinal measure of mobility, recognizing types, such as fully nomadic, semi-nomadic, semi-sedentary, and fully sedentary (Beardsley et al. 1955; Murdock 1967). Binford's "Willow Smoke and Dogs' Tails: Hunter-Gatherer Settlement Systems and Archaeological Site Formation" improved on these early models when he devised the now-familiar forager-collector continuum. This model emphasizes mobility form, rather than simply the degree of mobility. Binford argued that short-term and seasonal mobility among hunter-gatherers correlates with environmental structure and especially temporal and spatial resource distribution. He described a continuum with two mobility types defining opposite ends: residential (whole group relocation to new base camps) and logistical mobility (movement of organized task groups on short-term excursions from base camps). The model identified two general settlement-subsistence systems based on mobility: foragers (low logistical and high residential mobility) and collectors (low residential and high logistical mobility). Binford argued that the forager strategy represents an adaptation to landscapes with homogeneous resource distribution. Whereas, collector strategies are associated with environments with spatially or temporally irregular distributions of subsistence resources, typically those associated with seasonal, middle latitudes.

The forager-collector continuum describes idealized and relatively short-term mobility patterns keyed to generalized environmental conditions (Binford 1980). Kelly (1992) and others (e.g., Bettinger 2001; Bettinger and Baumhoff 1982; Binford 1990;

Grove 2009) argued that long-term mobility patterns (multiple year), as well as cultural factors such as trade, territoriality, division of labor and demography also influence mobility adaptations and the formation of archaeological assemblages. Further, actual behaviors of hunter-gathers rarely if ever adhere to the precise definitions of either logistical or residential mobility, and often reflect a combination of several behavioral options available within this continuum (Binford 1980).

Despite its simplification of hunter-gatherer decision-making, the forager-collector model contributes a useful heuristic device for comparison across regions, environments and across time. Within the UGB, nearly all prehistoric archaeological research following the 1980s employs the forager-collector model (e.g., Metcalf and Black 1997; Pitblado 2003; Reed and Metcalf 1999; Stiger 2001). The remaining discussion is structured around these central concepts established by Binford (1980) as they relate to site types, mountain adaptations and the organization of technology.

Binford's (1980) forager-collector model specified archaeological expectations of hunter-gatherer behavior in terms of site types and assemblage characteristics, promoting applications of the model in a wide range of archaeological and ethnographic cases. Binford recognized two basic site types associated with foragers: residential bases and locations. Residential bases serve as the "hub of subsistence activities" and the place where most resource processing, tool manufacturing and related activities take place (Binford 1980:9). Location sites are where hunter-gatherers extract resources from the environment (Binford 1980). Collector-strategy site types include these two essential types, residential bases and locations, and three additional site types resulting from the

logistical nature of their provisioning strategy (Binford 1980:10). These additional site types include field camp (temporary camp away from the residential base), stations (special purpose information gathering posts), and caches.

Metcalf and Black (1997) tailored Binford's (1980) forager-collector site types to reflect the environmental conditions and site expectations for the southern Rocky Mountains. A list of these site types and archaeological expectations are provided in Table 2-1. Normative site type definitions must be invoked with caution when interpreting the archaeological record and land use patterns. Factors used to assign site type, such as tool diversity, artifact density, and site size, are undoubtedly influenced by more factors than simply site type or mobility pattern. Site preservation, multi-occupation assemblages, and cultural factors, such as occupation length/span or occupation intensity, can blur these site types, rendering behavioral interpretations questionable (e.g., Cannon et al. 2004; Surovell 2009). Nevertheless, site type definitions provide a common vocabulary in the discussion of hunter-gatherer land use and mobility patterns by contributing a useful conceptual device.

Stiger's hypothesis specifically postulated a collector-type mobility pattern where big-game hunters occupied only station and location sites in the UGB during the Late Prehistoric. According to Stiger (2001), these site types should reflect short-term occupations made by small groups of hunters (Stiger 2001). Sites should not contain evidence of structures, long term occupations, small-game procurement, floral resource processing or intensive tool manufacture.

Table 2-1. Site types and archaeological expectations.

Site Type	Assemblage Expectations
Residential Base	<ul style="list-style-type: none"> -Structures, hearths, and storage facilities -Faunal/floral subsistence remains -Patterned refuse disposal -High tool assemblage diversity with task-specific work areas -Late-stage tool manufacture and tool maintenance debitage
Winter occupations	<ul style="list-style-type: none"> -Substantial structural remains with interior hearths and storage -Accumulated trash middens
Field Camps	<ul style="list-style-type: none"> -Hearths and structures present but no storage facilities -Faunal/floral subsistence remains -Low to medium tool diversity -Late-stage tool manufacture and tool maintenance debitage -Little secondary refuse
Locations	<ul style="list-style-type: none"> -Lack of domestic features -Low tool diversity and greater tool specificity -Facilities indicative of function (game drives, ground stone)
Lithic procurement	<ul style="list-style-type: none"> -Dense chipped-stone accumulations with high incidence of debris and core reduction flakes dominated by local raw materials -Low tool diversity
Stations	<ul style="list-style-type: none"> -Selected site locations with extensive view sheds -Minimal assemblages (low tool diversity and density) -Debitage either absent or casual knapping in late-stage manufacture or maintenance -Subsistence resources (if present) represent immediate consumption

Note: Adapted from Metcalf and Black (1997).

Mountain Adaptations

The UGB is a high-altitude southern Rocky Mountain basin with vegetation zones ranging from Foothills-Semidesert Shrub on the valley floor through Alpine communities along the mountain peaks (Johnston et al. 2001). The enclosed nature of the basin coupled with its relatively small size produces many economically productive floral and faunal resources varied by elevation and season within relatively short distances (Andrews 2010; Pitblado et al. 2013). As such, archaeologists typically frame

interpretations of UGB prehistory within hunter-gatherer mountain adaptations (e.g., Andrews 2010; Black 1991; Pitblado 2003; Schroeder 1953; Stiger 2001).

Two main perspectives guide most archaeological interpretations of hunter-gatherer mountain adaptations. The first body of theory emphasizes that high elevation settings are comparatively economic resource poor and that occupations incur higher energy costs and are risky (Aldenderfer 2006; Benedict 1992; Hevly 1983; Winter 1983). Within mountain settings, hypoxia begins to take its first substantive effect above about 2500 m (8200 ft); both temperature and mean biotic productivity are reduced, caloric requirements increase, and the environment becomes more variable (Aldenderfer 2006; Andrews 2010; Thomas 2012; Winter 1983). From this perspective, some sort of impetus (e.g., environmental degradation or demography) is required to force people to assume the risks and higher workload of mountain settings (Aldenderfer 2006; Benedict and Olsen 1978; Winter 1983).

Husted (2002) wrote that early archaeological research viewed mountain settings under this first perspective where mountains were considered marginal resource areas. This is particularly true of early interpretations of UGB prehistory (e.g., Schroeder 1953) and more recently Stiger's interpretation of the Late Prehistoric (2001). Stiger's (2001) Late Prehistoric hypothesis can be characterized as a task-specific logistical model of land use driven by the availability of big-game. Archaeologists working under these assumptions believed that long-term or substantial occupations of the southern Rocky Mountains would increase when the surrounding regions experienced environmental stress (Benedict and Olsen 1978).

Benedict and Olsen (1978) tested this hypothesis by reviewing radiocarbon-dated archaeological components on the Plains and in adjacent higher elevation regions, including the southern Rocky Mountains and Great Basin. They constructed population curves based on radiocarbon-dated archaeological components that span the Altithermal (Antevs 1948, 1954) and generalized within 500-year (rcybp) intervals. Benedict and Olsen postulated that the Altithermal consisted of two shorter drought periods (about 7000 to 6500 B.P. and 6000 to 5500 B.P.) and by comparing regional population curves with this climatic cycle, they concluded that arid regions, including the Great Basin, experienced reduced population during these Altithermal droughts. At the same time, surrounding regions less affected by drought served as refugia, such as the southern Rocky Mountains and the Pacific Northwest (Benedict 1979; Benedict and Olsen 1978).

Subsequent archaeological (e.g., Bender and Wright 1988; Sheehan 1995) and paleoenvironmental research (e.g., Meltzer 1995, 1999) cast some doubt on the Altithermal Refugium model. Nevertheless, most archaeologists working in the UGB after the 1980s, particularly for the Curecanti and Mount Emmons Projects, invoked the model to interpret the marked increase in early-to-middle Archaic radiocarbon-dated components (e.g., Baker et al. 1981; Jones 1986a, 1986b; Stiger 1993, 2001). This perspective continues to play an important role in more recent interpretations of regional culture history (see Stiger 2001; Reed and Metcalf 1999). For example, Stiger's (2001) version of UGB culture history argues that following the more favorable conditions of the middle Archaic, conditions substantially worsened to the point that long-term occupations in the UGB became unsustainable.

The second perspective focuses on the idea that while mountain settings eliminate some foraging opportunities, it fosters others (Thomas 2012; Wright et al. 1980). For example, the geographic and environmental variability of the southern Rocky Mountains yields seasonally productive habitats and importantly forage for large ungulates (Andrews 2010; Black 1991). In some mountain settings, as Wright et al. (1980) observed, the local abundance of plant resources fluctuates by elevation and time of year such that higher elevation plant communities become available when lower elevation resources fall out of season. Under this perspective, archaeologists view mountain settings as integral rather than marginal components to regional prehistoric land use (e.g., Bender and Wright 1988). Some mountain environments possibly even served as a distinct cultural homeland apart from surrounding lowland traditions (Black 1991).

Archaeological research in mountain settings continues to document considerable variation in site types, land use patterns, subsistence economies and other hunter-gather activities at higher altitude, including extensive lithic quarry sites (e.g., Bamforth 2006), large game drive systems (e.g., Benedict 1996; Hutchinson 1990), and large residential sites (e.g., Andrews 2010; Bettinger 1991; Metcalf and Black 1991; Morgan et al. 2012; Thomas 1982). The UGB, in particular, contains possible Folsom residential structures (Stiger 2006), a cribbed log Archaic structure (Euler and Stiger 1981), Archaic structures constructed with poles and adobe (Euler and Stiger 1981; Stiger 1981), extensive game drive systems (Hutchinson 1990), large lithic procurement locations (e.g., Liestman 1985) and other sites that suggest a rich and diverse cultural history.

To further illustrate this point, Pitblado (2003) conducted an interregional comparison of Late Paleoindian projectile point technology sampled from the southern Rocky Mountains, eastern Great Basin, southwestern Great Plains, and Colorado Plateau. Through an investigation of the organization of technology, Pitblado (2003) observed at least three distinctive patterns in the southern Rocky Mountain projectile point technology during the Late Paleoindian. Based on these patterns, Pitblado concluded the southern Rockies supported at three distinct land use adaptations, including year-round, seasonal/short-term, and sporadic forays (Pitblado 2003:235). The adaptive variability identified by Pitblado (2003) during the relatively temporally confined Late Paleoindian in the southern Rocky Mountains suggests land use patterns may have dynamically fluctuated throughout prehistory.

Organization of Lithic Technology

The organization of lithic technology generally refers to a body of archaeological theory that investigates how the procurement, manufacture and maintenance (e.g., tools use life cycle) of lithic technology are structured within the lives and adaptive choices of hunter-gatherers (Andrefsky 2008:4). Lithic procurement is a logical starting point for an introduction to the organization of technology as investigated here, because site 5GN1 is a lithic procurement site. Additionally, all technological decisions are constrained by the decisions made by hunter-gatherers at procurement sites (Beck 2008; Beck et al. 2002; Wilson 2007).

At 5GN1 quartzite exposures of the Junction Creek Formation and secondary cobbles provide an abundant local source of fine-grained quartzite (Andrews 2010; Black

2000; Pitblado et al. 2013; Stiger 2001). Liestman (1985) and others (e.g., Stiger 2001) describe these quartzite raw materials at 5GN1 as medium to high quality. More generally, the UGB contains numerous other quartzite raw material sources as well as cryptocrystalline-silicate (CCS), basalt and some obsidian sources (Black 2000; Liestman 1985; Pitblado et al. 2008, 2013).

Ethnographic and archaeological research document considerable variation in how hunter-gatherers procured raw lithic materials (e.g., Bamforth 2006; Binford 1979; Gould 1978). Typically, archaeologists view lithic procurement along a continuum with embedded strategies (low cost) on one end and direct procurement (high cost) on the opposite end. Embedded procurement represents a minimal energy investment strategy where hunter-gatherers acquired lithic material during trips made for other purposes including trade through unplanned encounters (Bamforth 2006; Binford 1979; Smith et al. 2012). Embedded strategies, also termed gradual replacement, are best suited for wide-ranging mobile populations living in regions with adequate toolstone sources (Thomas 2012).

Direct procurement strategies incur an independent cost to acquire lithic resources (Bamforth 2006). For example, lithic materials often do not conveniently occur near subsistence resources and lithic procurement can require adjustments to settlement locations, dedicated procurement trips or even formal planned exchange (e.g., Gould 1978; Smith et al. 2012). Binford described direct procurement strategies as hunter-gatherers gearing up with toolstone that reflects planning (Binford 1980; Thomas 2012). Gearing up ensures that sufficient high-quality toolstone will be available at some

anticipated future time (Thomas 2012). Highly mobile foragers are expected to employ direct procurement lithic procurement strategies in regions with inadequate or scattered toolstone sources.

Direct procurement can also include quarrying (Burton 1984; Findlow and Bolognese 1984; Holmes 1890, 1891, 1894, 1919; Jenney 1891). Sometimes suitable lithic raw materials are not readily available on the ground surface and require time consuming quarrying, as is the case at Windy Ridge in north-central Colorado. At Windy Ridge, Bamforth (2006) argued prehistoric groups acquired quartzite raw materials by first quarrying through sandstone.

Activities at lithic procurement sites can include material extraction, quality testing, initial reduction, preparation for transport (field processing), and even formal tool manufacture and use (Burke 2007; Jones et al. 2003). Not all procurement sites retain evidence of all or any of these activities. For example, lithic material might be removed as unworked surface cobbles, leaving no trace of lithic reduction or quarrying (Ross et al. 2003). Three primary factors - lithic abundance/quality, hunter-gatherer mobility and technological considerations - primarily influence hunter-gatherer decisions at lithic procurement sites (e.g., Andrefsky 1994a,b; Bamforth 1986, 2006; Beck et al. 2002; Kamp and Whittaker 1986).

High quality raw material refers to stone that permits controllable flintknapping, maintains a consistent sharp edge, and occurs in large enough nodules to produce tools (e.g., Andrefsky 1994a,b; Ricklis and Cox 1993). Kamp and Whittaker (1986) investigated prehistoric reduction activities at chalcedony procurement sites near Lake

Mead, Nevada, to evaluate the relationship between tool-stone quality and the level of reduction at procurement sites. They concluded that hunter-gatherers chose to spend more time and effort reducing higher quality lithic materials at procurement sites. However, procurement site assemblages also indicated that hunter-gatherers minimally reduced the highest quality materials, typically only removing cortex, before it was transported to residential sites (Kamp and Whittaker 1986).

Metcalfe and Barlow (1992) expanded the procurement site expectations generated by Kamp and Whittaker (1986). Metcalfe and Barlow's research focused on the economic tradeoffs, derived through principles of evolutionary ecology, between subsistence resource field processing and transport among central place foragers. Field processing is the act of dividing a resource package into components and selecting only those components with high-utility value (Metcalfe and Barlow 1992). Lithic reduction represents a means of field processing raw material that both reduces weight and increases the utility of transported products.

Metcalfe and Barlow (1992) generated a mathematical formula that considered two primary factors in structuring optimal field processing behavior at procurement sites. The first variable is transport distance. The farther the transport distance between procurement site and consumer site, the more field processing is expected. The second variable is the change in utility of a resource through field processing. The greater this change, taking into account time costs, the more field processing is expected at procurement sites (Metcalfe and Barlow 1992).

Andrefsky (1994a) tested the hypothesis that raw material abundance and quality condition the organization of technology. Andrefsky (1994a) studied ethnographic lithic procurement and archaeological data from Australia and three regions in North America. He observed that hunter-gatherers generally employed low quality raw materials for informal tool production regardless of raw material abundance. Conversely, groups used high quality materials to produce formal tools, and when those materials were highly abundant they also produced informal tools. Andrefsky's results are summarized in Table 2-2.

Table 2-2. Raw-material availability, quality and tool production.

		Lithic Quality	
		High	Low
Lithic Abundance	High	Formal and informal tool production	Primarily informal tool production
	Low	Primarily formal tool production	Primarily informal tool production

Note: Adapted from Andrefsky (1994a:30).

Site 5GN1.2 is adjacent to extensive sources of fine-grained quartzite raw material in both bedrock and cobble forms. These sources provided abundant tool-stone for prehistoric site occupants. Liestman (1985) and others (e.g., Andrews 2010; Stiger 2001) have observed that these fine-grained sources, especially Junction Creek quartzite,

represent medium-to-high quality material suitable for manufacturing a broad array of tool types. Following Andrefsky (1994a), 5GN1.2 should contain evidence for both formal and informal tool manufacture, because raw material is both abundant and of sufficient quality. Additionally, if prehistoric site occupants are highly mobile (either residential or logistical), then they are expected to field process raw quartzite material at 5GN1.2 by producing reduced blanks and tools, as opposed to large amorphous cores. According to Stiger's hypothesis, Late Prehistoric hunter-gatherers at 5GN1.2 are also expected to maintain a curated toolkit made of mainly non-local materials.

Technological Considerations

If the organization of technology is an adaptation to mobility and environmental context, then what factors influenced the prehistoric acquisition, mode of reduction, tool form, and maintenance of lithic technology? At the most basic level, hunter-gatherers employ two primary technological design strategies. These strategies include curated and expedient technologies. Generally, curated technologies refer to transported tools that are manufactured in anticipation of use, are maintained, multifunctional and recycled (e.g., Bamforth 1986; Binford 1979; Nelson 1991). On the other hand, expedient tools are produced when needed or through minimal time and energy investment in manufacture (Gould 1980; Nelson 1991).

Nelson (1991) differentiated two categories of expedient tools. The first type reflects a minimal technological investment for planned tasks, where the tools are used for only a short period of time and discarded at the activity locale. The second type, called opportunistic expedient tools, represents an unplanned technological response to

unanticipated tasks (Nelson 1991). The distinction here may be extremely difficult to recognize based on artifact morphology alone (Bousman 1993). But in both cases, expedient-based technology minimizes production time, creates tools with a short-expected use life and generally requires abundant sources of raw material (Bousman 1993; Nelson 1991).

In this theoretical framework, hunter-gatherers select between alternative technological strategies to meet tool-stone needs within differing contexts. Archaeologists commonly approach the organization of technology through identifying tool-production trajectories (e.g., Cowan 1999; Hayden et al. 1996). The tool-production trajectory approach is particularly important when the culture history is poorly understood (e.g., Cowan 1999; Shott 1986), as is the case with the Late Prehistoric in the UGB. For the purposes of this research, three common and archaeologically differentiable tool-production trajectories - expedient core-flake, portable long-use and the biface trajectory – are discussed and evaluated. Each trajectory refers to a specific set of tool production techniques, goals and tool types that exhibit different economic costs and benefits (Hayden et al. 1996).

Expedient Core-Flake Trajectory

For hunter-gatherers who employ the expedient core-flake, also called amorphous or unpatterned, reduction trajectory, the main technological objective is the production of simple flake edges and retouched flake tools (Bousman 1993; Cowan 1999). Expedient flake technology requires a minimal time investment, thereby emphasizing quicker tool production time (Bleed 1986). Core-flake reduction is represented by irregular cores

without patterned flake removal, a high occurrence of larger and thicker flakes, utilized flakes, and simple retouch flake tools, among other characteristics (Hayden et al. 1996). Flake tools have a short expected use life compared to formal tools such as bifaces and places fewer demands on material quality. As such, hunter-gatherers typically produce expedient flake tools as needed and abandon them at use locales.

Compared to formal tools, simple flake tool production wastes raw material and requires readily available stone (Bousman 1993; Cowan 1999; Johnson 1986). Core-flake strategies are expected at more sedentary sites, where lithic raw material can be stored, or near sources of lithic raw material (Bleed 1986; Bousman 1993; Cowan 1999; Hayden et al. 1996).

Portable Long-use Trajectory

The goal of the portable long-use strategy, based on Kuhn's (1994) mobile toolkit model, is for highly mobile hunter-gatherers to carry a mobile toolkit that maximizes tool utility (working edges) and minimizes transport costs (tool weight). Kuhn (1994) defined mobile toolkits as those artifacts that are carried by mobile individuals most or all of the time. Kuhn developed a formal model to investigate the technological tradeoffs within mobile toolkits. In short, the model addresses the issue of whether it is more economically efficient for mobile toolkits to contain a few cores or many small flake tools.

Kuhn's (1994) model generated two primary conclusions. First, efficient mobile toolkits should not include cores. Surovell (2003) explained that core reduction in all circumstances produces some waste. Therefore, to maximize transport efficiency mobile

hunter-gatherers will always carry finished tools or flake tool blanks. Second, Kuhn (1994) concluded that the most efficient mobile toolkit will consist of many small flake tools that are approximately 1.5 times the minimum usable length. Following these conclusions, mobile hunter-gatherers are expected to produce tools and tool blanks at or near raw material sources and to not transport cores.

Hunter-gatherers employing the portable long-use strategy carry specialized flake tools as an adaptation to highly mobile land use strategies. These small flake tools should be made of the most durable materials, so they last as long as possible (Hayden et al. 1996). Non-local flake tools within mobile tool kits will display extensive use-wear and retouch.

Biface Trajectory

Bifacial reduction involves the regular flake removal from two alternative faces to create a single edge around a core (Jennings et al. 2010; Kelly 1988). This single edge serves as the platform from which flakes are progressively removed (Jennings et al. 2010). The term “bifacial tools” as used here refers to relatively large, bifacially reduced tools that are not projectile points, drills or other small, often bifacially reduced tools (Hayden et al. 1996). Archaeologists typically view the production of a biface as a series of stages or as a continuum that begins with a blank and ends with a finished product (e.g., Andrefsky 2005; Callahan 1979). The technological stages that a blank must undergo to be manufactured into a biface are referred to as the bifacial reduction sequence. Each progressive stage of the bifacial reduction sequence, except the initial stage, depends on the previous stages having been accomplished (Callahan 1979).

Therefore, the production of a biface requires the knapper to employ a planned strategy and often employs specialized tools (e.g., hard hammer, soft hammer, pressure flakers) and methods to produce a final product with preferred features (Callahan 1979).

Although archaeologists do not agree on the number of bifacial reduction stages, the necessary sequential tasks that are included in each stage are essentially identical (Andrefsky 2005). Even if prehistoric knappers did not conceptualize bifacial reduction as stages identical to lithic analyst's interpretations, bifacial reduction stages presents a useful tool for lithic analysts (Andrefsky 2005; Flenniken 1978). For example, stage-based typologies can be used to indicate where in the reduction sequence a biface was rejected due to internal flaws in the raw material or mistakes in knapping. The presence or absence of stages of reduction in an assemblage provides an indication of the length of the manufacturing trajectory at a site (Andrefsky 2005). These data, along with raw material sourcing, can lead to inferences of whether the sequence was partially accomplished at the raw material source, finished at a particular site, or completed in its entirety at the source, at a lithic workshop, at a base camp, or some combination (Kotcho 2009). This in turn can lead to inferences concerning the organization of technology, site function and settlement-subsistence structure.

Andrefsky (2005) describes five stages within the bifacial reduction sequence based largely on Callahan's (1979) and Whittaker's (1994) models. Stage 1 is represented by a large flake blank, comprising an irregularly shaped spall or cobble with a high probability of cortical surfaces. In Stage 2, bifacial reduction of the blank begins by removing flakes around the block of material to form a rudimentary bifacial shape also

called an edged biface. During Stage 3, knappers remove large flakes to at least the center of the biface. By this point, most of the cortical material is removed and the biface appears relatively flat in cross-section and uniform in shape. Stage 4 represents a biface tool blank. Specific forms of bifacial implements are produced during Stage 5, often by pressure flaking, and can include preparation for hafting or serrating edges, among other final treatments (Andrefsky 2005).

Bifacial reduction requires comparatively higher quality raw material, more time investment in manufacturing and greater knapping skills than simple flake-tool production (Cowan 1999; Kelly 1988). Bifacial tools can function as cores (source of flake edges), as long use life tools and can be resharpened or reshaped into various forms relatively easily with minimal material waste (Cowan 1999; Kelly 1988). The biface trajectory emphasizes increased use life, increased effectiveness, and increased production volume design goals described by Bleed (1986). Highly mobile land use strategies constrain the amount of tool-stone that can be carried and increases the consequences of technological failure; therefore, highly mobile land use systems are expected to employ the biface strategy (Hayden et al. 1996).

Debitage Analysis

The purpose of this thesis is to use an individual flake attribute analysis to test Stiger's interpretation of the Late Prehistoric. Debitage is among the most ubiquitous artifact type identified in hunter-gatherer assemblages and represents all non-tool lithic material generated through lithic reduction, tool production/repair and tool use (Andrefsky 2005; Cotterell and Kamminga 1979; Shott 1994). The interpretive value of

debitage for understanding the organization of technology is inherent in the waydebitage is deposited in the archaeological record (Surovell 2009). While tools used by hunter-gatherers are often made, utilized, repaired and discarded at different points on the landscape, mostdebitage is deposited at the time of lithic reduction (Bradbury and Carr 1999; Magne 1985; Surovell 2009). Individual flakes retain attributes that provide a record of a discrete point in the lithic reduction process. For example, successive individual flakes produced through the bifacial reduction trajectory retain unique and identifiable characteristics often discernible by reduction stage. Generally, as bifacial reduction proceeds from blank to finished forms, the amount of cortex on the dorsal surface decreases, dorsal flake scars increase in numbers, platform preparation increases and flakes become thinner and smaller (Andrefsky 2005).

Numerousdebitage analysis studies focus on identifying robust flake attribute patterns to discern tool-production trajectories and stages of reduction (e.g., Ahler 1989; Crabtree 1972; Magne 1985; Magne and Pokotylo 1981; Patterson 1990; Prentiss 1998, 2001; Shott 1994; Sullivan and Rozen 1985). Contemporary studies advocate a host of analytical methods and interpretive techniques, although no one method or set of methods is considered essential or standard (Andrefsky 2005; Carr and Bradbury 2001; Odell 1980, 2004). This thesis research employs multiple analytical strategies to analyze and interpret thedebitage assemblage recovered from site 5GN1.2. Multiple methods of analysis provide a balanced approach to the interpretation of lithicdebitage data.

CHAPTER 3

ENVIRONMENTAL CONTEXT

This chapter presents an environmental context of the Upper Gunnison Basin (UGB) important for understanding the ecological conditions and resources available for prehistoric hunter-gatherers during the Late Prehistoric. The UGB is located within the southern Rocky Mountains of southwestern Colorado (Figure 3-1). The geographic extent of the UGB adopted in this thesis follows the hydrological definition used by ecologists (e.g., Johnston et al. 2001) and borrowed by archaeologists (e.g., Andrews 2010; Stiger 2001). The basin includes over 11,000 km² (2.5 million acres) of land, covering about four percent of the state of Colorado, including most of Gunnison County and portions of Hinsdale and Saguache Counties. Elevation in the UGB ranges from about 2300 m (7500 ft) on the west side of the basin along the Gunnison River up to several mountain peaks soaring over 4250 m (14,000 ft) along the basin rim. The UGB is surrounded by high elevation (at least 3050 m or 10,000 ft) mountainous terrain, except for a narrow corridor entering the basin from the west through the gorge of the Black Canyon of the Gunnison. Prominent mountain ranges frame the basin, including the West Elk and Elk Mountains (north), Sawatch Range (east), La Garita Mountains (southeast), and the San Juans (south).

The enclosed nature of the UGB limits lower elevation adapted vegetation and animal species, culminating in unique biotic diversity (Armstrong 1972; Emslie 1986), as well as potentially distinctive aboriginal adaptations and culture history (e.g., Black 1991; Stiger 2001). Species such as *Pinus edulis* (pinyon pine) and *Fraxinus* spp. (ash) are rare

in the UGB, yet these species frequently occur in the surrounding region within similar elevation zones, climates and habitats (Johnston et al. 2001; Stiger 2001).

Site 5GN1.2 is located less than a kilometer from the historic channel of the Gunnison River, currently covered by the Blue Mesa Reservoir. The Gunnison River drains the UGB through the Black Canyon of the Gunnison. During the 1960s and 1970s,

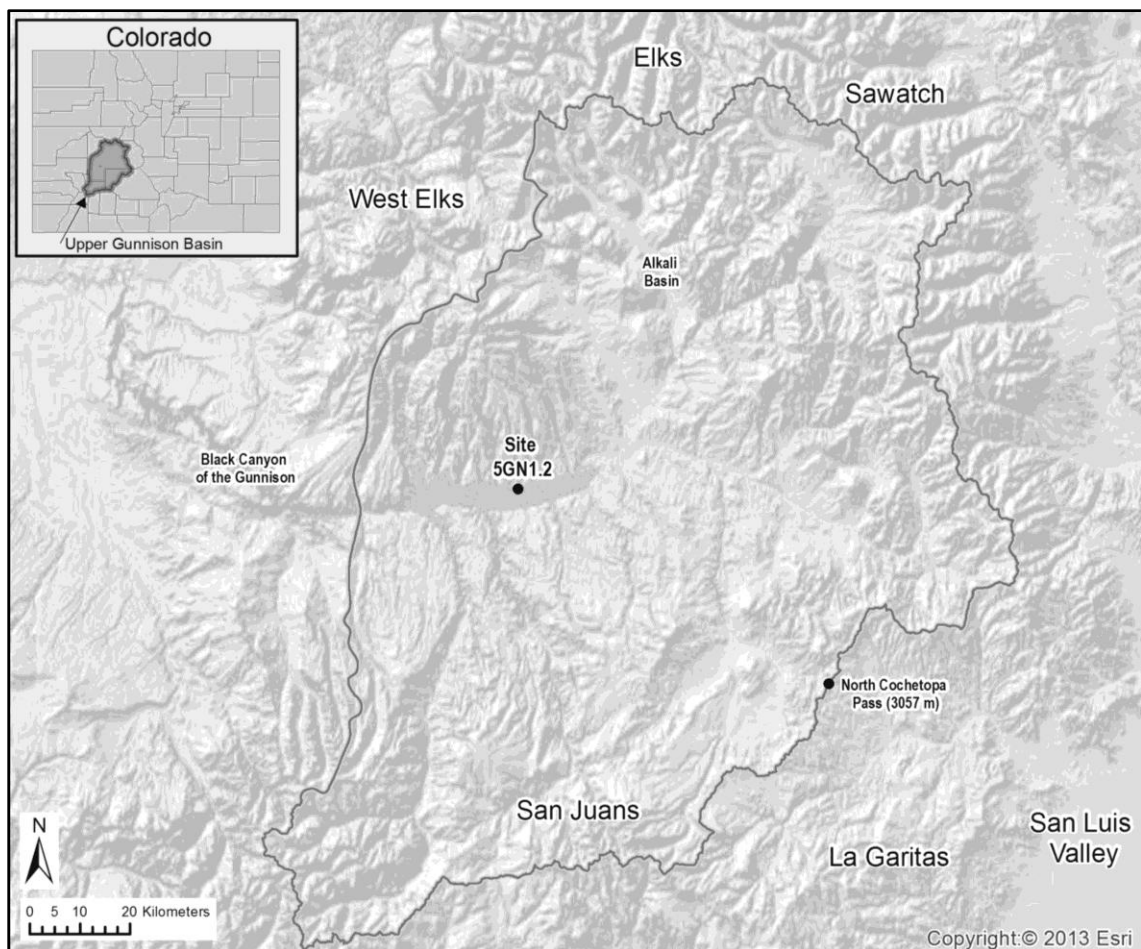


Figure 3-1. Upper Gunnison Basin location map showing site 5GN1, prominent mountain ranges, and the Alkali Basin.

the Bureau of Reclamation constructed three major dams (Blue Mesa, Morrow and Crystal dams) on the Gunnison River as part of the Curecanti Project. These dams backed up nearly 65 km (40 miles) of the Gunnison River, mainly within the UGB. The Blue Mesa Reservoir measures over 32 km (20 miles) long with 154.5 km (96 miles) of shoreline and when full contains over 1.16 km³ (940,000 acre ft) of water (Zaenger 2009). These reservoirs give a false impression of the landscape, by filling in deep canyons and lower parkland areas along the Gunnison River (Stiger 1980; Woodbury et al. 1962).

Prior to the construction of these dams, archaeologists conducted a series of surface archaeological inventories within the proposed reservoirs and recorded relatively few archaeological sites (e.g., Breternitz 1974; Buckles 1964; Lister 1962). Subsequent research adhering to more rigorous archaeological survey and excavation standards continues to document numerous sites in more upland environments (e.g., Baker 1980; Baker et al. 1981) and notably along these reservoir shorelines (e.g., Jones 1986a,b; Peart 2011; Stiger 1980). As a result, archaeological reconstructions of the basin's prehistory are biased towards upland occupations away from the resource-rich riverine and parkland areas surrounding the former Gunnison River channel.

Environment and Climate

Numerous published paleoenvironmental data sources are available for the UGB and the surrounding region, including glacial sequences in the San Juan Mountains (Pierce 2003), pollen and macrobotanical columns from the UGB and San Juan Mountains (Briles et al. 2012; Carrara et al. 1991; Fall 1997; Marksgraf and Scott 1981;

Petersen 1988), tree ring studies (e.g. Woodhouse 2003) and a pack-rat midden macrobotanical study (Emslie et al. 2005). Pollen core and plant macrofossil sequences documented by Fall (1997) provide the highest resolution published source of Holocene-aged past environmental data for the UGB (Reed and Metcalf 1999). Fall (1997) compiled pollen and plant macrofossil data from eight sedimentary basins on the west slope of the southern Colorado Rocky Mountains. By tracking the extent of the largely moisture-controlled lower-timberline and temperature-controlled upper-timberline, Fall (1997) identified broad-scale past climatic patterns for the region beginning with the terminal Pleistocene.

Topographic variability, as well as other factors, including prevailing wind direction and especially overlapping rain shadows produces highly variable localized diachronic weather patterns throughout the UGB (Reed and Metcalf 1999). Accordingly, the results from one location or paleoenvironmental data source may not seamlessly correlate with data collected in other areas. For the purposes of this thesis, this section discusses a generalized paleoclimatic model for the study area focused on the last 3000 B.P. This discussion emphasizes the fine-grained pollen study results reported by Fall (1997) and pack-rat midden research conducted by Emslie et al. (2005). These two sources of environmental data provide the most applicable data available in the UGB as sample locations are nearest site 5GN1.2 and both span the Late Prehistoric.

Of the eight sample locations described by Fall (1997), the Alkali Basin I and II samples were collected at the lowest elevation (2750 m [9000 ft]) within the UGB and about 50 km from site 5GN1 (Figure 3-1). Several of the pack-rat middens sampled by

Emslie et al. (2005) are located within about 10 km of site 5GN1.2 (Figure 3-2). The findings of these two studies (Emslie et al. 2005; Fall 1997) are summarized in Table 3-1 and provide a general broad-scale model for the past environment and climate of the UGB. Pollen and pack-rat paleoenvironmental studies provide fundamentally different sources of data. Pollen studies recover and interpret a near continuous record of pollen rain representing surface vegetation within both the local and regional environment (Kneller 2009). Conversely, pack-rat middens provide an episodic record of localized vegetation (Wells 1976).

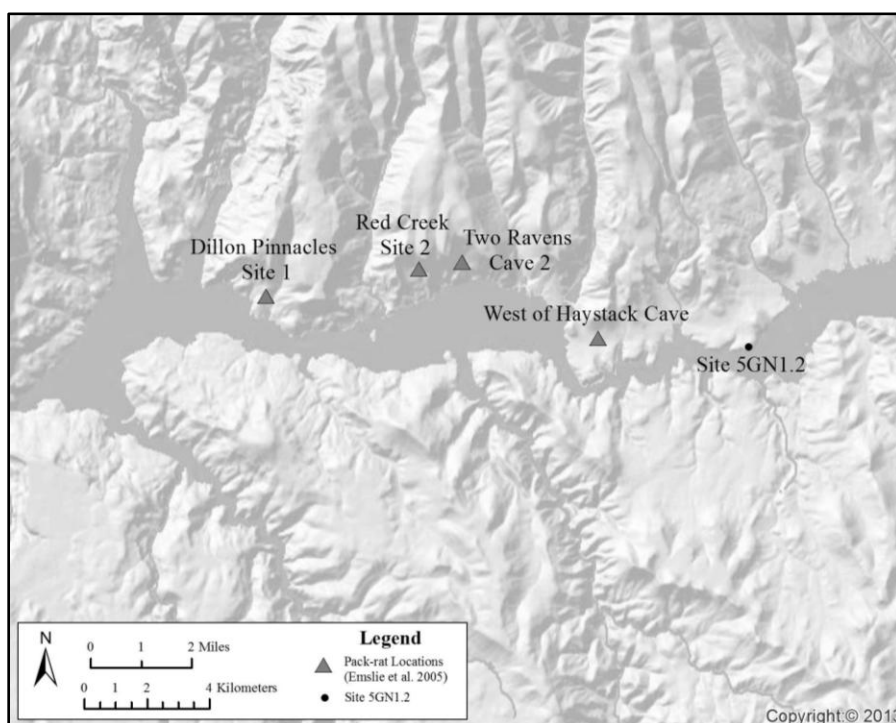


Figure 3-2. Map showing the location of site 5GN1.2 and Emslie et al. (2005) pack-rat midden sample locations.

Paleoclimatic data indicates a relatively gradual pattern of shrinking forests, decreasing temperatures, and decreasing precipitation through the Holocene (Table 3-3). Pollen data reported by Fall (1997) indicates that between 6000 and 4000 B.P. the lower limit of the subalpine forests retreated upslope, probably in response to drier conditions during the Middle Holocene (Briles et al. 2012) and roughly contemporaneous with Antev's (1948, 1955) Altithermal (ca. 7000 to 4500 B.P.). The upper timberline descended after 4000 B.P., suggesting temperatures cooled to about 1°C warmer than modern climate averages (Fall 1997). At the same time, the lower timberline retreated upslope. Fall (1997) suggested that modern climatic conditions were established by about 2000 B.P. (Fall 1997).

Paleoenvironmental reconstructions provided by Emslie et al. (2005) and Fall (1997) suggest that vegetation stabilized near modern distributions between 4000 and 2000 B.P. across much of the UGB. Both also argued that by about the same time, climatic conditions became slightly warmer and drier akin to modern averages. To provide an accessible point of comparison for most of the last 3000 years B.P. in the UGB the following discussion presents a summary of present climatic conditions.

The nearest weather station to site 5GN1.2 is located at Blue Mesa Lake at an elevation of 2316 m (7600 ft). Data collected at this weather station from 1967 to 2012 records the average July maximum daily temperature at 28.3°C (minimum 8.2°C) and the average January maximum daily temperature at -2.3°C (minimum -18.0°C [Western Regional Climate Center 2012]). Annual average precipitation is 24.1 cm (9.5 in) with

Table 3-1. Past environment and climate summary table.

k B.P.	Vegetation (Fall 1997)	Climate (Fall 1997)	k B.P.	Pack-rat data (Emslie et al. 2005)
1		Modern conditions	0.5	---170--- Cooling period ---660---
2	<i>Artemisia</i> steppe	-----	1	----- Warming period
3		Cooler, slightly moister	1.5	-----
4	-----	-----	2	
5	<i>Artemisia</i> steppe with <i>Pinus</i> on slopes	Warmer (~1°C) 6 cm more moisture	2.5	Vegetation stabilizes near modern limits
6			3	-----
7		Warmer (~2°C) 8-11 cm more moisture	3.5	Cooler and wetter <i>Pinus</i> in lower elevations
8	<i>Pinus</i> forest			
9				
10	-----			
11	<i>Picea-Abies-Pinus</i> Forest	----- Max. winter moisture		
12	-----	Cooler (2-5°C) 7-16 cm more moisture		
13	<i>Picea</i> parkland			

Notes: Adapted from Reed and Metcalf (1999). Bolded text highlights the period of interest (post-3000 B.P.).

most of the precipitation occurring as snow (138.2 cm; 54.4 in). Table 3-2 lists historic weather station climatic data collected at the Blue Mesa Lake, Crested Butte, Powderhorn, and Taylor Park weather stations to highlight both temperature and precipitation variability across the UGB. At these weather stations, yearly precipitation varies from less than 24.1 cm (10.0 in) to over 59.6 cm (23.5 in) and average maximum daily temperature from 9.6°C to 13.6°C (Western Regional Climate Center 2012).

Table 3-2. Selected historic weather station data.

Climate Data	Blue Mesa Lake	Crested Butte	Powderhorn	Taylor Park
	1967-2012	1909-2012	1964-1971	1940-2012
Elevation	2316 m	2707 m	2470 m	2810 m
Mean July Max. Temp	28.3 °C	24.4 °C	26.0 °C	22.1 °C
Mean July Min. Temp	8.2 °C	3.6 °C	3.6 °C	4.9 °C
Mean January Max. Temp	-2.3 °C	-2.3 °C	-0.2 °C	-2.9 °C
Mean January Min. temp	-18.0 °C	-20.2 °C	-21.5 °C	-23.6 °C
Annual Precipitation	24.1 cm	59.6 cm	29.3 cm	42.6 cm
Annual Snowfall	138.2 cm	501.7 cm	119.9 cm	278.4 cm
Daily Snow Depth	5.1 cm	25.4 cm	-	20.3 cm

Note: Data source Western Regional Climate Center (2012).

Generally, precipitation and temperature change proportionally to variation in elevation. Average daily July temperatures decrease about 6.9°C, mean daily recorded maximum temperature decreases 6.0°C, and mean annual precipitation increases at a rate of about 22.5 cm per 1000 m of elevation gain in the UGB (Fall 1997). However, localized factors produce widely different conditions within a few kilometers even at the same elevation (Reed and Metcalf 1999). Much of this variation arises from location-specific topography, aspect, and the combined effects of prevailing wind direction and rain shadows. Rain shadows form behind the San Juan and West Elk Mountains and are

particularly prominent in the valleys of Cebolla Creek, middle Tomichi Creek, and along the upper Cochetopa Creek watersheds (Johnston et al. 2001).

The modern climate of the UGB represents a relatively cold and dry mid-latitude continental-interior, high-elevation basin. According to existing paleoenvironmental research, the climate and distribution of major vegetation zones in the UGB compares well with modern features for most if not all of the Late Prehistoric (e.g., Emslie et al. 2005; Fall 1997). Even though the record is incomplete and fragmentary, existing research does not provide evidence of an abrupt climatic shift at about 3000 B.P., as implied by Stiger's (2001) interpretation of the archaeological record. It does suggest a gradual pattern of moderately decreasing temperatures and decreasing precipitation through the Holocene (Emslie et al. 2005; Fall 1997). As such, modern distributions of the biotic communities provide a reasonable analog in understanding the resources available to hunter-gatherers for the last 3000 B.P.

Flora and Fauna

Johnston et al. (2001) published the results from a twenty-year cooperative ecological management study of the UGB conducted by the US Forest Service (Grand Mesa, Uncompahgre, and Gunnison National Forests), Bureau of Land Management (Gunnison Field Office), and the Colorado Division of Wildlife (Habitat Partnership Program). The study collected data on vegetation, soils, and landform distribution at over 1500 points across the UGB. The study resulted in the classification of 97 Ecological Types grouped into the 33 Ecological Series. This complex and detailed classification system developed by Johnson and colleagues (2001) highlights the ecological variability

within the UGB. For simplicity, the basic vegetation zones defined by Johnston et al. (2001) include Alpine, Subalpine, Montane, Mountain Shrub, and the Foothills-Semidesert Shrub. Elevation ranges and dominant vegetation of each zone are provided in Table 3-3. The UGB contains only a few small isolated stands of Pinyon-Juniper Woodlands in the Gunnison Uplift Area (Arnette 2002; Taylor 2000).

Animal species found in the UGB include large mammals such as mule deer (*Odocoileus hemionus*), elk (*Cervus canadensis*), pronghorn antelope (*Antilocapra americana*), bighorn sheep (*Ovis Canadensis*) and bison (*Bison* spp. [now extirpated in the UGB]). Other mammals include coyote (*Canis latrans*), gray wolf (*Canis lupus*), marten (*Martes americanus*), lagomorphs (*Sylvilagus* spp. and *Lepus* spp.), and chipmunks/squirrels (e.g., *Eutamias* spp. and *Spermophilus* spp.) among other species (Armstrong 1972; Johnston et al. 2001). Other potential aboriginal prey species found in the basin include sage grouse, various migratory water fowl, fish, reptiles, and insects (Beals 1935; Fowler 1972; Johnston et al. 2001; Smith 1974; Stewart 1942).

Stiger (2001) emphasized that big-game, particularly bison, dominated the prehistoric diet during the Late Prehistoric. Bison are primarily grazers that feed on a diet rich in grasses and sedges (McDonald 1981; Meagher 1986). Bison habitat includes sagebrush steppe, pinyon-juniper woodlands, and oak-brush at lower elevations and aspen/spruce forests and subalpine meadows at higher elevations (Armstrong 1972). Modern and prehistoric bison populations lived in high elevation (above 3000 m) settings within the region indicating that altitude does not represent a significant limiting factor for bison foraging (Beidelman 1955; Cannon 2004; Fryxell 1926, 1928).T

Table 3-3. Upper Gunnison Basin vegetation zones.

Zone	Dominant Plant Species	North and east slopes	South and west slopes
Alpine	Curly sedge (<i>Carex</i> spp.) Alpine avens (<i>Acomastylis rossii</i> spp.) Tufted hairgrass (<i>Deschampsia cespitosa</i>)	> 3600 m	> 3718 m
Subalpine	Subalpine fir (<i>Abies bifolia</i>) Engelman spruce (<i>Picea engelmannii</i>) Aspen (<i>Populus tremuloides</i>) Lodgepole pine (<i>Pinus contorta</i>) Douglas-fir (<i>Pseudotsuga menziesii</i>) Bristlecone pine (<i>Pinus aristata</i>) Planeleaf and Wolf willows (<i>Salix</i> spp.)	2956- 3600 m	3078- 3749 m
Montane	Douglas-fir (<i>Pseudotsuga menziesii</i>) Ponderosa pine (<i>Pinus ponderosa</i>) Lodgepole pine (<i>Pinus contorta</i>) Aspen (<i>Populus tremuloides</i>) Arizona fescue (<i>Festuca arizonica</i>) Saskatoon serviceberry (<i>Amelanchier alnifolia</i>) Gambel oak (<i>Quercus gambelii</i>) Yellow-Geyer-Bebb willows (<i>Salix</i> spp.)	2774- 3261 m	2865- 3382 m
Mountain Shrub	Douglas fir (<i>Pseudotsuga menziesii</i>) Big sagebrush (<i>Artemisia tridentata</i> spp.) Muttongrass (<i>Poa fendleriana</i>) Gambel oak (<i>Quercus gambelii</i>) Yellow-Geyer-Bebb willows (<i>Salix</i> spp.)	2316- 3078 m	2316- 3078 m
Pinyon-Juniper	Rocky Mtn. juniper (<i>Juniperus scopulorum</i>) Pinyon pine (<i>Pinus edulis</i>)	Very rare	Very rare
Foothills-Semidesert Shrub	Big sagebrush (<i>Artemisia tridentate</i> spp.) Indian rice-grass (<i>Achnatherum hymenoides</i>) Rocky Mtn. juniper (<i>Juniperus scopulorum</i>)	< 2560 m	< 2560 m

Note: Data source, Johnston et al. (2001:6).

The southwestern region of Colorado, including the UGB, contains few archaeological and paleontological bison faunal remains when compared with other regions of Colorado. Some researchers have argued that this may indicate that bison were

limited in the region (e.g., Armstrong 1972; Fitzgerald et al. 1994; McDonald 1981). While others, including Meaney and Van Vuren (1993), argued that the limited evidence for bison in southwest Colorado may be the result of heavy predation by Ute groups during the Protohistoric and early Euroamerican contact periods. Nevertheless, archaeologists have identified bison remains within several archaeological sites in the UGB (Andrews 2010; Stiger 2001).

Historic accounts dating from the middle-to-late nineteenth century document bison at nearly every elevation zone within present-day Colorado and the southern Rocky Mountains (Meaney and Van Vuren 1993). For example, Captain John Williams Gunnison's 1853 Union Pacific Railroad survey expedition noted the presence of bison herds in both the San Luis Valley and the UGB (Beckwith 1855). Gunnison's expedition traveled west through the San Luis Valley into the UGB via Cochetopa Pass. Official records of the expedition described the San Luis Valley as "fine prairie-grass fields, directly in the course to the Coochepota [sic]" Pass (Beckwith 1855:44). The name Cochetopa is commonly translated from the Ute language as "the pass of the buffalo" (Meaney and Van Vuren 1993:5; Simmons 1979). After the expedition crossed over the pass into the UGB, Beckwith reported that "numerous elk-horns and buffalo-skulls lay scattered whitening on the hills, attesting to the former range of the latter animals to these pastures" (Beckwith 1855:49). During the early 1850s, bison herds occupied both the San Luis Valley and the UGB and the Cochetopa Pass may have served as a bison migration corridor.

Lithic Resources

Quartzite raw materials dominate archaeological site assemblages across the UGB, frequently representing over 90 percent of chipped-stone site assemblages (Pitblado et al. 2013; Stiger 2001). Consequently, archaeologists working in the UGB have conducted numerous archaeological and geologic surveys to identify procured quartzite sources (e.g., Liestman 1985; Pitblado et al. 2013; Stiger 2001). Quartzite procurement sites occur in many diverse locations across the basin as both bedrock outcrops and secondary sources (e.g., alluvial gravels and cobbles). Based on the abundance of these quartzite sources, Liestman (1985:34) argued that there are few if any places in the UGB that lithic procurement required extensive acquisition effort.

Numerous non-quartzite sources also exist in the UGB with cryptocrystalline-silicate (CCS) sources being the second-most-common raw material type (Black 2000). Exploited CCS sources tend to cluster in lower-elevation settings near quartzite sources (Black 2000). Named CCS procurement sites include Cochetopa Game Drive Quarry Site, Cochetopa Banana Quarry and Parlin Flats Quarry (Stiger 2001). Obsidian raw material occurs in the Cochetopa area east of Gunnison. Obsidian from this source is poorly represented in the archaeological record, presumably because nodules are often too small for tool production and other non-obsidian raw material sources are readily available (Stiger 2001).

Site 5GN1 is located in the Curecanti National Recreation Area (CURE), an area containing quartzite raw material so common and widespread that the area is virtually covered with quartzite sources (Black 2000). 5GN1 local exposures of the Junction Creek

Formation sandstone (locally quartzitic) and alluvial cobbles provide an ample source of fine-grained quartzite. The Junction Creek formation consists of well-sorted, fine-to-medium-grained yellow and white quartz-rich sandstone which yields localized exposures of bedrock quartzite (Tully 2009). Jones (1986a, 1986b) suggested that the bedrock quartzite deposits at 5GN1 likely were procured and reduced at nearby sites, including 5GN191 (Kezar Basin Site), 5GN247 and others. According to Liestman (1985), Junction Creek formation quartzites represent high quality raw material often selected for formal bifacial tool production, especially during later periods in UGB prehistory.

Summary

The high degree of topographic variability within the UGB, coupled with its relatively small size, concentrates vertically stratified biotic zones. This characteristic provided aboriginal occupants of the UGB access to a wide variety of resources found in different ecological settings within relatively short distances. According to the published paleoenvironmental data (e.g., Emslie et al. 2005; Fall 1997), the Late Prehistoric does not represent a period of severe environmental degradation (c.f., Stiger 2001) as compared with the conditions the Middle Holocene. Therefore, it seems highly plausible that a single family or small extended family group could have residentially occupied the rockshelters at 5GN1 (and for that matter, other sites) and procured a variety of locally available subsistence resources during the Late Prehistoric.

CHAPTER 4

ARCHAEOLOGICAL CONTEXT

Despite the mountainous terrain and relatively small size of the UGB, it has received a considerable amount of archaeological research since the 1930s. Clarence Thomas Hurst conducted the first archaeological field research in the UGB during his tenure at Western State College in Gunnison, Colorado. During the 1930s, Hurst and his students conducted numerous archaeological surveys and excavations throughout the region (e.g., Brunswig 2006; Hurst 1940, 1941, 1947, 1948; Hurst and Hendricks 1952). Schroeder (1953) summarized the results of previous UGB investigations and provided the first synthesis of the archaeological record of the UGB. Schroeder characterized prehistoric occupations of the basin as short-term and nomadic with a preference for lower elevations near the Gunnison River. He assumed the basin was generally ignored prehistorically until later periods and theorized a close cultural association with Basketmaker groups from the American Southwest prior to the Ute (Schroeder 1953).

Detailed archaeological reports and professional excavations in the UGB began during the 1960s. Among these early projects, the University of Colorado conducted an archaeological survey prior to the construction of the Blue Mesa Reservoir (Lister 1962), followed by a similar survey for the Marrow Reservoir (Buckles 1964) and later the Crystal Reservoir (Breternitz 1974). Of these surveys, only the Blue Mesa survey (Lister 1962) identified archaeological sites. The Blue Mesa survey located ten prehistoric lithic scatters, two of which extended above the high water mark of the reservoir, notably 5GN1. The surveys conducted by Lister (1962), Buckles (1964), and Breternitz (1974)

did not identify the high site densities observed by subsequent archaeological investigations above the reservoirs (e.g., Stiger 1980). This is possibly due to inconsistent and informal survey methods (15 m to greater than 30 m intuitively-spaced transects) and that site visibility may have subsequently increased as the reservoirs exposed sites along shorelines.

During the 1970s and 1980s archaeological research in the basin flourished as a result of the Curecanti and the Mount Emmons Projects (Baker 1980, Baker et al. 1981; Black 1983; Dial 1989; Euler and Stiger 1981; Jones 1984, 1986a, 1986b; Jones and Anderson 1982; Rossillon 1984; Stiger 1980, 1981; Tipps 1976; Wilkins and Rapp 1982). Taken together, the Curecanti and Mount Emmons (located in higher elevation mountain environments) projects generated a wealth of archaeological information on the prehistory of the UGB within nearly every elevation zone. These projects provided the first intensive surface inventories, professionally documented excavations, and radiocarbon dates of archaeological components within the basin.

More recent investigations, including both academic and cultural resource management (CRM) projects, expanded research into a broader range of geographic settings across the basin. In the early 1990s, Western State College's Anthropology program began excavating archaeological sites in the UGB. Significant investigated sites include Tenderfoot (Stiger 1993, 2001), Chance Gulch (Pitblado et al. 2001) and others. Archaeologists at Western State College partnered with those at Southern Methodist University to conduct investigations at the Mountaineer Site (Andrews 2010; Stiger 2002, 2006). After leaving Western State College, Pitblado continued excavations at Chance

Gulch (Pitblado and Camp 2003), conducted excavations at the Capitol City Moraine Site (Merriman 2005), the Heath Site (Merriman et al. 2008), and initiated an ongoing quartzite geochemical sourcing project (Pitblado et al. 2006, 2008, 2013). Most academic research in the UGB has focused on Paleoindian and Early Archaic sites (e.g., Andrews 2010; Cooper 2006; Cooper and Meltzer 2009; Euler and Stiger 1981; Jones 1986a; Pitblado and Camp 2003; Pitblado et al. 2001; Stamm et al. 2004; Stiger 2006). On the other hand, archaeologists have reported on comparatively few post-3000 B.P. site components (e.g., Dial 1989; Hutchinson 1990; Rossillon 1984; Peart 2011). A selected list of major archaeological projects is provided in Table 4-1.

Table 4-1. List of major archaeological projects in the UGB.

Project	Reference(s)
Chance Gulch Site Excavations	Pitblado et al. 2001; Pitblado and Camp 2003; Stamm et al. 2004
Curecanti Project Inventory	Stiger 1980
Curecanti Project Excavations	Dial 1989; Euler and Stiger 1981; Jones 1986a,b; Rossillon 1984; Stiger 1981
Mount Emmons Inventory	Baker 1980
Mount Emmons Excavations	Baker et al. 1981
Mountaineer Site Excavations	Andrews 2010; Stiger 2002, 2006
Tenderfoot Site Excavations	Stiger 1993, 2001

Curecanti Project

The National Park Service established the Curecanti National Recreation Area (CURE) in 1965 to manage the Blue Mesa, Morrow, Crystal Reservoirs and associated federal property (Mueller and Stiger 1983). As a result, federal and state funding

provided for nearly a decade of archaeological research associated with the Curecanti Project and produced the most extensive archaeological research program thus far in the basin (Stiger 2001). In 1976, archaeologists from the Midwest Archaeological Center (MWAC) conducted an intensive pedestrian inventory of the CURE (Stiger 1980). The survey recorded over 130 archaeological sites, temporally spanning from the Paleoindian to Protohistoric eras, based on temporally diagnostic projectile point types (Stiger 1980). This initial inventory project also reevaluated site 5GN1 and recorded many of the archaeological sites that would later receive additional archaeological research, including surface collections, testing and block excavations.

Excavated sites within the CURE include 5GN41 (Pioneer Point), 5GN189 (Haystack Cave), 5GN191 (Kezar Basin), 5GN1664 (Marion) and numerous others (Table 4-2). The Curecanti Project led to the nomination of the Curecanti Archaeological District in 1979 to the National Register of Historic Places (Jones and Anderson 1982). At the time of the nomination, the district included 79 archaeological sites and covered over 6750 acres in three discontinuous units (Jones and Anderson 1982). During the Curecanti Project, archaeologists from the MWAC generated an enormous quantity of data and collected impressive numbers of artifacts from these investigated sites. Extensive archaeological research associated with the Curecanti Project ended in the 1980s, although smaller scale and more focused archaeological research in the CURE continues.

Table 4-2. Non-exhaustive list of Curecanti excavations.

Site	Field Season(s)	Reference(s)
5GN41 (Pioneer Point)	1981, 1982	Dial 1989
5GN189 (Haystack Cave)	1978	Euler and Stiger 1981
5GN191 (Kezar Basin)	1978, 1979, 1981	Euler and Stiger 1981; Jones 1986a Stiger 1981
5GN204/205	1978, 1980	Euler and Stiger 1981
5GN207	1976, 1979, 1980	Stiger 1977, 1981
5GN212	1979, 1980, 1981	Stiger 1981
5GN222	1982	Jones 1986b
5GN247	1979, 1982	Jones 1986b, Stiger 1981
5GN1664 (Marion)	1983	Rossillon 1984

Aside from excavation reports and a few peer-reviewed articles, archaeologists never produced a comprehensive document synthesizing all the findings of the Curecanti Project (Stiger 2001). One such article provided a detailed summary of the radiocarbon dates (Jones 1984) and another delivered a cross-site lithic analysis and technological summary (Liestman 1985). Radiocarbon dates generated by the Curecanti Project spike between about 8000 and 4000 B.P., possibly indicating a period of intensive occupation concurrent with Antev's Altithermal (Jones 1984). Jones (1984) suggested that an increase in radiocarbon dates during the Altithermal may be related to a similar pattern observed by Benedict and Olsen (1978). Otherwise, the radiocarbon dates suggest essentially continuous use of the Curecanti area for the last 10,000 years (Jones 1984).

Liestman (1985) conducted an independent cross-site comparative study of recovered prehistoric chipped-stone technology at CURE sites focused on raw material use, tool production, and bifacial technology. Liestman found that quartzite lithic raw

materials dominated archaeological site assemblages within CURE and quartzite sources are widespread in the area (1985). Based on a visual inspection and comparisons with raw materials from CURE, Liestman argued that prehistoric occupants preferentially selected high-quality quartzite raw materials from the Junction Creek Formation for tool manufacture (1985). Liestman further suggested that about half of the lithic tools randomly selected for analysis (including quartzite tools) exhibited evidence of heat-treatment. To identify heat-treated artifacts, Liestman used scanning-electron microscopy and compared the assemblage with a sample of experimentally heat-treated materials (Liestman 1985).

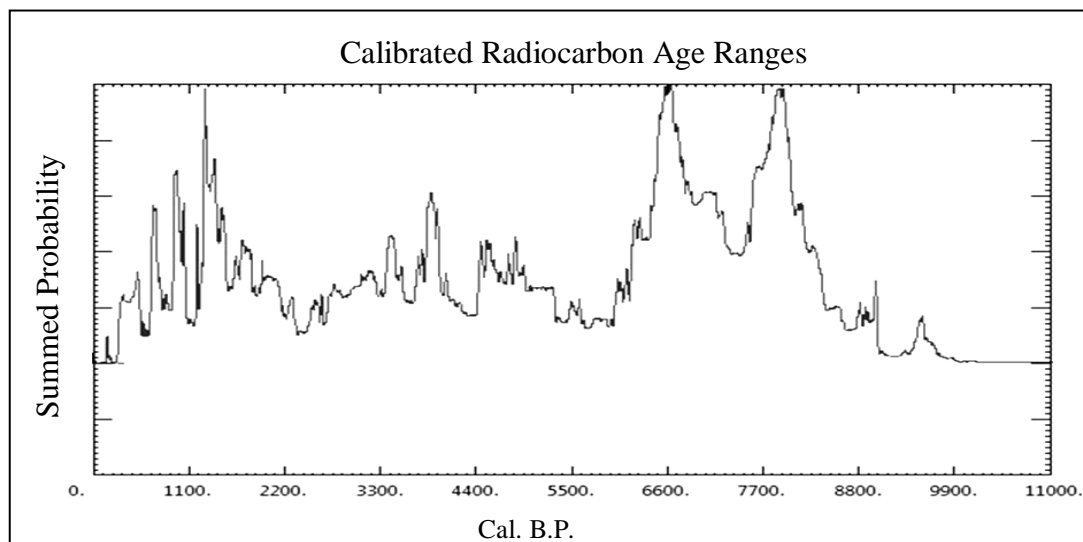
An important result of this study was that high quality quartzite lithic raw materials predictably occurred within areas of geologic faulting and/or volcanic venting (Liestman 1985:65). The location of large prehistoric sites with evidence of intensive quarrying activity concentrated near these finer-grained and arguably higher quality quartzite sources, such as 5GN1 (Liestman 1985). The only chronological pattern in lithic technology observed by Liestman is that post-2000 B.P. chipped-stone assemblages exhibit a higher “production index” than older sites (1985:39). Production index as used by Liestman (1985) measures the level of reduction and tool specialization, such that a higher production index correlates with more intensive bifacial knapping (smaller and thinner tools) and more specialization in tool function and form.

Contemporary View of UGB Culture History

Archaeologists have recorded more than 3000 prehistoric sites within the UGB. Only a fraction of these sites have been tested or formally excavated. Stiger (2001) identified a total of 163 radiocarbon-dated archaeological features in the basin. These features range in age from about 10,500 B.P. to 250 B.P. and indicate Paleoindian through Ute occupations (Stiger 2001). Figure 4-1 provides a summed radiocarbon calibrated probability distribution chart of archaeological features reported in the UGB (Merriman et al. 2008; Moore and Firor 2009; Peart 2011; Pitblado and Camp 2003; Stiger 2001, 2006). Radiocarbon date probability distribution remains relatively even through time with two large spikes during the early Archaic (about 6600 cal. B.P. and 8000 cal. B.P.) and a much later smaller spike dating to the Late Prehistoric (about 1500 cal. B.P.). Jones (1984) first identified an increase in radiocarbon-dated features during the early Archaic and interpreted it as a possible indication of increased UGB occupation intensity.

For the larger Northern Colorado River Basin Region, Reed and Metcalf (1999) summarized the archaeological radiocarbon-date record and identified different patterns. They observed that radiocarbon-date frequency (both total number of dates and dated components) generally increases from the Paleoindian through the Archaic and peaks from about 2600 B.P. to 1200 B.P. This possible radiocarbon-date frequency discrepancy between the UGB and the surrounding region has led several researchers (e.g., Black 1991; Jones 1984; Stiger 2001) to advocate a unique UGB culture history following the assumption that changing frequencies of radiocarbon dates over time correlate with

demographic patterns. However, identifying and extracting robust demographic patterns is complicated by the nature of radiocarbon calibration curves (Bamforth and Grund 2012) and the complexity of acquiring datasets with an adequate number of radiocarbon-dated occupations. According to Williams (2012), a minimum of 500 radiocarbon dates should be used in any form of summed probability analysis for statistical reliability. Neither Reed and Metcalf's (1999) compiled dates nor the number of dated sites in the UGB exceeds the 500 radiocarbon age minimum established by Williams (2012) and as such any interpretations of demographic patterns should be regarded as tentative.



Notes: Data sources include Stiger (2001) and amended with Moore and Firor (2009), Merriman et al. (2008), Peart (2011), Pitblado and Camp (2003), and Stiger (2006). Chart produced using CALIB Radiocarbon Calibration Program version 6.1.1 (Struiver et al. 2013; Struiver and Reimer 1993) using the intcal 09.14 calibration dataset (Reimer et al. 2009).

Figure 4-1. Summed calibrated radiocarbon age range chart of radiocarbon-dated archaeological features in the UGB.

Reed and Metcalf (1999) synthesized the prehistoric cultural context for the Northern Colorado River Basin, which comprises much of western Colorado (Table 4-3). In his 2001 book, Stiger offered the most recent published synthesis of the archaeological record and his version of UGB cultural history. The cultural histories produced by Reed and Metcalf (1999), and Stiger (2001), contain many substantial differences. In the context of this thesis research, the most significant variation is that Stiger entirely replaces the Formative era with the term “post-3000 B.P.” and avoids any substantive discussion of Protohistoric or Ute occupations in the basin. To provide a context for post-3000 B.P. hunter-gatherer adaptations proposed by Stiger, the following discussion begins with a summary of the Archaic. Following the Archaic, this chapter includes a discussion of Stiger’s version of post-3000 B.P. occupations and concludes with a summary of the Protohistoric and ethnographic context.

Table 4-3. Northern Colorado River Basin cultural chronology.

Era	Tradition, Phase or Period	Calendar Age Range
Paleoindian	Clovis Tradition	11,500 to 10,500 B.C.
	Goshen Tradition	11,000 to 10,700 B.C.
	Folsom Tradition	10,800 to 9500 B.C.
	Foothill Mountain Tradition	9500 to 6400 B.C.
Archaic	Pioneer Period	6400 to 400 B.C.
	Settlement Period	4500 to 2500 B.C.
	Transitional Period	2500 to 1000 B.C.
	Terminal Period	1000 to 400 B.C.
Formative	Gateway Tradition	400 B.C. to A.D. 1300
	Aspen Tradition	A.D. 1 to 1300
	Fremont Tradition	A.D. 200 to 1500
Protohistoric	Anasazi Tradition	A.D. 900 to 1100
	Canalla Phase	A.D. 1100 to 1650
	Antero Phase	A.D. 1650 to 1881

Note: Data source Reed and Metcalf (1999:6).

Archaic Era

Within the Northern Colorado River Basin region, the Archaic Era represents a long period of relatively stable hunter-gatherer traditions (Reed and Metcalf 1999). According to Reed and Metcalf (1999), the Archaic contrasts with the preceding Paleoindian Era in that life ways were less mobile and more focused on the use of a broadening set of local resources collected on a scheduled seasonal basis. Technological adaptations observed during the Archaic include the transition from large lanceolate projectile points to smaller stemmed and notched point types and an increase in the overall point style variety (Reed and Metcalf 1999). During the Archaic, ground stone artifacts become more common, possibly indicating a more intensive use of plant resources (Reed and Metcalf 1999; Stiger 2001). Excavated archaeological sites in the UGB with Archaic Era components include Chance Gulch (Pitblado et al. 2001; Pitblado and Camp 2003), Checkers Site (Jones 1995), Elk Creek Village (Rood et al. 1996), Kezar Basin Site (Euler and Stiger 1981; Jones 1986a), Tenderfoot (Stiger 1993; 2001), 5GN10 (Stiger 1981), 5GN212 (Jones 1986a), 5GN222 (Jones 1986a), 5GN344 (Black 1983), 5GN2262 (Moore and Firor 2009), 5GN2405 (Moore and Firor 2009), and others (see Stiger 2001).

Archaic archaeological site components in the UGB are well-represented compared to earlier and later occupations (Cooper and Meltzer 2009; Mueller and Stiger 1983; Stiger 2001). Jones (1984) first recognized this pattern in summed radiocarbon-dated archaeological components recorded as a result of the Curecanti Project and subsequent archaeological research in the UGB continues to conform to this general

pattern (Jones 1984; Figure 4-1). Archaic sites are associated with a proliferation of variable-sized hearth feature types, including slab-lined and “big deep fire-cracked-rock features,” as well as structural remains from possible wikiups, residences and sun shades (Stiger 2001). Early Archaic sites with structural remains probably represent both short-term and long-term camps occupied in warmer months with possible evidence of winter occupations (Metcalf and Black 1997). Stiger (2001) concluded that the increase and diversification of hearths, structures and storage features during the Archaic indicates residential occupations with bulk-processed and stored resources.

A few archaeological sites dating between about 8000 and 3000 B.P. contain pinyon wood remains and others contain a small number of pinyon nuts (Stiger 2001). Based on this evidence, Stiger (2001) concluded that pinyon likely went extinct in the basin around 3000 B.P. and did not contribute to later diets. The extirpation of pinyon, according to Stiger (2001), indicated deteriorating climatic conditions and it may have served as a catalyst that ended Archaic residential occupations within the basin.

Post-3000 B.P. (Late Prehistoric)

Both Black (1983) and Stiger (2001) suggested that a drastic shift in the occupation and use of the UGB occurred at about 3000 B.P., spurred by possible environmental degradation. Stiger (2001) further argued that a reduction in radiocarbon dates, the higher proportion of scapula/pelvic big-game elements in archaeological assemblages, decreasing size and diversity of feature types, increased use of game drive sites, and increased frequency of non-quartzite tool-stone signaled the end of residential occupations in the UGB. Archaeological sites with post-3000 B.P. components include

those at Elk Creek Village (Rood et al. 1996), the Heath Site (5GN3418; Merriman et al. 2008), Marion Site (Rossillon 1984), Mast Site (Bjordstad 2003), Tenderfoot (Stiger 1993, 2001), 5GN1.2 (Peart 2011), 5GN247 (Jones 1986a), Monarch Pass game drive sites (Hutchinson 1990), and others (see Stiger 2001).

Stiger (2001) characterized post-3000 B.P. occupations as short-term hunting camps and kill sites left by logistically organized and highly mobile big-game hunting parties originating from unidentified base camps located outside of the UGB. This narrative further advocated that these hunting parties entered the basin equipped with tools and food supplies to facilitate full-time hunting. The groups constructed temporary wickiup-type structures and small shallow hearth features while in the basin (Stiger 2001). According to Stiger's narrative, successful hunting parties field processed meat (e.g., jerky or pemmican), hides and bone grease for transport out of the basin (Stiger 2001).

Stiger's (2001) hypothesis is largely based on the rather incomplete and highly fragmentary Late Prehistoric faunal record. The vast majority of known archaeological faunal remains consist of unidentifiable, small and highly fragmented bone pieces, many from undated contexts (Stiger 2001). For example, at the time Stiger wrote his cultural history (2001) four sites (Tenderfoot, Elk Creek, Pioneer Point, 5GN204/205 and Marion) contained over 97 percent of all faunal artifacts recovered in the UGB. He further noted that the presence of highly fragmented faunal remains in the UGB, provided the fragments were produced through cultural rather than natural processes, suggested near complete exploitation of available faunal resources. He argued that the presence of

big-game scapula and pelvic elements on only four sites in the UGB, three of which date during the Late Prehistoric (Marion, Elk Creek Village, and Pioneer Point), indicated camp-maintenance food and dried meat prepared for transport.

The first game drive sites in the UGB occur during the Archaic and continue into the Late Prehistoric. Stiger (2001) argued that the increased use of game drives during the Late Archaic and Late Prehistoric may indicate hunter-gatherers experienced resource stress as opposed to innovations in hunting technology. Monarch Pass contains the most prominent game drive sites within the UGB. These sites, Water Dog Divide and Garfield Game Drive, are located between about 3500 and 3700 m in elevation along the Continental Divide on the eastern edge of the UGB. Monarch Pass provides one of the few favorable routes over the Continental Divide in the region (Hutchinson 1990).

The Water Dog Divide Site (5CF373) contains the most extensive set of game-drive walls along Monarch Pass. Hutchinson (1990) argued, based on projectile points, radiocarbon dates, and comparisons with other game drive sites in the region that the Water Dog Divide Site game drive features were heavily utilized between about 5000 and 1000 B.P. Hutchinson found evidence of post-1000 B.P. occupations at the nearby and smaller Garfield Game Drive Site (5CF499). Hutchinson (1990) stated that these game drive systems at Monarch Pass indicated a planned and cooperative hunting strategy based on a sophisticated knowledge of animal behavior. Stiger (2001) argued that increasing use of game drive sites during the Late Prehistoric signaled a high level of group cooperation and focused big-game procurement.

Protohistoric

Stiger's (2001) version of UGB culture history combines the Formative Era and the Protohistoric Era, including Ute occupations, into one essentially continuous cultural period. Within the larger Northern Colorado River Basin region, Reed and Metcalf (1999) argued that the beginning of the Protohistoric Era can be identified by significant alterations to both subsistence and settlement patterns. According to Reed and Metcalf (1999), the Protohistoric Era began after the decline of the region's Formative traditions (ca. A.D. 1300) and ended when the Ute were forcefully expelled from most of the southern Rocky Mountains to live on reservations (A.D. 1881). They further divide the Protohistoric into the Canalla (A.D. 1100 to 1650) and Antero phases (A.D. 1650 to 1881).

During the Canalla phase, Reed and Metcalf (1999) suggested that the ancestral Ute possibly migrated into the region. The timing and historicity of the initial Ute migration remains an important research arena and represents a significant data gap for archaeologists investigating regional cultural history (Baker et al. 2007, 2008; Buckles 1971; Reed and Metcalf 1999). For example, Baker et al. (2008) suggested that old wood radiocarbon dates of Ute archaeological sites likely misrepresent the arrival of the Ute possibly up to several hundred years.

Only a few excavated archaeological components dating to the Protohistoric are reported in the UGB. These include sites 5GN222, Pioneer Point, Heath Site, and possibly 5GN1.2 (e.g., Dial 1989; Jones 1986a,b; Merriman et al. 2008; Peart 2011). Jones (1986a) reported finding a tinkler cone or metal bangler at 5GN222. Pitblado

directed excavations at the Heath Site, located along a terrace above the Lake Fork of the Gunnison River (Merriman et al. 2008). Excavations unearthed a Protohistoric roasting hearth radiocarbon dated to 790 ± 40 B.P. and attributed to the Ute by the presence of brownware ceramics (Merriman et al. 2008). Additionally, site 5GN1.2 contains rock art that may indicate a Ute component.

Despite the fact that the UGB contains relatively few Ute attributed archaeological sites, the record does indicate diverse occupations not specifically focused on big-game procurement. For example, Pioneer Point contains exposed probable hearths within concentrations of lithics, brown ware ceramics, ground stone and both floral and faunal remains (Dial 1989). She suggested that Pioneer Point represents a temporary seasonal occupation made by a small family group practicing a mixed hunting and gathering economy (Dial 1989). Archaeological materials recovered from the site provide evidence of big-game procurement (e.g., mule deer, bison and bighorn sheep), plant resource processing (*Chenopodium* and *Gramineae* seeds) and both chipped-stone and bone tool manufacture (Dial 1989).

Regionally, the Ute represented a highly mobile population of hunter-gatherers who constructed wickiups for shelter, produced brown-ware ceramics, hunted with bow and arrow technology and manufactured Desert Side-notched and Cottonwood Triangular projectile points (Reed and Metcalf 1999). The introduction of horses from the Spanish and increased Euroamerican contact characterizes the Antero Phase. Expanded Euroamerican influence contributed to a greater reliance on trade goods and the

introduction of the horse promoted group solidarity and increased group regional mobility (Reed and Metcalf 1999).

As previously stated in the *Environmental Context* chapter, existing paleoenvironmental data suggests that near modern vegetation and climatic conditions were established in the UGB at least by 2000 B.P. and possibly as early as 3000 B.P. or earlier (Emslie et al. 2005; Fall 1997). Without additional and finer-grained paleoenvironmental research to the contrary, it appears that most, if not all, of the last 3000 B.P. represents comparable environmental conditions present during later Ute occupations. As such, Ute ethnographic information provides applicable data in understanding Late Prehistoric occupations within the UGB.

Ute Ethnographic Context

Existing Ute ethnographic data, particularly mountain adaptations in Colorado, represent an incomplete and relatively sparse record (Beals 1935; Steward 1938). Only about 20 years passed from when Euroamerican settlers arrived in western Colorado, ca. A.D. 1860, to when the Ute were forcefully removed to live on reservations (Brett 2003). Since the Ute of Colorado rapidly acquired the horse (becoming nearly fully equestrian by A.D. 1650) and upon Euroamerican settlement were relocated to live on reservations, ethnographic information does not provide the data quality necessary to fully characterize the pre-contact Ute diet, settlement pattern or much else (Brett 2003; Petersen 1977).

Ute groups in Colorado, before they were removed to live on reservations, consisted of seven loosely defined bands distinguished by geographic range (Young 1997). The Tabegauche Tribe historically lived along the Gunnison and Uncompahgre

River Basins in Colorado, including the UGB (Pettit 1990; Simmons 2000). The Ute maintained a simple kin-based social structure and followed an established mountain-centered annual migration circuit that incorporated adaptations to both upland and lowland environments (Petersen 1977; Steward 1938). They often returned to the same hunting grounds in the high country each summer from winter villages along lowland river drainages (Baker et al. 2007). Where available, they occupied rockshelters and caves. Otherwise they erected temporary wickiup structures, and following the introduction of the horse, they commonly lived in portable tipis (Pettit 1990; Simmons 2000). Ute groups manufactured ceramics, hunted with bow and arrow technology, processed plants and seeds with ground stone, fished with hooks and weirs, and captured small animals with traps and nets. They also participated in communal hunts and annual Bear Dances (Pettit 1990; Simmons 2000).

Petersen (1977) summarized Ute camp location, elevation and occupation season for the Tabeguache and Elk Mountain Ute in western Colorado based on historic accounts dating from A.D. 1776 to A.D. 1868. He concluded that the first Euroamerican accounts documented that the Ute maintained a subsistence and settlement pattern heavily dependent on equestrian mounted mobility anchored to traditional mountain centers. The Ute maintained an annual mountain-centered mobility pattern with flexible and informal group territories (Petersen 1977). The Ute periodically occupied nearly every elevation zone in the mountains of Colorado, hunting and gathering a variety of subsistence resources. Winter camps typically were located at lower elevation and during the summer months Ute groups participated in large rendezvous in both mountains and

lowland settings (Petersen 1977). By the late 1800s, this mountain-centered exploitative pattern effectively ended when Euroamerican miners, ranchers, and farmers settled the area and the United States military expelled the Ute (Petersen 1977).

The documented Ute diet included a wide variety of animal and plant food resources. The Ute hunted big-game, including antelope, bighorn sheep, mule deer, elk, moose, bear and bison (Albers and Lowry 1995; Beals 1935; Fowler 1986; Petersen 1977; Smith 1974). They also acquired smaller mammals such as lagomorphs, marmots, squirrels and mice. Other ethnographically documented prey species include sage grouse, ducks, various fish, reptiles, and insects (Beals 1935; Fowler 1972; Smith 1974; Stewart 1942).

Stiger (2001) argued that from about 3000 B.P. to European contact the main subsistence focus for groups living in the UGB was the procurement of big-game, specifically bison. Although not a universal focus of Ute occupations, ethnographic sources document that the Ute hunted bison using variable methods and technologies (Pettit 1990; Smith 1974; Stewart 1942). Hunting practices included individual hunters or hunting parties ambushing prey near salt licks or springs and in coordinated bison stampedes over cliffs or jumps (Stewart 1942). Following a successful hunt, the Ute often field processed bison by producing jerky and bone grease (Smith 1974).

Smith (1974) suggested that in addition to animal protein, berries and roots were the basic foods eaten by Ute groups. Callaway et al. (1986) calculated that 40 percent or more of Ute subsistence came from plant resources. Many ethnographically documented plant species used by the Ute are available in the UGB within multiple vegetation zones

(Table 4-4). The Ute ate fruits and berries from bilberry, elderberry, blueberry, raspberry, huckleberry, buffaloberry, serviceberry, juniper, skunkbrush, chokecherry, whortleberry, and others (Chamberlin 1909, 1911; Palmer 1878a,b; Pettit 1990; Smith 1974). Additionally, the Ute consumed wild rose fruit and rose hips, the roots of arrowleaf balsamroot, leaves and bulbs of wild onion, and processed wild rye, Indian ricegrass and buckwheat (Fowler 1986; Pettit 1990; Smith 1974). The UGB also contains a variety of plants that the Ute used for medicinal purposes including kinnikinnik, Oregon grape, Colorado cough root and valerian (Fowler 1986; Smith 1974). Pinyon and camas represent the only major Ute plant food resources not available in the UGB during the Late Prehistoric or Protohistoric eras (Fowler 1986; Johnston et al. 2001; Smith 1974; Stiger 2001).

Culture History Summary

Radiocarbon-dated archaeological components within the UGB represent all culture history periods from Folsom to the Protohistoric (Reed and Metcalf 1999; Stiger 2001). Shallow surface lithic scatters overwhelmingly dominate the archaeological record found within the UGB and sites often contain over 90 percent quartzite raw material (Stiger 2001). During the late Paleoindian and early Archaic, occupations within the basin flourished as evidenced by increased numbers of well-dated components, diversification of hearth features, presence of possible substantial structures and several sites with evidence of intensive reoccupation (Jones 1984; Stiger 2001). However, most previously conducted archaeological research projects within the UGB have focused on

these time periods, possibly biasing the archaeological record and interpretations of the basin's culture history.

Table 4-4. Non-exhaustive list of ethnographic plant resources in the UGB.

	Species	Elevation	Species	Elevation
Trees	Rocky Mountain juniper (<i>Juniperus scopulorum</i>)	2295 to 2975 m	Limber pine (<i>Pinus flexilis</i>)	2579 to 3060 m
Shrubs	Serviceberry (<i>Amelanchier</i> spp.)	2316 to 3209 m	Raspberry (<i>Rubus idaeus</i>)	2530 to 3328 m
	Currants (<i>Ribes</i> spp.)	2316 to 3230 m	Strawberry (<i>Fragaria</i> spp.)	2319 to 3615 m
	Kinnikinnick bearberry (<i>Arctostaphylos uva-ursi</i>)	2380 to 3243 m	Dwarf bilberry, whortleberry (<i>Vaccinium</i> spp.)	2743 to 3755 m
	Oregon-grape (<i>Mahonia repens</i>)	2401 to 3236 m	Elderberry (<i>Sambucus</i> spp.)	~2720 m
	Prickly-pear (<i>Opuntia</i> spp.)	2339 to 2709 m	Woods Rose (<i>Rosa woodsii</i>)	2295 to 3252 m
	Chokecherry (<i>Padus virginiana</i>)	2316 to 3041 m	Russet buffaloberry (<i>Shepherdia Canadensis</i>)	2636 to 3310 m
Edible Roots	Pygmy bitterroot (<i>Oreobroma pygmaea</i>)	-	Biscuitroot (<i>Lomatium</i> spp.)	2438 to 2563 m
Forbs and Grasses	Wild onion (<i>Allium</i> spp.)	2560 to 3541 m	Solomon-plume (<i>Maianthemum stellatum</i>)	2307 to 3614 m
	Indian Rice-grass (<i>Achnatherum hymenoides</i>)	2335 to 3035 m	Elkslip marsh-marigold (<i>Psychrophilia leptosepala</i>)	2487 to 3927 m

Note: Data source Johnston et al. (2001).

After about 3000 B.P., archaeological sites within the basin contain smaller, more uniform hearth features, greater assemblage proportions of non-quartzite raw materials, increased utilization of game drives and other indicators of changing settlement-subsistence organization (Black 1983, 1991; Stiger 2001). Stiger (2001) interpreted this change as a shift to logistical big-game hunting from residential base camps located outside of the UGB. Others have suggested that this shift indicated less intensive and shorter term use of the UGB (e.g., Black 1983, 1991; Reed and Metcalf 1999).

During the regionally defined Protohistoric, Ute sites with rock art, ground stone, brown ware ceramics, Cottonwood Triangular and Desert Side-notched projectile points occur in the basin (e.g., Dial 1989; Reed and Metcalf 1999). Ute occupations at Pioneer Point may indicate short-term residential occupations made by a small family group practicing a mixed hunting and gathering subsistence economy (Dial 1989). Paleoenvironmental data suggests that although conditions undoubtedly fluctuated post-3000 B.P. the distribution of vegetation communities and general climatic conditions did not drastically differ from modern equivalents (e.g., Emslie et al. 2005; Fall 1997; Reed and Metcalf 1999). Therefore, Ute ethnographic data provides a valuable context in understanding the available Late Prehistoric resources of the UGB. This ethnographic context suggests that during the Late Prehistoric the UGB contained a suite of ethnographically utilized plant and animal resources across multiple elevation zones.

CHAPTER 5

SITE 5GN1.2 ROCKSHELTER

Site 5GN1 (Big-game Hill Site) is located within the Curecanti National Recreation Area between the Blue Mesa Reservoir and US Highway 50 about 22 km west of Gunnison, Colorado. Vegetation within the site consists of Foothills-Semidesert Shrub community species with a few scattered Rocky Mountain juniper trees (Johnston et al. 2001). Buckles, working at the University of Colorado, originally recorded 5GN1 in 1962 during an inventory of the Blue Mesa Reservoir (Buckles 1962; Lister 1962). He described it as a large multi-component prehistoric lithic procurement site containing scattered quartzite reduction workshop locations and thousands of surface artifacts. Later, Liestman (1985) identified several bedrock exposures of Junction Creek quartzite along Big-game Hill (within 5GN1) all associated with areas of geologic faulting and/or volcanic venting. Stiger (2001) and Andrews (2010) further investigated fine-grained quartzite exposures at 5GN1. They observed large flake scars on several quartzite bedrock outcrops, indicating bedrock lithic reduction and observed a high degree of color variability (white, gray, red, and brown combinations) among the bedrock exposures and cobble sources.

In 2009, Utah State University (USU) archaeological field school, under the direction of Dr. Bonnie Pitblado, conducted archaeological and geological surface surveys at site 5GN1. Pitblado's students found seven previously undocumented small rockshelters at an approximate elevation of 2340 m (7680 ft) along the southern edge of the site. The rockshelters are located along outcrops of the Junction Creek Formation

with a commanding view shed overlooking the Gunnison River (currently the Blue Mesa Reservoir) and valley. 5GN1.2 rockshelter (5GN1.2) is the most prominent of those recorded in 2009 and USU students named it Picasso's Den referencing the shelter's rock art (Figure 5-1). 5GN1.2 is located under a sandstone overhang extending over a crescent-shaped area measuring approximately 20 m long (east-to-west) by 4.5 m wide (north-to-south [Figure 5-2]). The rockshelter is located about 182 m (600 ft) to the north and 115 m (380 ft) above the historic channel of the Gunnison River.

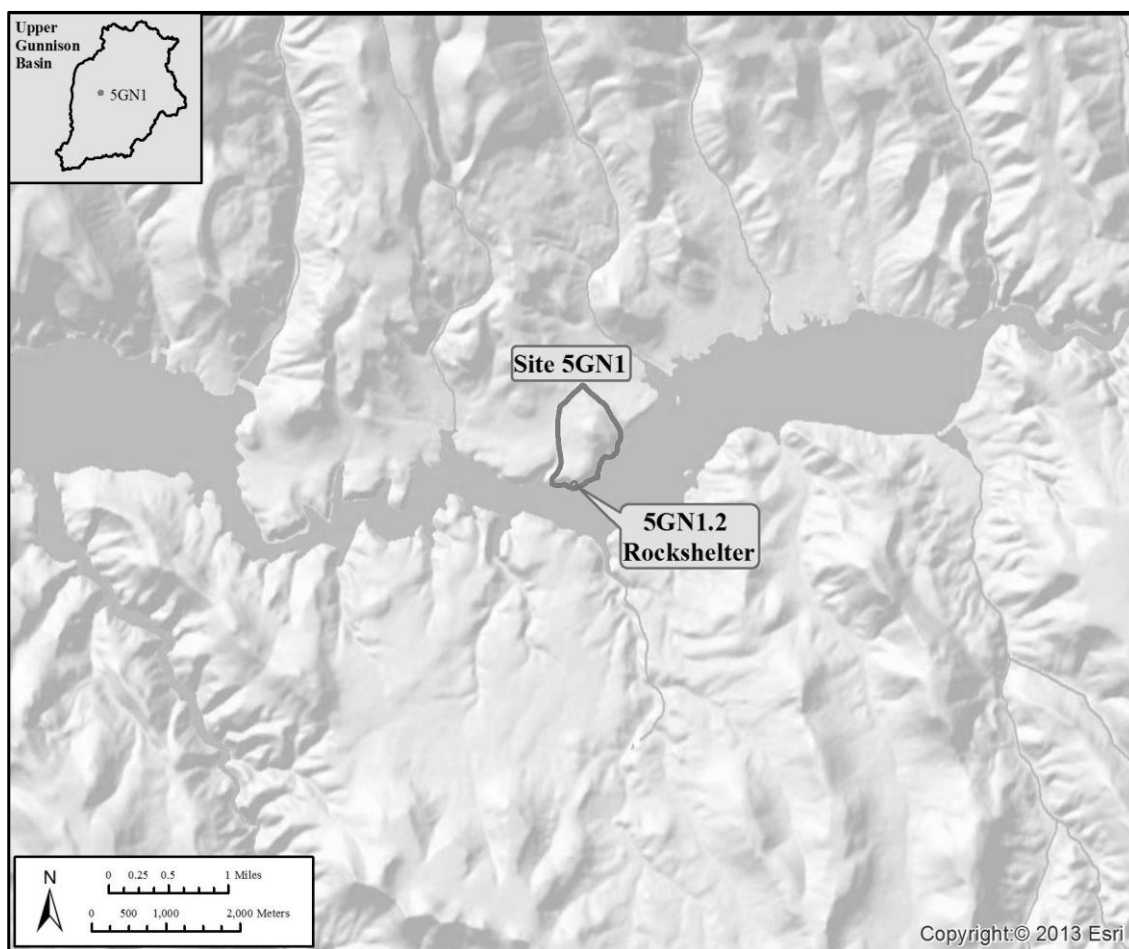


Figure 5-1. 5GN1.2 site location map.



Figure 5-2. 5GN1.2 east-facing overview with the Blue Mesa Reservoir in background.

Surface Inventory

With the assistance of Bonnie Pitblado (project Principal Investigator), we conducted archaeological investigations at 5GN1.2 in July 2010. Additional crew members included Jason Patten (USU student), Carl Haberland (volunteer), Barbara Haberland (volunteer), and Forest Frost (NPS archaeologist). The field crew conducted a supplemental pedestrian inventory from the rockshelter to the shoreline of the Blue Mesa Reservoir covering about three acres with transects spaced no more than five meters. We identified a total of 15 chipped-stone and ground stone tools, including a complete

quartzite corner-notched projectile point (possible Elko Corner-notched [Drager and Ireland 1986; Reed and Metcalf 1999]), five quartzite bifaces, eight sandstone manos and a non-diagnostic ground stone fragment (Table 5-1). Additionally, we estimated a surface assemblage of more than 450 flakes (over 95 percent quartzite), about 64 scattered fire-affected rock fragments (FAR) and six surface charcoal stains interpreted as possible hearth features (Peart 2011).

Table 5-1. Surface tools within 5GN1.2.

Tool #	Material	L	W	Th	Basic tool description	Biface stage
T01	Quartzite	2.9	2.2	.5	Biface fragment	3
T02	Quartzite	5.8	2.4	.8	Biface base fragment	4
T03	Sandstone	9.0	8.0	4.0	Slab metate with one pecked and moderately-utilized worked surface	-
T04	Quartzite	2.9	1.6	.3	Complete corner-notched projectile point; possible Elko Corner-notched	5
T05	Sandstone	4.3	5.2	3.8	Reddish-brown coarse-grained, lightly utilized mano fragment	-
T06	Sandstone	7.2	3.5	3.5	Burnt dark-gray river-rounded cobble mano fragment	-
T07	Sandstone	16.0	10.0	3.6	Burnt reddish-brown river-rounded cobble mano fragment	-
T08	Quartzite	5.0	2.5	1.0	Biface fragment	2
T09	Sandstone	8.3	8.0	5.0	Burnt reddish-yellow river-rounded cobble mano fragment	-
T10	Quartzite	3.5	2.2	.9	Biface fragment	3
T11	Quartzite	7.0	4.5	1.5	Complete biface	3
T12	Sandstone	12.0	7.5	4.5	Burnt brown and dark gray river-rounded cobble mano with moderate use-wear	-
T13	Sandstone	9.0	9.5	5.0	Reddish-brown and possibly burnt fine-grained coarse-grained sandstone mano or hammer stone	-
T14	Sandstone	7.0	3.5	3.0	Burnt dark-gray river rounded mano fragment	-
T15	Sandstone	10.6	7.7	4.5	Complete reddened (possibly burnt) mano with formal shaping/pecking and heavy use-wear	-

Notes: Data source Peart (2011). L, W and Th refer to maximum length, width and thickness in cm respectively. Biface stages (1-5) based on Andrefsky (2005:187-189).

Along the 5GN1.2 rock face, we identified six petroglyph panels (Figure 5-3). All of the rock art elements were abraded or incised into the exposed Junction Creek sandstone formation and protected under the rockshelter overhang. Elements include possible starbursts, rectilinear elements, bird footprints, sets of incised vertical lines or possible sharpening grooves, vulvas and artiodactyl hoof prints (see Hays-Gilpin 2004; Patterson 1998; Patterson et al. 2006; Whitley 1998 [Figure 5-4]).

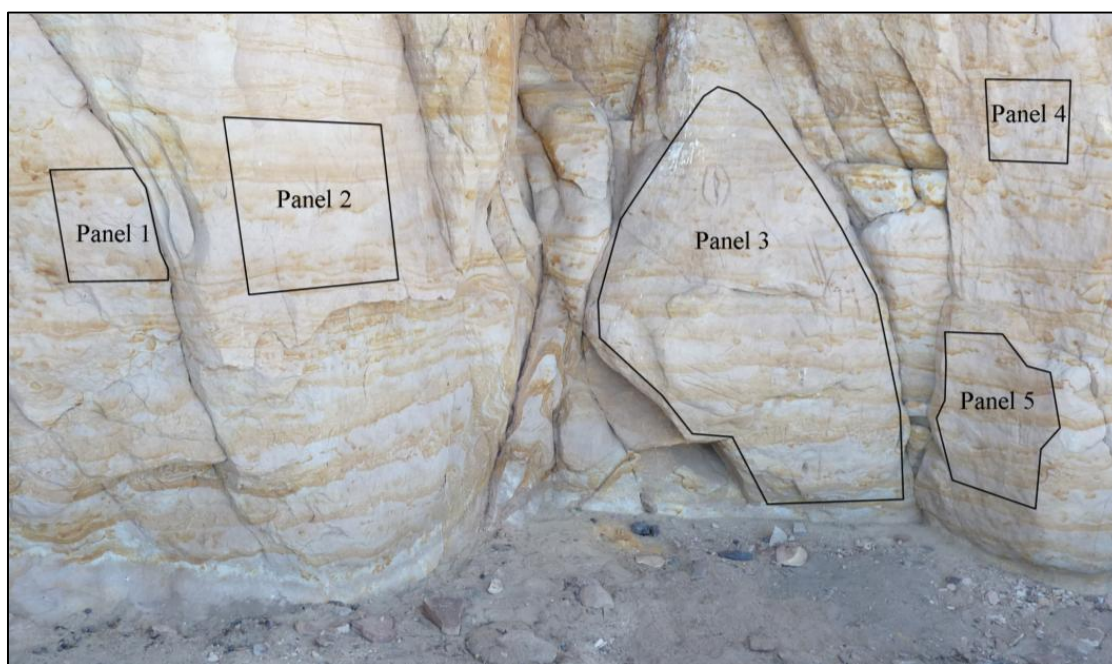


Figure 5-3. Rock art Panels 1 through 5 at 5GN1.2, facing north. Panel 6 (not pictured) located about two meters to the right (east).

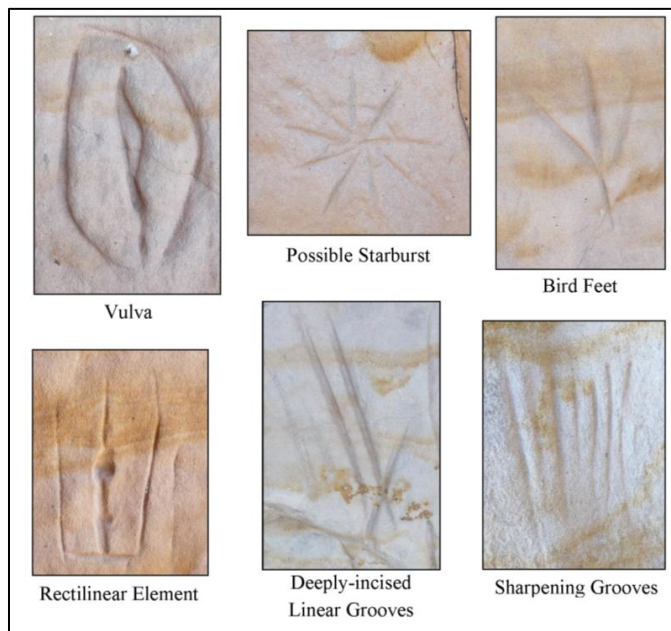


Figure 5-4. Selected rock art elements at 5GN1.2.

Archaeological research in the UGB has identified only a few other sites with rock art, including 5GN7, 5GN928 and 5GN1275 (Scott 1981). Site 5GN7 contains linear and rectilinear petroglyphs incised into a boulder. At site 5GN928, archaeologists identified two white painted figures. One of the figures is geomorphic and the other consists of a broad-shouldered figure with a triangular body (arguably similar to Fremont styled rock art). Site 5GN1275 contains a series of pecked or incised petroglyphs on boulders near Sheep Gulch. In total, 5GN1275 contains 14 distinct petroglyph elements, including eight zoomorphic (probably representations of elk, deer, mountain sheep, hoof prints and a paw print), five linear elements and a single anthropomorphic hand print (Scott 1981). Rock art within the basin is poorly understood and most elements and styles remain undated (Reed and Metcalf 1999; Scott 1981).

Excavation Results

Following the surface inventory, the 2010 field crew excavated a total of four units (three .5-x-1-m and one .5-x-.5-m unit) in 10 cm arbitrary levels until encountering bedrock (Figure 5-5). In the main excavation block (100N 100E, 100N 101E and 101N 102E) bedrock occurred between about 5 to 25 cm below ground level (BGL). In Unit A, we reached bedrock at about 65 cm BGL. The crew used 1/8-inch nested mesh hand-shakers to screen a total of about .6 m³ of matrix. We collected an additional 17 liters (.02 m³) of feature fill for offsite aerated flotation to recover organic materials.

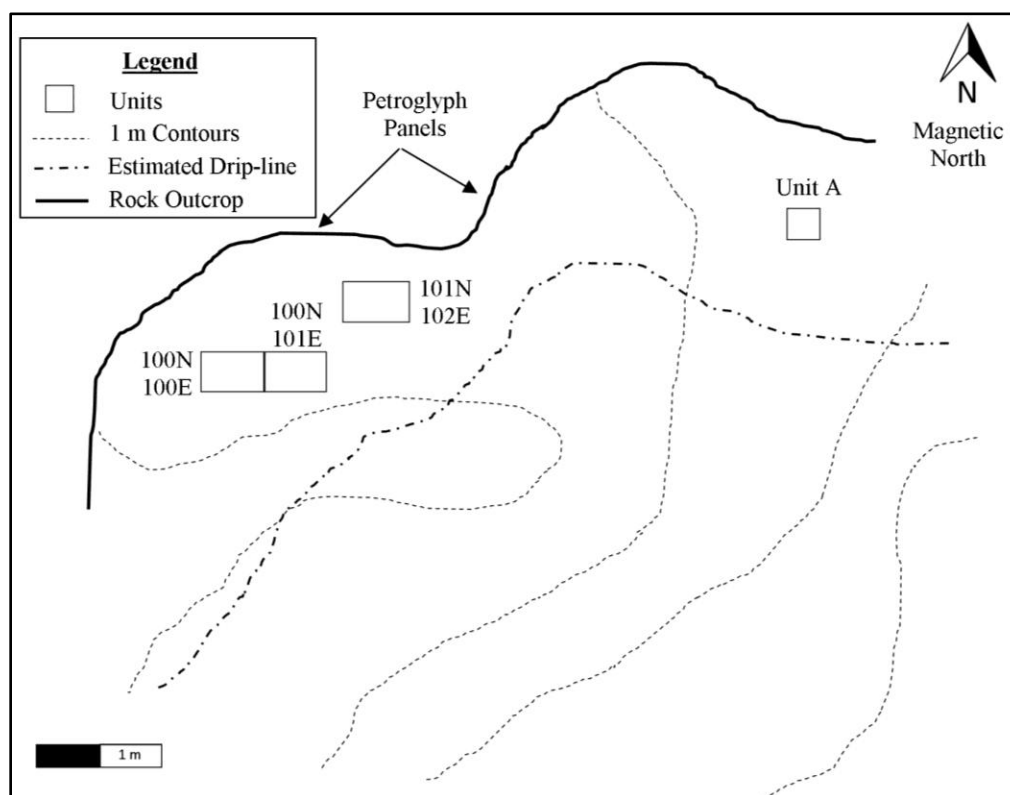


Figure 5-5. Site 5GN1.2 rockshelter excavation plan view map.

We identified two primary stratigraphic components (Stratum 1 and 2) comparable across the main excavation block (Figure 5-9). Stratum 1 occurred between the surface and about 2 to 15 cm BGL and consisted of very loose light yellowish-brown (10YR6/4), medium to fine-grained sand mixed with roots, animal dung and other organic matter. The loose sediment composition coupled with possible krotovina and large amounts of organic matter indicated that bioturbation and other natural disturbances significantly impacted the depositional integrity of Stratum 1. Stratum 1a separated Strata 1 and 2. It consisted of slightly darker (10YR5/4), more compact sandy sediment, containing more charcoal and less other organic detritus (e.g., twigs, roots and animal dung). Stratum 2 contained dark brown to black (10YR4/3) sandy sediments, rich in charcoal and loaded with burnt angular sandstone gravels and cobbles (Peart 2011).

Units 100N 100E and 100N 101E contained evidence of bioturbation and sediment mixing, except within Feature 3. No evidence of any disturbances, such as roots or krotovina, were identified within Stratum 2 in Unit 101N 102E. Unlike the other units, Unit 101N 102E was set further back in the rockshelter, better protecting it from moisture and turbations, such as vegetation growth and animal burrowing (Peart 2011). Strata 1 and 2 grade into each other and likely do not represent a significant change in deposition or site occupation. The main difference between them is that Stratum 2 is more compact and contains additional charcoal and fire-affected rock. Strata 1 and 2 likely do not mark a meaningful temporal or depositional change and artifacts present within excavation levels likely embody a mixed Late Prehistoric assemblage.

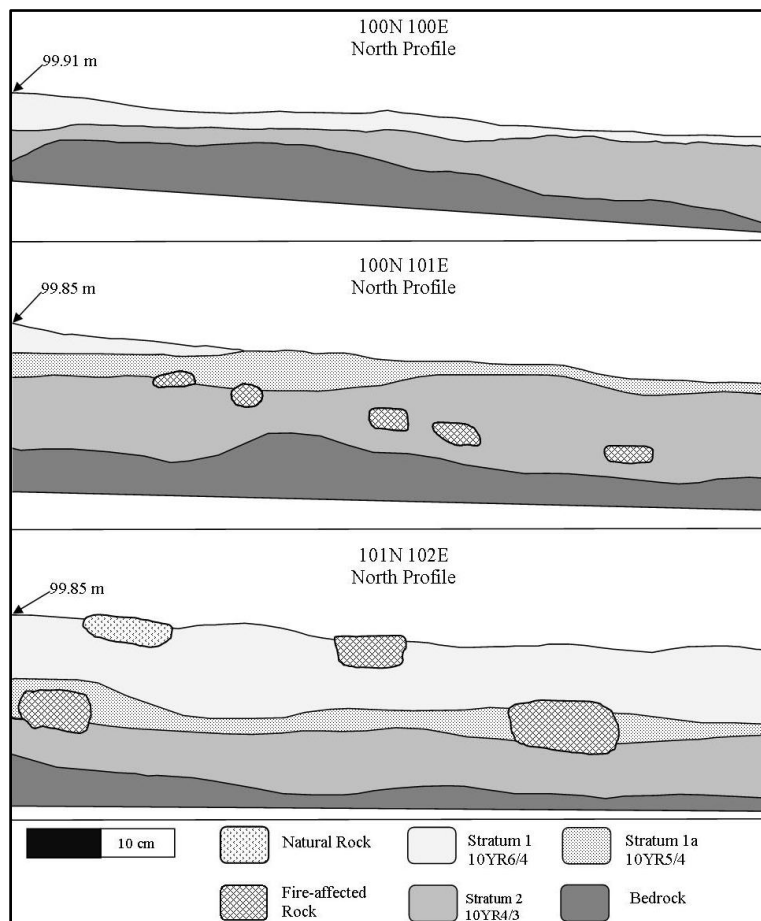


Figure 5-6. Units 100N 100E, 100N 101E and 101N 102E north side wall profiles.

Unit A contained equivalent components for Strata 1, 1a and 2 as identified in the main excavation block (Figure 3-11). Stratum 1 in Unit A consists of very loose fine-grained sands (10YR4/2) mixed with organic material including animal dung, twigs and grasses. Stratum 1a consists of compact, slightly darker sandy sediments (10YR3/1) mixed with more charcoal and organics. We identified roots and krotovina within Strata 1 and 1a, suggesting mixed sediments. Stratum 2 consists of dark (10YR2/1) sandy sediments among large stacked FAR and contains Feature 4 (Peart 2011).

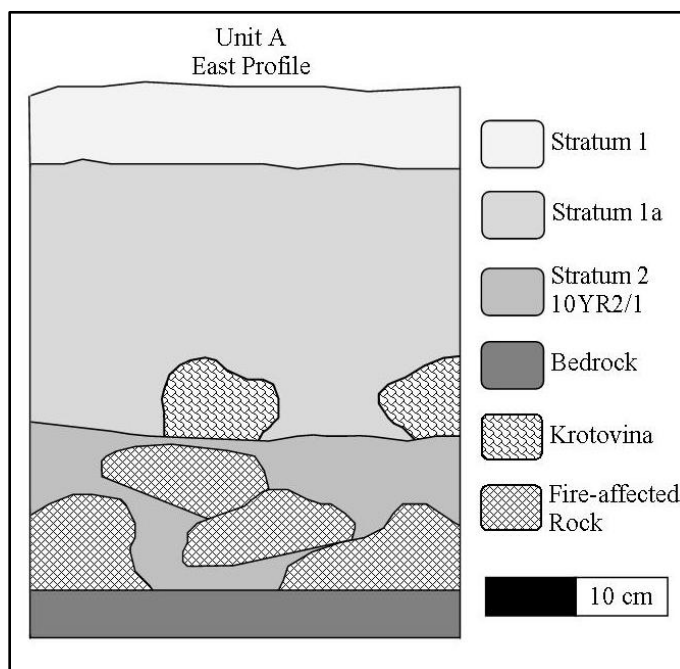


Figure 5-7. Unit A east profile diagram.

Features

The 2010 excavations documented four subsurface archaeological features (Figure 4-10). In all four units, the field crew noted the underlying bedrock retains evidence of intensive heat alteration, suggesting that prehistoric fire hearths were set directly on bedrock. Feature 1 is an undated, surface-exposed 75 cm-diameter half-circle of FAR fragments located in the east half of Unit 100N 100E and west half of Unit 100N 101E within Strata 1 and 1a. This feature is very shallow (less than 10 cm maximum depth) and contains minimal charcoal staining. The field crew collected samples of charcoal from this feature; however, due to questionable feature integrity they were not submitted for radiocarbon dating.

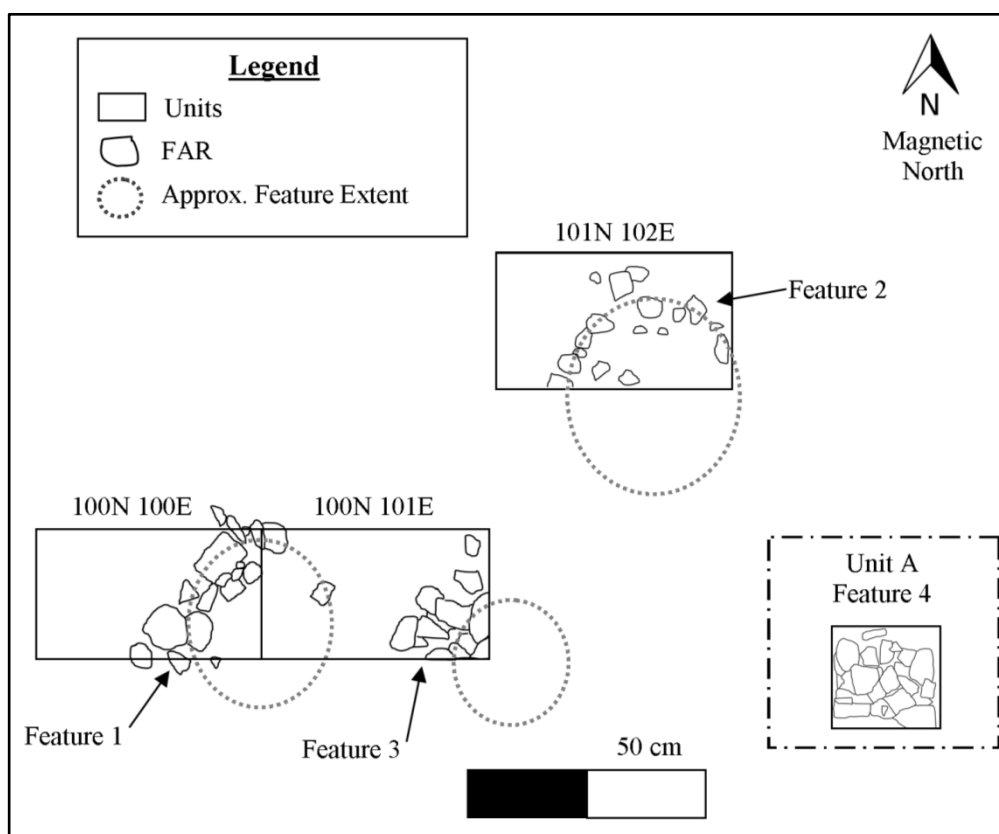


Figure 5-8. Plan view of Features 1 through 4.

Feature 2 is a subsurface scatter of small, less-than 5 cm maximum dimension, FAR fragments and charcoal-stained sandy sediment within the eastern half of Stratum 2 in 101N 102E. This hearth feature measures at least 75 cm in diameter. Sagebrush charcoal (Alden 2011) recovered from the bottom of Feature 2 radiocarbon dated to 1520 ± 30 B.P. (Table 4-5). Feature 3 consists of large, 10 to 20 cm maximum dimension, stacked and heavily burnt sandstone FAR within Stratum 2 in the southeast corner of Unit 100N 101E. This feature resembles a Big Deep FCR Feature, as defined by Stiger (2001), and may indicate more intensive site occupation and possibly bulk resource processing

(Stiger 2001). Sagebrush charcoal (Alden 2011) collected from the base of this feature dated to 1330 ± 30 B.P. (Peart 2011). For both Feature 2 and 3, sagebrush charcoal was selected for radiocarbon dating. Old tree wood can last on the landscape for hundreds of years (Baker et al. 2008) potentially biasing archaeological chronologies based on wood radiocarbon dates (Schiffer 1986). For this reason, sagebrush charcoal from Features 2 and 3 were submitted for radiocarbon dating to minimize the effects of old wood radiocarbon dating (Schiffer 1986). Nevertheless, sagebrush wood can remain on the landscape for longer than 100 years and therefore is unlikely to completely avoid potential age estimation problems (Geib 2008).

Table 5-2. 5GN1.2 radiocarbon dates.

Sample	Feature	Measured age	$^{13}\text{C}/^{12}\text{C}$	Conventional age	Calibrated age
Beta-293434	F3	1320 ± 30 B.P.	-24.1	1330 ± 30 B.P.	CAL B.P. 1510-1460 CAL B.P. 1430-1340
Beta-393435	F2	1500 ± 30 B.P.	-23.6	1520 ± 30 B.P.	CAL B.P. 1300-1240 CAL B.P. 1200-1190
Beta-293436	F4	2950 ± 40 B.P.	-21.7	3000 ± 40 B.P.	CAL B.P. 3330-3070

Note: Data source Peart (2011).

Feature 4 is located within Unit A about 30 cm below the ground surface. This feature is very similar in composition to Feature 3 and likely represents a Big Deep FCR Feature or FCR-outside Feature according to Stiger's feature typology (2001). Exact feature size measurements cannot be ascertained due to the limited excavation size of test Unit A (.5-x-.5-m). The hearth contained over 30 stacked, heavily-burnt and charcoal-

stained angular sandstone FAR fragments and measures at least 30 cm tall. White Pine group charcoal (Alden 2011) from the bottom of this feature radiocarbon dated to 3000 ± 40 B.P. (Peart 2011).

Floral and Faunal Remains

The field crew collected bulk feature fill sediment samples from each feature for aerated flotation processing and macrobotanical identification at the USU archaeological laboratory in Logan, Utah. Flotation processing allows for the recovery of nearly all classes of botanical material preserved in a sediment sample, making quantitative analysis possible (Pearsal 1989).

I used the Flotation Device manufactured by William Sandy to process the collected samples. Following flotation processing, I sorted both the hard and soft matrix, using small hand tools, and when needed, under hand-lens magnification (5-20X). I conducted a preliminary visual identification of the recovered seed assemblage comparing seed shape and size (Pearsal 1989) with a private comparative collection of common Colorado plant seeds as well as seed identification manuals (Davis 1993; Delorit 1970; Martin and Barkley 2000). This preliminary identification included 321 seeds, the majority of which were burnt or charred (about 65 percent) and include *Achnatherum hymeniodes* (Indian rice grass), *Amaranthus* spp. (pigweed), *Chenopodium* spp. (goosefoot), *Opuntia* spp. (prickly-pear cactus), *Physalis* spp. (ground cherry), *Rosa Woodsii* (Wood's Rose) seeds within the assemblage as well as a burnt *Juniperous scopulorum* (Rocky Mountain juniper) berry (Peart 2011).

Due to National Park Service project stipulations for this test excavation, we were unable to collect an off-site sediment sample for botanical comparison. As a result an unknown portion of the recovered seed assemblage associated with these hearth features may represent natural seeds (Pearsal 1989). Nevertheless, greater than 60 percent of the recovered seed assemblage appeared burnt or charred and owing to the paucity of identified seeds elsewhere in the UGB (e.g., Stiger 2001) these preliminary results warrant additional research and consideration.

Table 5-3. Recovered seeds.

Species	100N 100E Feature 1	100N 101E Feature 3	101N 102E Feature 2	Unit A Feature 4	Total
<i>Achnatherum hymenoides</i>	1	0	8	25	34
<i>Amaranthus</i> spp.	4	0	5	2	11
<i>Chenopodium</i> spp.	20	1	88	76	185
<i>Juniperous scopulorum</i> berry	0	0	1	0	1
<i>Opuntia</i> spp.	1	0	0	0	1
<i>Physalis</i> spp.	2	1	4	2	9
<i>Rosa woodsii</i>	0	1	0	1	2
Unidentified	16	5	46	11	78
Total	44	8	152	117	321

In addition to floral ecofacts, the excavation and flotation processing recovered highly fragmented and burnt faunal remains in nearly every level of each unit, totaling 1356 bone fragments. Of these bone fragments, 1255 showed evidence of heat-alteration (93 percent). We recovered the vast majority (98 percent) of bone fragments from Unit 101N 102E associated with Feature 2. The size and fragmented nature of the faunal remains prohibited identification by species or even specific bone element. The largest

bone fragment measured 29.9 mm in maximum length and identified long bone shaft fragments averaged 12.5 mm in maximum length (n = 64). Long-bone shaft diameter averaged 6.8 mm (n = 43; minimum = 2.0 mm; maximum = 15.9 mm; standard deviation = 3.7) and long bone cortical thickness averaged 2.9 mm (n = 43; minimum = 1.1 mm; maximum = 5.4 mm; standard deviation = 1.1). Based on these size characteristics, the faunal remains recovered from 5GN1.2 represent small mammals or birds and not big-game such as bison.

Table 5-4. Recovered faunal remains.

Unit	Unidentifiable	Tooth enamel	Bone bead	Quantity	Mass (g)
100N 100E	15	2	0	17	.53
100N 101E	3	1	0	7	.12
101N 102E	1310	13	1	1324	99.77
Unit A	8	0	0	8	2.12
Totals	1336	16	1	1356	102.54

Stone Tools

The excavation recovered a total of 15 chipped-stone tools, six ground stone tools (five manos and one slab metate fragment) and 3565 pieces of lithic debitage. Debitage analysis methods and results are presented in the following chapter. Five of the ground stone artifacts were recovered from Unit 101N 102E and one was recovered in Unit 100N 101E (Table 5-5). Five of the manos represent river-rounded cobbles, of which three exhibits moderate to heavy use-wear indicated by pecking, striations, and polish.

Table 5-5. Recovered ground stone artifacts.

FS#	Material	L	W	Th	g	Description
2-09 G-1	Sandstone	46.6	28.7	34.3	54.5	Heavily utilized river rounded cobble mano fragment
4-02 G-1	Sandstone	111.9	85.9	25.0	200.0	Slab metate fragment with light use-wear on one surface
4-05 G-1	Sandstone	38.7	20.3	26.4	19.4	Moderately utilized river rounded cobble mano fragment
4-05 G-2	Quartzite	39.4	30.0	26.6	30.5	Mano fragment with light use-wear
4-12 G-1	Sandstone	58.1	35.2	17.4	40.2	Mano fragment with light use-wear
4-28 G-1	Quartzite	34.9	25.5	15.5	13.7	Moderately utilized river rounded cobble mano fragment

Note: L, W and Th refer to maximum length, width and thickness in mm respectively.

Recovered subsurface chipped-stone tools include seven quartzite bifaces or biface fragments, one CCS biface, one CCS possible tested cobble or hammer stone, four non-diagnostic projectile point fragments, one CCS flake scraper and a quartzite amorphous core (Table 5-6). Of the projectile point fragments, three are quartzite and one is made of CCS. Two of the quartzite bifaces (4-7.1 and 4-28.1) appeared heavily polished from use and may represent broken hafted knives.

Summary

Test excavations at 5GN1.2 revealed deposits reflecting aboriginal habitation dating between about 3000 and 1300 B.P. Radiocarbon-dated features suggest at least three site occupations, two occurring between about 1300 and 1550 B.P. and an older occupation at about 3000 B.P. Rock art elements may represent a fourth occupation dating to the Protohistoric; however, the chronology of rock art elements and styles in the UGB is poorly understood and more research is needed to affiliate the rock art with a culture or time period.

Table 5-6. Recovered chipped-stone tools.

FS#	Material	L	W	Th	g	Description	Biface stage
1-1.1	Quartzite	48.1	33.5	12.3	19.8	Biface	2
1-2.1	Quartzite	38.4	25.4	8.8	6.2	Biface fragment	3
1-3.1	CCS	56.2	40.6	27.3	51.6	Possible tested cobble	-
1-3.2	Quartzite	11.9	14.9	3.0	.8	Projectile point medial fragment	5
4-4.1	Quartzite	25.6	10.0	3.1	.9	Biface edge fragment	4
4-5.1	CCS	30.5	23.1	10.0	7.6	Well-worn bifacial scraper	-
4-6.1	Quartzite	40.1	40.0	14.2	18.7	Biface fragment	2
4-6.2	CCS	7.9	12.3	5.1	.5	Biface edge fragment	3
4-6.3	CCS	14.9	15.6	2.5	.6	Projectile point fragment	5
4-7.1	Quartzite	18.0	13.3	2.8	.4	Biface tip; utilized	5
4-11.1	Quartzite	55.1	46.4	23.9	73.2	Amorphous core; exhausted	-
4-14.1	Quartzite	6.2	6.2	2.5	.1	Biface edge fragment	4
4-28.1	Quartzite	24.5	17.7	5.1	2.5	Biface tip fragment; use-polish, possibly hafted biface	5
4-29.1	Quartzite	15.3	14.6	2.7	.6	Projectile point tip and medial fragment	5
A11.1	Quartzite	16.4	12.2	2.5	.4	Projectile point tip and medial fragment	5

Notes: L, W and Th refer to maximum length, width and thickness in mm respectively. Biface stage (1-5) based on Andrefsky (2005:187-189).

The shallow and unconsolidated stratigraphy within the rockshelter indicates that it may be difficult if not impossible to tease apart individual occupations. It is possible that these shallowly buried deposits have mixed through bioturbation and other post-depositional disturbances. Multiple occupations across at least 1500 years, and perhaps 3000 years, are conflated within a single deposit. Still, the site contains charred floral and faunal remains within protected hearth features. Two of these hearth features are constructed with stacked and heavily burnt fire-affected rock and were set on bedrock. Floral and faunal remains provide evidence of plant resource use and small-game procurement. Hearth features, particularly Feature 2, contain numerous burnt faunal fragments possibly as a byproduct of bone grease production. However, the faunal

remains at 5GN1.2 likely only include small mammals and birds not commonly used to produce bone grease (Enloe 1993).

Recovered artifacts include several bifaces, non-diagnostic projectile point fragments, manos and metate fragments, a bifacial scraper, a tested cobble and an amorphous core. Bifacial tools (not including the scraper or projectile point fragments) represent all major stages of bifacial reduction and generally increase in number by stage (Figure 5-9). The 2010 test excavations of site 5GN1.2 recovered a total of 3565 pieces of lithic debitage. Subsurface debitage density within 5GN1.2 is high, about 600 flakes per .1 cubic meters of matrix (or 600 flakes per 1-x-1-m by 10 cm level). Debitage represents the most common artifact class recovered from the site. The following chapter provides a detailed discussion on debitage analysis methods employed for this project and associated results.

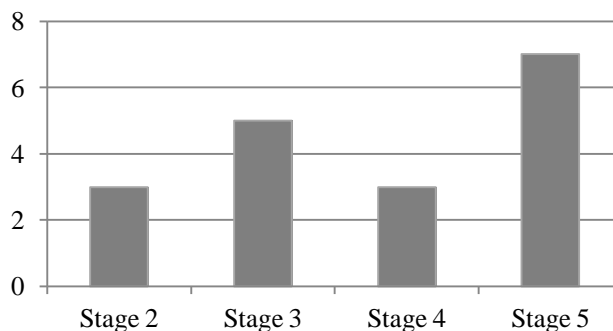


Figure 5-9. Surface and excavation biface reduction stage count of 5GN1.2 bifaces, based on Andrefsky (2005:187-189).

Judging from the small but diverse collection of chipped-stone tools and ground stone, coupled with the floral and faunal evidence, this site likely represents a series of intermittent aboriginal residential occupations during the Late Prehistoric. Site occupants procured a variety of floral and faunal resources, constructed features and maintained a chipped-stone tool kit dominated by quartzite materials. Dense accumulations of quartzite lithic debitage at this site also may indicate lithic procurement and intensive reduction of local quartzite raw material from the surrounding quarry site. Surface survey research at 5GN1 described the site as a prominent lithic procurement site with dense accumulations of primary lithic reduction debris. The relatively high number of later stage bifaces and formed tools is inconsistent with the site simply functioning as a special-use lithic procurement location and suggests a comparatively prolonged residential site function.

CHAPTER 6

DEBITAGE ANALYSIS METHODS AND RESULTS

This chapter begins with a summary of the debitage analysis methodology employed in this thesis research followed by analytical sections that provide more specific details of individual analysis methods and associated results. The following sections are organized in six parts: raw material selection, flake size, flake completeness (Sullivan and Rozen [1985] interpretation-free typology), application load typology, flake platform, and dorsal flake scar count.

I conducted the majority of the debitage analysis for this project with the assistance of fellow archaeology graduate students at USU (Ryan Breslawski, Jessica Dougherty, Tod Hildebrant, Ashley Losey, Britt McNamara, Elizabeth Seymour, and Dayna Reale). Graduate students analyzed a total of 700 flakes (19.6 percent), while I analyzed the remaining assemblage (80.4 percent). To maintain consistency among the lithic analysts, Dr. Bonnie Pitblado analyzed ten sets of ten flakes selected from the debitage assemblage. Each student practiced analyzing these sample sets until they could consistently reproduce the sample data with above 90 percent accuracy.

As explained in the previous chapter, the entire assemblage recovered from 5GN1.2 likely dates to the Late Prehistoric and the excavation levels likely do not mark a meaningful temporal change. For these reasons, the complete debitage collection was analyzed for this project. Rather than subjectively identifying flake types, such as early/late bifacial thinning or core reduction, this study uses combinations of individual flake attributes to identify flake removal techniques, tool-production trajectories and

stages of reduction. The analysis included a total of nineteen flake attributes (nominal, interval and metric data) for each of the 3565 pieces of lithic debitage recovered from site 5GN1.2. This analysis research primarily employed flake attribute definitions contained in Andrefsky (2005) for common debitage-related terms, such as heat-treatment, platform type, platform lipping and bulb of percussion attribute.

Recorded flake attributes include raw material type, color, evidence of heat-treatment or alteration, flake completeness (Sullivan and Rozen 1985), flake tools and pressure flake types, platform type, platform condition, platform lipping, bulb of percussion prominence and dorsal surface longitudinal cross-section. Other recorded flake attributes include dorsal cortex percentage and dorsal flake scar count. We identified nominal flake attributes based on a visual inspection and aided, when needed, by 5-20X magnifying hand lenses. Using digital calipers we generated metric measurements, in .1 mm increments, on all flakes for maximum flake length and thickness as well as platform width and depth. We also weighed each flake using digital scales in .01 gram increments. To facilitate a host of data querying and quantitative techniques, I entered all collected flake attributes and project data into a Microsoft Access version 2010 relational database. I used SPSS version 21.0 to calculate all descriptive and inferential statistics presented in this thesis, with statistical inferences based on a significance value of $p < .05$.

Raw Material Selection

Our team differentiated raw material types based on a combination of color, texture (grain size) and translucence using Andrefsky (2005:41-59) and Mottano et al. (1978) as primary terminology references. We used the more general category, cryptocrystalline silicate (CCS), to classify raw materials commonly identified in archaeological literature under the ambiguous terms chert, flint, chalcedony, opal and jasper (Andrefsky 2005). We identified 3400 quartzite (95 percent), 139 CCS (4 percent), 18 basalt (less than 1 percent), six rhyolite (less than 1 percent) and two flakes of unknown material type (less than 1 percent). Table 6-1 lists the raw material counts by excavation unit.

Table 6-1. Debitage raw material type counts by unit.

Unit	Quartzite	CCS	Other	Totals
100N 100E	555	5	2	562
100N 101E	208	2	-	210
101N 102E	2576	131	24	2731
Unit A	61	1	-	62
Total	3400	139	26	3565
Percent of total	95%	4%	< 1%	

The close proximity of several sources of quartzite raw material to site 5GN1.2 lends support to the assumption that identified quartzite artifacts represent locally procured raw materials. Sources of non-quartzite, while widely available within the UGB, do not occur within a typical hunter-gatherer daily foraging radius of less than 10 km (e.g., Kelly 1995; Morgan 2008) encircling 5GN1.2, and therefore are considered non-

local raw material types. Locally available quartzite raw material dominates (over 95 percent) the debitage assemblage at 5GN1.2.

Quartzite Flake Color

Both Stiger (2001) and Andrews (2010) observed that quartzite bedrock outcrops at 5GN1 contain a variety of colors and color combinations, but primarily include gray, red and brown varieties. Andrews (2010) noted that individual chunks of quartzite from 5GN1 derived from bedrock or cobbles often contain these primary colors banded or blended together. Recovered quartzite flakes from 5GN1.2 exhibit a variety of colors including tan (n = 2168; 64 percent), gray (n = 506; 15 percent) and white flakes (n = 125; four percent). While conducting the lithic analysis for this project, I found that these three colors (tan, gray and white) grade into each other, and despite my best efforts, were subjectively identified. Together these colors represent over 83 percent of the quartzite assemblage. Other quartzite flakes were made with red (n = 521; 15 percent), pink/pinkish (n = 29; less than one percent) and 52 flakes representing other colors or color combinations (one percent).

Heat-treatment

We identified heat-treated materials based on the presence of any combination of the following characteristics: change in luster or texture, color shift (commonly towards red) and glossy flake surfaces that are smooth/waxy to the touch (Anderson 1979). Archaeologists view heat-treatment as a technological adaptation that alters the structural properties of lithic materials towards greater internal homogeneity, thereby facilitating

easier or more predictable knapping (Anderson 1979). Of the 3400 quartzite flakes, only 241 (seven percent) appeared burnt, and about 17 (less than one percent) equivocally heat-treated, leaving about 92 percent (n = 3143) of the quartzite flake assemblage without any evidence of heat-alteration.

It is important to note here that Liestman's (1985) previous attempt at identifying heat-treated quartzite materials within CURE concluded that macroscopic visual identification methods generated unreliable and inconclusive results. Alternatively, Liestman employed scanning electron microscopy to successfully identify evidence of heat-treatment. The analysis reported that about 55 percent of the randomly selected and analyzed bifacial tools bore evidence of heat treatment. Scanning electron microscopy was not employed in this study; consequently, the results presented in this thesis most likely underestimate the proportion of heat-treated quartzite materials.

Non-quartzite flakes combined yielded 90 percent without any evidence of heat alteration, four percent appeared burnt and about six percent represent equivocally heat-treated materials. The presence of only five non-quartzite pot lid fragments lends further support to the conclusion that site occupants likely did not heat-treat or reduce heat-treated lithic material onsite.

Cortex Retention

Cortex represents the weathered exterior surface of a mass of lithic material (Andrefsky 2005). As lithic reduction proceeds, succeeding flakes retain less cortex and continued lithic reduction produces interior flakes without cortex. Archaeological debitage analysis methods often employ measures of cortex coverage as a means to infer

lithic reduction stage, especially when combined with other flake attributes (e.g., Amick et al. 1988; Andrefsky 2005; Magne and Pokotylo 1981; Odell 1989; Tomka 1989). Generally, higher proportions of cortex coverage indicate earlier reduction stages (e.g., Amick et al. 1988; Magne and Pokotylo 1981). Both nodule size and the nature of raw material sources influence the amount of cortex on lithics. For example, larger raw material nodules (especially bedrock sources) retain a lower proportion of cortical surface per volume than smaller raw material packages. As a result flakes derived from smaller nodules are inherently more likely to retain cortex.

We recorded dorsal cortex amount by visual inspection and from 0 to 100 percent with 25 percent intervals. The vast majority of both quartzite and non-quartzite flakes show no cortex (94 percent and 93 percent, respectively), consistent with later stage reduction of interior lithic material (e.g., Amick et al. 1988; Magne and Pokotylo 1981). Cortex cover proportions for quartzite and CCS flakes are not statistically different (Pearson's $\chi^2 = .191$; $df = 2$; two-tailed $p = .882$; Fisher's Exact Test = .182) when compared among three categories: no cortex, 1 to 50 percent and greater than 50 percent cortex coverage (Table 6-2). The low proportion of quartzite cortex coverage may result from observation error, since quartzite material contains coarse grains more difficult to visually differentiate from cortex.

Flake Size

Flake sizes produced by both core-flake and bifacial reduction become smaller as more flakes are removed (Andrefsky 2005). Based on this characteristic, most lithic

Table 6-2. Cortex retention percentage results by material type.

Material Type	No Cortex	1 - 50% Cortex	> 50% Cortex
Quartzite	3206	169	25
CCS	129	8	1
Other	21	1	1
Totals	3356	178	32

analysts employ some measure of flake size in lithic analysis (Andrefsky 2005). Table 6-3 provides summary descriptive statistics for the size variables recorded on quartzite and non-quartzite flakes. By nearly every measure, quartzite flakes are both larger on average and produce a more variable range of flake size measurements than non-quartzite flakes. The only contradiction is the ratio of complete flake length to thickness where complete non-quartzite flakes measure slightly larger on average than non-quartzite flakes.

Individual flakes of sufficient size can be used as expedient tools. For comparison with other lithic analysis projects, I used the minimum useable length of 2.5 cm to identify usable flakes (e.g., Rasic and Andrefsky 2001; Thomas et al. 2010). In total, only 143 quartzite flakes (4 percent of total) and three non-quartzite flakes (less than 2 percent of total) are larger than 2.5 cm in maximum length. Of these flakes, only 17 quartzite, one CCS and one basalt flake displayed evidence of use-wear. The majority of usable quartzite flakes retained no evidence of use or retouch. However, the coarse grain structure of quartzite flakes makes it difficult to visually identify minor retouch and use-wear (Toll 1978).

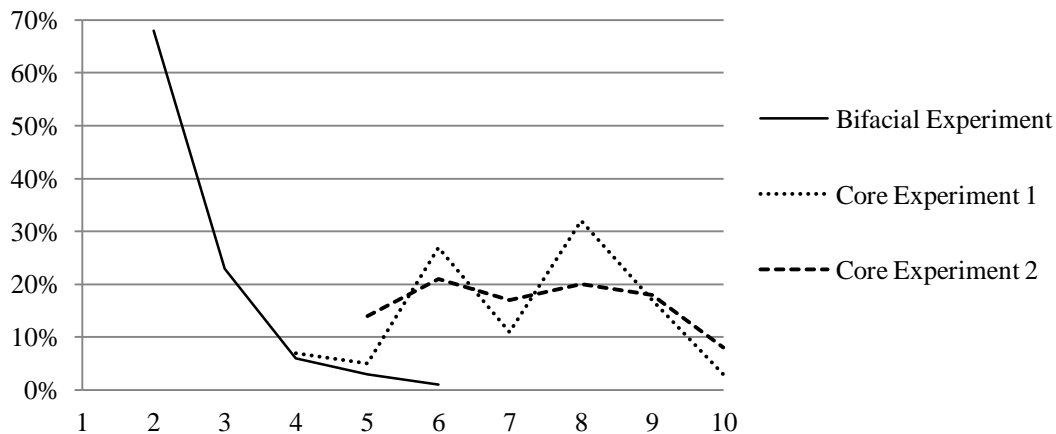
Table 6-3. Complete flake size descriptive statistics.

Material type	Variable	Mean	Variance	SD	Min	Max
Quartzite	Complete flake weight (g)	.81	6.28	2.51	< .01	38.7
Non-quartzite		.33	1.16	1.08	< .01	6.3
Quartzite	Complete flake max. length (mm)	14.30	122.18	11.05	2.9	126.1
Non-quartzite		9.67	49.88	7.06	.7	36.9
Quartzite	Complete flake max. thickness (mm)	2.77	6.51	2.55	.5	25.8
Non-quartzite		1.78	1.35	1.16	.3	6.1
Quartzite	Ratio max. length : thickness	6.06	11.97	3.46	.9	66.4
Non-quartzite		6.25	8.50	2.92	.8	15.0

Note: Complete flakes used in this analysis total 509 quartzite and 35 non-quartzite flakes.

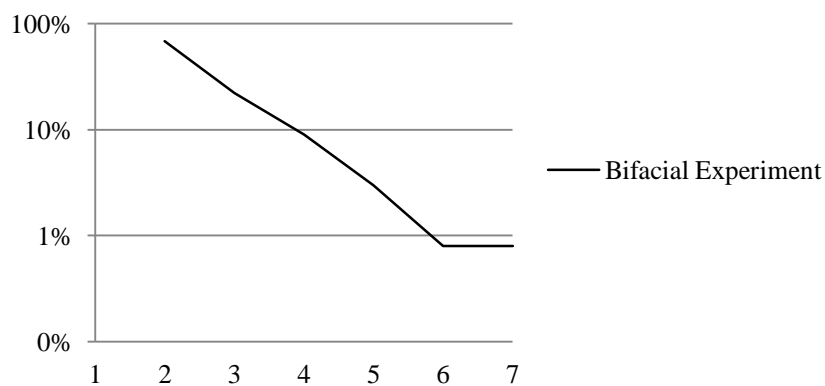
Patterson (1978, 1982, 1990) argued that size-graded flake counts can be used to discern bifacial reduction from core-flake reduction. According to Patterson's model, lithic assemblages generated by bifacial reduction produces an exponential decay curve when graphed. Additionally, when the size-grade results are plotted on a logarithmic scale it forms a characteristic straight-line. Non-bifacial reduction processes (e.g., core-flake, bipolar reduction, or mixed assemblages) produce irregular patterns (Figures 6-1 and 6-2). According to Patterson (1990), this pattern holds constant regardless of the number of bifacial reduction events contributing to the debitage and for each stage of biface reduction.

Experimental tests and reviews of Patterson's log-linear model (Gunn et al. 1976; Henry et al. 1976; Larson 2004; Newcomer 1971; Patterson and Sollberger 1978; Stahle and Dunn 1983) continued to identify this regular flake size distribution pattern even with different numbers and techniques of size grading an assemblage. Despite the potential problems with this methodology, most agree that assemblages produced primarily



Notes: Size grades: 1 (10-15 mm), 2 (15-20 mm), 3 (20-25 mm), 4 (25-30 mm), 5 (30-35 mm), 6 (35-40 mm), 7 (40-50 mm), 8 (50-60 mm), 9 (60-70 mm) and 10 (greater than 70 mm).

Figure 6-1. Experimental size-graded flake count percentage results for core-flake and bifacial reduction, based on Patterson (1990).

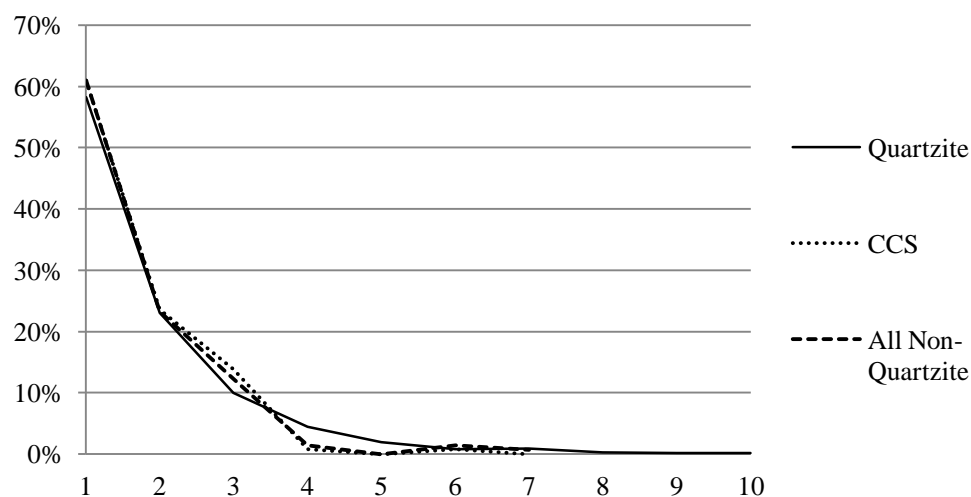


Note: Size grades begin at 5-10 mm and increase in 5 mm increments.

Figure 6-2. Experimental size-graded bifacial reduction flake counts plotted on a logarithmic scale, based on Patterson (1990).

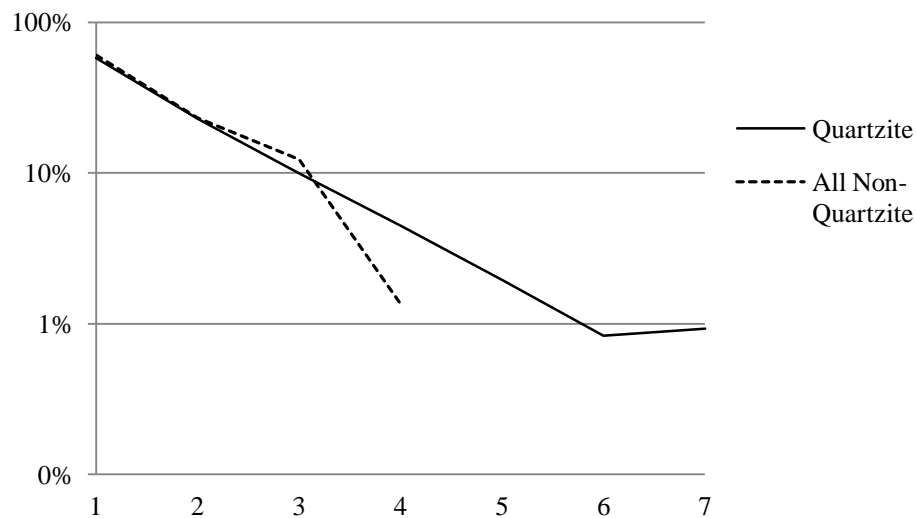
through bifacial reduction exhibit this characteristic exponential curve and logarithmic scale straight-line (e.g., Carr and Bradbury 2004; Stahle and Dunn 1983).

For this project, I used the linear measurement of maximum individual flake length to divide the debitage assemblage into 5 mm size grades beginning at 5 mm. When the size-grade proportions are graphed by material type, all distributions approximate exponential decay curves (Figures 6-3 and 6-4). When quartzite and all non-quartzite size-grade count proportions are graphed on a logarithmic scale, both produced nearly straight-lines, indicating prehistoric 5GN1.2 occupants predominately employed bifacial reduction.



Note: Size grades begin at 5-10 mm and increase in 5 mm increments.

Figure 6-3. Size-grade flake count results graph by material type.



Note: Size grades begin at 5-10 mm and increase in 5 mm increments.

Figure 6-4. Size-grade flake count results plotted on a logarithmic scale.

Flake Completeness (Interpretation-Free Typology)

Analysts categorized each flake according to the Sullivan and Rozen (1985) flake typology (SRT). Sullivan and Rozen (1985:759) developed the “interpretation free” typology that places individual specimens into four distinct debitage categories based on flake completeness: complete, broken, flake fragment and debris. Complete flakes retain a discernible interior surface, a point of applied force and intact margins. Broken flakes have a discernible interior surface, a point of applied force, and broken margins. Flake fragments exhibit a discernible interior surface without a point of applied force. Debris consists of shatter without a discernible interior surface (Sullivan and Rozen 1985).

Table 6-4 presents the results of this analysis differentiated by quartzite and non-quartzite flakes. Flake completeness proportions of quartzite and non-quartzite are

statistically different ($\chi^2_{.05} = 67.84$; $df = 3$; two-tailed $p = < .0001$), but both maintain high proportions of flake fragments and low proportions of complete flakes. Bifacial reduction produces thinner and more fragile flakes than core-flake reduction. Therefore, according to Sullivan and Rozen (1985), bifacial reduction should generate fewer complete flakes and more flake fragments. Following Sullivan and Rozen (1985), these data suggest that the debitage assemblage represents bifacial reduction as the primary tool-production trajectory for both quartzite and non-quartzite materials.

Table 6-4. Quartzite and non-quartzite SRT flake type proportions.

Flake Type	Quartzite (n = 3385)	Non-Quartzite (n = 161)	Z-score	Two-tailed <i>p</i> value
Complete	.150	.217	-2.300	.021
Broken	.143	.149	-.227	.821
Fragment	.672	.478	5.075	< .001
Debris	.352	.155	-7.540	< .001

Sullivan and Rozen (1985) identified four technological groups (IA, IB1, IB2, and II) based on analyzed archaeological lithic assemblages. Technological Group IA represents un-intensive core reduction identified by a high proportion of cores (14.7 percent) and complete flakes (53.4 percent). Groups IB1 and IB2 debitage results from a mixture of core reduction and tool manufacture. IB2 debitage is distinguished by a very high percentage of debris (23.0 percent), and according to Sullivan and Rozen (1985), signifies late-stage and exhausted core reduction. The debitage characteristics of

Technological Group II reflect tool manufacturing byproducts with a low percentage of cores (.6 percent) and complete flakes (21.0 percent).

Using Sullivan and Rozen's (1985) technological groups as a continuum model, both the quartzite and non-quartzite flake type proportions recovered from 5GN1.2 suggest intensive core reduction (Group IB2) and/or bifacial tool production (Group II; Figure 6-5). Further, non-quartzite debitage exhibit a higher proportion of debris, suggesting a closer connection with Technological Group II, identified as late-stage intensive bifacial reduction.

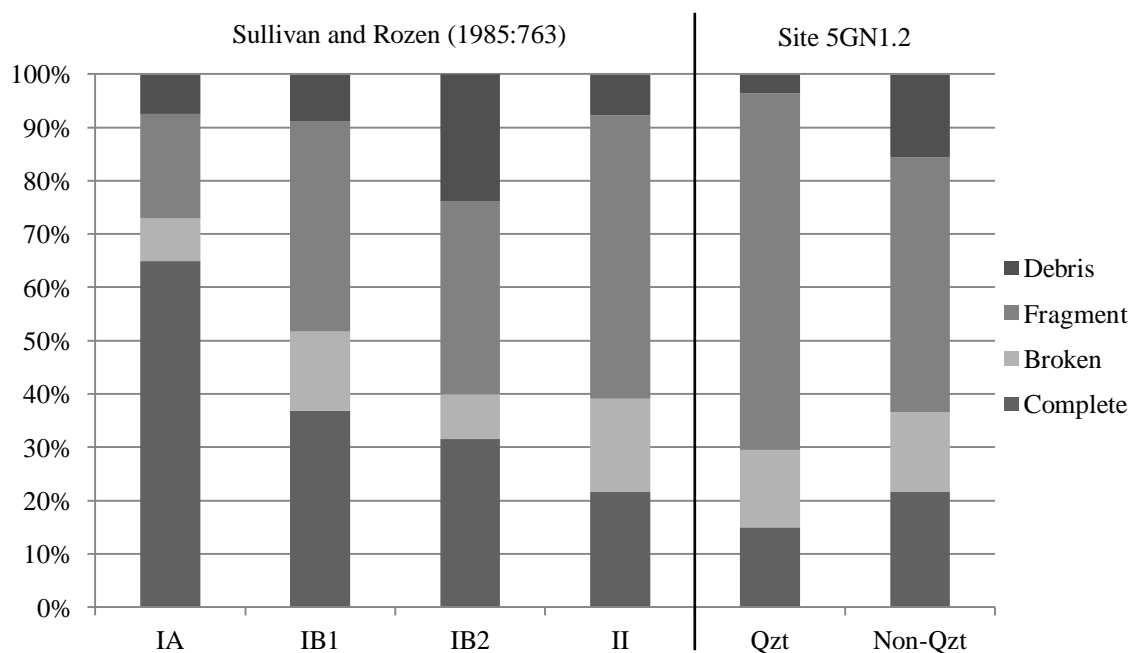


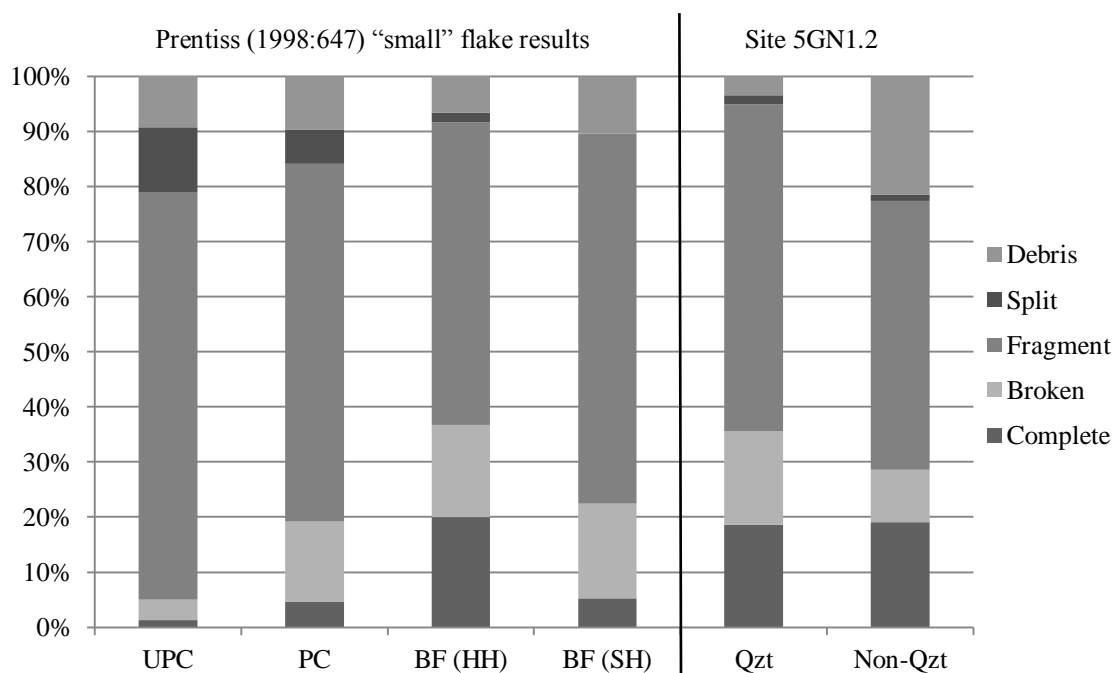
Figure 6-5. Proportion comparison bar graph between SRT technological group expectations and site 5GN1.2 quartzite (Qzt) and non-quartzite (Non-Qzt) flakes.

Sullivan and Rozen's (1985) interpretation-free typology stimulated numerous lithic reduction studies to evaluate the model's predictions (e.g., Baumler and Downum 1989; Kuijt et al. 1995; Prentiss 1998, 2001). These studies indicated that flake breakage patterns are sometimes more variable than originally identified by Sullivan and Rozen. The studies also indicated that the observed variability is graded by size and raw material type among other parameters. In general, replication experiments have demonstrated some usefulness of the typology, sometimes with modification (e.g., Prentiss 1998, 2001), to identify bifacial versus core-flake reduction when applied in specific contexts (Andrefsky 2005).

Prentiss (1998, 2001) examined experimentally derived debitage assemblages size-graded into four categories (extra-large [greater than 64 cm²], large [16 to 64 cm²], medium [4 to 16 cm²] and small [.64 to 4 cm²]), and categorized all flakes according to the SRT typology with the added category of split flake. The study found that flake type proportions vary between size grades in ways not predicted by SRT (Prentiss 1998, 2001). To incorporate experimental results, Prentiss (2001) developed a modified SRT (MRST) that incorporates size grades.

I used the linear measurement of maximum flake length to size-grade the 5GN1.2 assemblage to compare the assemblage with the experimental results reported by Prentiss (1998). I found that the majority of quartzite and non-quartzite flakes fall within the category of small (.64 to 4 cm squared) flake grade size (n = 1742) or smaller (n = 1534). Figure 6-6 compares the experimentally derived SRT flake proportions for small size-grade debitage provided by Prentiss (1998) with those identified at 5GN1.2. Again, site

5GN1.2 debitage most closely matches that of prepared core and biface reduction with relatively high frequencies of complete flakes and low proportions of split flakes. Further, small-sized quartzite flakes nearly match the experimental results generated by Prentiss (1998) for bifacial reduction using hard-hammer percussion. Taken together, SRT and MSRT analysis results provide strong evidence of bifacial reduction as the principle tool-reduction trajectory at 5GN1.2 for both quartzite and non-quartzite raw materials.



Notes: UPC = unprepared core both hard and soft hammer percussion; PC = prepared core hard and soft hammer percussion; BF = biface; HH = hard hammer; SH = soft hammer.

Figure 6-6. Proportion comparison bar graph between Prentiss's (1998) experimental data and site 5GN1.2 quartzite and non-quartzite flakes.

Application Load Typology

Under the application load typology, lithic analysts classify flakes by reduction technique with hard-hammer, soft-hammer and pressure as primary flake types (Andrefsky 2005). As previously stated in previous sections of this thesis, bifacial reduction can be thought of as a planned and staged process. Earlier stages of bifacial reduction, such as cortex removal and the production of an edged biface, can employ hard or soft-hammer percussion tools. Later stages, such as edge sharpening and final treatments, often require more controllable pressure flaking (Andrefsky 2005).

No universal method or set of flake attributes are accepted as standard to differentiate flakes according to the application load typology (Andrefsky 2005; Cotterell and Kamminga 1979; Crabtree 1972). Lithic analysis research does suggest that even though soft and hard-hammer reduction produces flakes with attributes that overlap in their range of bulb morphology and amount of lipping; in most cases, these characteristics can be used to effectively discriminate between the two hammer types (Andrefsky 2005). Lithic analysts tend to agree that hard-hammer percussion flakes retain pronounced bulbs of force, no lipping and slightly crushed platforms (Andrefsky 2005; Odell 1989). Conversely, soft-hammer percussion flakes exhibit a diffuse bulb of force and a pronounced lip (Andrefsky 2005; Crabtree 1972; Odell 1989).

For this lithic analysis project, we categorized each complete and broken flake's bulb of percussion as prominent, semi-prominent or flat. We also coded platform lipping as either present or absent. Table 6-5 compares complete and broken quartzite flakes, measuring greater than 1 cm in maximum linear dimension, with bulb of percussion and

platform lipping attributes. The analysis of quartzite flakes identified 325 hard-hammer percussion flakes (lipping absent with either prominent or semi-prominent bulb of percussion) and 87 soft-hammer percussion flakes (lipping present with semi-prominent or flat bulb of percussion). Only 13 total non-quartzite complete and broken flakes measure greater than 1 cm in maximum length and of these flakes, eleven retain attributes associated with hard-hammer percussion and two may represent soft-hammer percussion flakes.

Table 6-5. Quartzite complete flake bulb of percussion and platform lipping attribute results.

Bulb of Percussion	Platform Lipping		Totals
	Present	Absent	
Prominent	71	102	173
Semi-prominent	68	223	291
Flat	19	81	100
Totals	158	406	564

Pressure flaking removes flakes or chips by applying force directly to an objective piece without percussion striking (Andresfky 2005). Pressure load application directs energy to a specific point of applied force, thus increasing accuracy and minimizing flake production errors, such as flake step/hinge terminations or objective piece snap fractures (Andrefsky 2005). As such, pressure flakes become more common as lithic reduction proceeds towards finished products and/or as a result of edge retouch or tool sharpening. Experiments in pressure flake production generates small flakes, typically less than about 1 cm in maximum length (e.g., Ahler 1989; Andrefsky 2005), except with specialized

pressure flaking techniques (e.g., Crabtree 1966). Andresfky (2005) noted lithic analysts have not generated a universally accepted definition or set of mutually exclusive flake characteristics specific for pressure flakes. However, most analysts agree pressure flakes can be distinguished from percussion flakes on the basis of general size characteristics (pressure flakes are smaller, thinner and weigh less).

As a result of the debitage analysis for this project, I found that the coarse grain structure of the quartzite flakes rendered pressure flake categories impossible to identify consistently. For this reason, I am not including a discussion of the results from the pressure flake typology. However, since archaeologists typically identify pressure flakes using a combination of more objectively derived flake metrics (length, width, and platform size) the concept of pressure flake will be addressed in subsequent sections of this chapter.

Flake Curvature

Flake longitudinal curvature generally decreases as bifacial reduction approaches finished products, such as shaping projectile points (Andrefsky 1986, 2005). However, experimental bifacial reduction results presented by Hayden and Hutchings (1989) indicated that flakes produced through hard and soft-hammer bifacial reduction maintain comparable flake curvature characteristics throughout the reduction process. They also noted that flake curvature generally decreases in late bifacial reduction.

For this project, we recorded flake curvature as curved or flat based on a visual inspection of each flake. Of the total number of quartzite flakes ($n = 3400$), 1242 appeared curved (36 percent), 2017 flat (60 percent) and 141 indeterminate (4 percent).

Non-quartzite flakes total 162 and include 85 curved (52 percent), 52 flat (32 percent) and 25 indeterminate (15 percent). Non-quartzite flakes exhibit a statistically significant higher proportion (Pearson's $\chi^2 = 31.6351$; $df = 1$; two-tailed $p < .0001$) of curved flakes as compared with quartzite flakes. This may indicate non-quartzite flakes represent earlier stages of bifacial reduction. However, the smaller sample size and differing fracture mechanics between raw material types, quartzite and non-quartzite, may account for some of this variation.

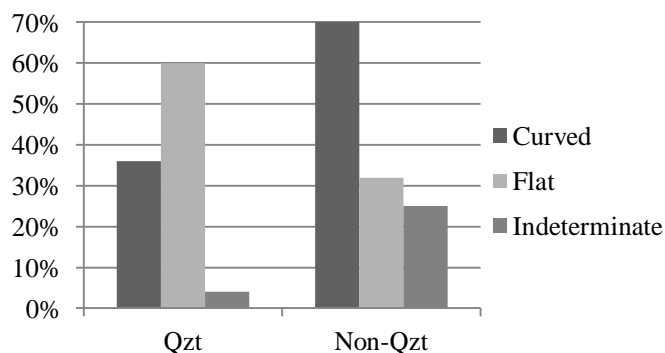


Figure 6-7. Flake curvature results.

Flake Platforms

Flake platform is defined as the surface area of a flake that received the application of force to detach it from an objective piece (Andrefsky 2005; Crabtree 1972). Lithic analysts consider flake platforms as a key attribute of debitage and employ a host of different platform typologies and measurements in individual flake attribute analysis research (Andrefsky 2005). As bifacial reduction progresses and a piece

becomes smaller and thinner, the risk of platform failure increases. As a result, knappers prepared platforms by grinding or by creating small platform flakes or chips. Lithic analysts call these small flakes platform facets (Andrefsky 2005). By counting the number of facets on flake platforms on both experimental and archaeological debitage assemblages, archaeologists have successfully separated bifacial and core-flake reduction (e.g., Magne and Pokotylo 1981; Morrow 1984; Shott 1994; Tomka 1989). However, as Andrefsky (2005) and Odell (1989) concluded, facet counts are difficult to precisely replicate among analysts. As a result, they advocate an ordinal classification of platform facet counts.

For this lithic analysis project, we characterized flake platforms by an ordinal measure of facet count (cortical [zero facets], plain [one facet], dihedral [two facets], faceted [three or more facets], or crushed) and generated metric measurements of platform width and thickness. This approach is based on the methodology and definitions suggested by Andrefsky (2005). Results from the typological analysis are presented in Table 6-6 and Figure 6-8.

Table 6-6. Flake platform type count results.

Material	Cortical	Plain	Dihedral	Faceted	Crushed
Quartzite	61	237	29	602	44
Non-Qzt	3	9	4	40	2

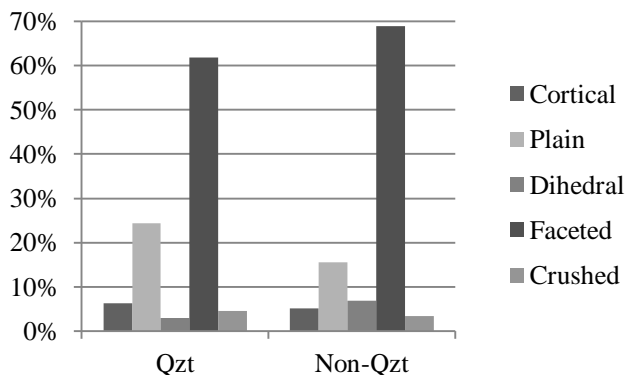


Figure 6-8. Flake platform type count proportions bar chart.

Both quartzite and non-quartzite flakes exhibit a high proportion of faceted platforms (over 60 percent) and low proportions of plain platform types (24 percent for quartzite and 16 percent for non-quartzite). The greater proportion of quartzite plain platforms may indicate an earlier stage reduction signature of local quartzite materials from 5GN1. Additionally, cortical and crushed platform proportions are low indicating later stage reduction and limited use of hard-hammer percussion techniques that more often crush platforms (Andrefsky 2005).

We also recorded flake platform condition (ground or nibbled, worn or unmodified/un-impacted) for each flake. The results of this analysis are presented in Table 6-7 and Figure 6-9. Both quartzite and non-quartzite flakes exhibit a high proportion of ground/nibbled flake platforms, indicating time investment in platform preparation. Again, greater investment in platform preparation indicates later stages of lithic reduction expected with smaller and thinner pieces. Non-quartzite flakes are more likely to exhibit evidence of a worn platform edge, suggesting removal from a utilized

tool as opposed to platform preparation grinding. 5GN1.2 analysis results are consistent with the conclusion that non-quartzite tools represent a curated and maintained tool-kit (Andrefsky 2005).

Table 6-7. Flake platform condition at 5GN1.2.

Material	Ground/nibbled	Worn	Unmodified
Quartzite	347	45	514
CCS	19	7	29
Totals	336	52	543

Note: Quartzite and non-quartzite flake platform condition attribute proportions are statistically different (Pearson's $\chi^2 = 6.11$; $df = 2$; two-tailed $p < .047$).

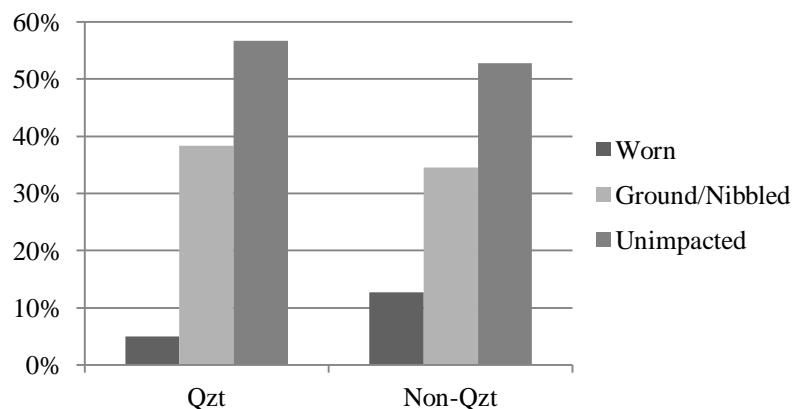


Figure 6-9. Platform condition bar graph comparing quartzite to non-quartzite flakes.

Experimentally produced flakes exhibit a positive and predictable relationship between platform dimensions, flake dimensions, exterior platform angle and the necessary percussive force required to initiate a fracture (Dibble and Rezek 2009; Nonaka et al. 2010). In other words, the removal of larger flakes requires more energy and larger platforms. Flake platform metric measurements indicate that quartzite flake platforms are

on average slightly wider, deeper and more variable than non-quartzite flakes at 5GN1.2 (platform area; Mann-Whitney U test, $z = -3.624$, $p < .001$ [Table 6-8]). Again, these data indicate greater range in flake size and earlier represented stages of reduction for quartzite debitage.

Table 6-8. Flake platform size descriptive statistics.

Material	Variable	n	Mean	Variance	SD	Min	Max
Quartzite	Platform width	919	6.38	15.34	3.92	.9	39.7
Non-quartzite		50	4.54	3.52	1.89	1.6	9.9
Quartzite	Platform depth	919	2.13	2.51	1.59	.1	17.8
Non-quartzite		50	1.42	.91	.96	.3	4.7
Quartzite	Platform area (width times depth)	919	18.37	1371.68	37.07	.46	706.7
Non-quartzite		50	7.66	65.88	8.11	.6	36.6

Note: Both quartzite and non-quartzite flake platform area data are not normally distributed (Kolmogorov-Smirnov test, $p < .001$; $p = .006$, respectively).

Dorsal scars

The number of dorsal flake scars generally increases through the reduction sequence (e.g., Andrefsky 2005; Magne 1985; Magne and Pokotylo 1981). Odell (1989) suggested dorsal flake scars only include scars with discernible flake attributes (e.g., point of applied force, negative bulb of percussion and terminations) that are separated by distinct dorsal ridges. Although this definition removes the majority of scars resulting from edge damage, platform preparation, flake breaks, or ridge scars, dorsal flake scar counts are known to be difficult to precisely replicate among lithic analysts (Andrefsky 2005; Shott 1994). For this reason, analysts typically employ an ordinal measure of flake dorsal scar count (e.g., Andrefsky 2005; Magne 1985).

For this flake attribute, we visually counted dorsal flake scars on each flake based on the definition provided by Odell (1989). Because flake completeness complicates the relationship between dorsal flake scar count, and inferred reduction stage, the following tables and figures presented in this section include only complete or broken flakes (Table 6-9; Figure 6-10). Mauldin and Amick (1989) found that flake size also influences dorsal flake scar count, however, the vast majority of flakes recovered from 5GN1.2 fit within the same size grade. As such, the entire assemblage is considered in the following analysis of dorsal flake scar counts.

Table 6-9. Dorsal flake scar counts by material type.

Dorsal Scar Count	Quartzite	Non-Quartzite
Cortical	7	1
1	214	6
2	352	16
3	253	17
4 +	114	14

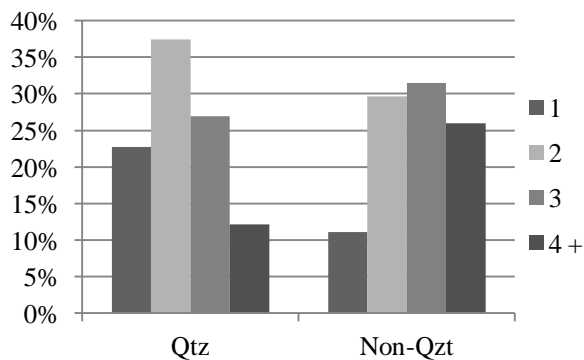


Figure 6-10. Dorsal flake scar count proportions by material type.

Experimental reduction results presented by Magne (1985) indicated that the number of dorsal scars increases from an average of one dorsal scar per flake to more than three scars over the reduction sequence. Subsequent reduction experiments conducted by Mauldin and Amick (1989) demonstrated that early stages in the reduction sequence (from nodule to bifacial preform) produced on average less than three dorsal scars per flake, while later reduction stages (blank to finished tool) produce greater than three dorsal scars per flake. These experimental results when compared with 5GN1.2 debitage suggest that both quartzite and non-quartzite flakes reflect later stages of bifacial reduction and final tool production. Non-quartzite flakes exhibit roughly even dorsal flake scar count proportions (between about 27 and 32 percent) between the categories of two, three and four or greater flake scar counts as compared with quartzite flakes. Quartzite flakes exhibit a spike in the proportion of two flake scars (about 37 percent) that suggests a greater proportion of bifacial blank production debitage (Mauldin and Amick 1989).

Debitage Analysis Results Summary

The lithic raw materials represented within site 5GN1.2 chipped-stone assemblage are overwhelmingly dominated by quartzite (over 95 percent). Local cobble and bedrock sources of quartzite are readily available within a few hundred meters of the rockshelter. Based on the dense accumulations of quartzite flakes within these deposits, Late Prehistoric site occupants likely procured and reduced local Junction Creek formation quartzite at the rockshelter. The very low proportion of quartzite flakes with any cortical

surface material (about six percent) provides evidence of late stage reduction and possibly that prehistoric occupants preferentially selected local bedrock quartzite sources. The high proportion of gray, white and tan colored quartzite flakes (over 82 percent) may indicate a planned lithic procurement strategy focused on acquiring higher quality quartzite for bifacial reduction.

Non-quartzite raw materials represent less than five percent of the chipped-stone assemblage. Although many non-quartzite raw material sources occur within the UGB, no known sources occur within a typical daily hunter-gatherer foraging radius of less than 10 km. Therefore, these materials likely represent non-local raw materials carried to the site from some distance. On average, metric measurements indicate that non-quartzite flakes are on average shorter, thinner and less variable than quartzite flakes. Again, this suggests non-quartzite flakes represent raw materials transported greater distances (Beck 2008; Beck et al. 2002; Newman 1994).

To identify tool-production trajectories this research employs three fundamentally different debitage analysis interpretive methods: SRT flake completeness typology (Sullivan and Rozen 1985), Patterson's size-graded log-linear model (1990) and flake platform attributes. All three methods identified bifacial reduction as the primary tool-production trajectory for quartzite and non-quartzite debitage at this site. As explained in Chapter 2, lithic analysts view the production of a finished biface as a planned and staged process (e.g., Andrefsky 2005). Each bifacial reduction stage produces flakes that retain unique and identifiable characteristics. Generally, as bifacial reduction proceeds from blank to finished forms, the amount of cortex on the dorsal surface decreases, dorsal flake

scars increase, platform preparation increases and flakes become thinner and smaller (Andrefsky 2005). For the purposes of this project, four primary flake attributes (cortex, platforms, dorsal scar counts and flake metrics) provide the most meaningful evidence of represented bifacial reduction stages.

The vast majority (over 92 percent) of both quartzite and non-quartzite flakes retain no cortex on the dorsal surface and no cortex on flake platforms. Typically, quarry site debitage assemblages include relatively large numbers of flakes with cortex representing early stage reduction. At 5GN1.2 this is not the case. The low proportion of cortex on quartzite indicates later-stage reduction of interior lithic material and possibly preferential reduction of bedrock raw materials (e.g., Amick et al. 1988; Magne and Pokotylo 1981). Alternatively, the lack of cortex may indicate that initial reduction occurred away from the rockshelter presumably near outcrops or cobble sources.

Both quartzite and non-quartzite flakes exhibit a high proportion of faceted platforms (over 60 percent), relatively low proportions of plain platform types (24 percent for quartzite and 16 percent for non-quartzite) and few crushed platforms. Both quartzite and non-quartzite flakes also exhibit a high proportion of ground/nibbled flake platforms, indicating time investment in platform preparation. Non-quartzite flakes are more likely to exhibit evidence of a worn platform edge, suggesting removal from a utilized tool. Both quartzite and non-quartzite flakes exhibit on average greater than three dorsal flake scars, indicating late-stage bifacial reduction as the dominant reduction stage (Magne 1985; Mauldin and Amick 1989). Taken together, these characteristics suggest quartzite flakes represent all stages of bifacial lithic reduction, from initial bifacial edging

to finished tool production. Conversely, non-quartzite raw flakes represent only late-stage bifacial reduction probably representing tool maintenance debitage.

These debitage analysis results present a consistent account of the organization of Late Prehistoric lithic reduction activities. During the Late Prehistoric, occupants of site 5GN1.2 procured locally available quartzite and bifacially reduced those materials. These occupants arrived at the site with a curated biface dominated toolkit that included non-quartzite tools. While at 5GN1.2, these non-quartzite bifacial tools were maintained.

CHAPTER 7

DISCUSSION AND CONCLUSIONS

The purpose of this thesis is to use archaeological research and particularly debitage analysis at site 5GN1.2 to evaluate Stiger's Late Prehistoric hypothesis. Stiger (2001) proposed that during the Late Prehistoric, aboriginal occupations of the UGB were limited to short-term and long-range logistical big-game, particularly bison, hunting forays originating from base camps located outside of the basin. Since Stiger's hypothesis is based on the forager-collector continuum model, associated archaeological test implications include settlement mobility, site types, features, subsistence remains and the organization of technology (see Binford 1980; Metcalf and Black 1997; Stiger 2001). A summary of these basic test implications is provided in Table 7-1.

Table 7-1. Test implications of Stiger's Late Prehistoric hypothesis.

Characteristic	Expectations
Mobility pattern	-Logistically mobile collectors on task-specific forays
Site types	-Location or station (e.g., Binford 1980; Metcalf and Black 1997) but no residential sites (see Stiger 2001).
Subsistence	-No evidence of floral or small-game procurement or processing -Big-game butchering and processing
Lithic tools	-Assemblages dominated by projectile points and butchering tools -Low tool diversity and high tool specificity -No ground stone
Organization of technology	-Curated biface dominated tool-kit made of non-local materials -Embedded procurement of local quartzite raw materials -Debitage reflects tool maintenance of curated bifacial tools

Test excavations at 5GN1.2 revealed intact archaeological deposits reflecting aboriginal occupation during the Late Prehistoric. Four subsurface hearth features with

radiocarbon dates reflect at least three site occupation episodes, one older occupation at about 3000 B.P. and two occurring between about 1550 and 1300 B.P. Taken together, these radiocarbon dates suggest the site was occupied during the Late Prehistoric but prior to Ute occupations (Reed and Metcalf 1999). Unfortunately, outside of the hearth features within the rockshelter, the loose sandy and shallowly buried deposits may have been mixed by bioturbation and other processes. These multiple occupations span at least 1500 years (3000-1500 rcybp) and are contained within this single deposit, but do appear to be confined to the Late Prehistoric. For these reasons, the archaeological materials at 5GN1.2 present an opportunity to test Stiger's hypothesis.

The 2010 test excavations at 5GN1.2 processed a total of about .6 m³ of site matrix, yet documented a dense accumulation of cultural material including hearths, debitage, chipped-stone tools, ground stone, subsistence remains and FAR. The four hearth features include an undated, surface-exposed, half-circle of FAR measuring about 75 cm in diameter (Feature 1), a subsurface scatter of FAR fragments also measuring about 75 cm in diameter (Feature 2) and two features constructed with heavily burnt and stacked large (10 to 20 cm maximum dimension) sandstone FAR (Features 3 and 4). Aerated flotation processing of 17 liters of feature fill produced 320 seeds and one burnt Rocky Mountain juniper berry. Of these seeds, this research tentatively identified Indian rice grass (n = 34), *Amaranthus* spp. (n = 11), *Chenopodium* spp. (n = 185), *Opuntia* spp. (n = 1), Ground cherry (n = 9) and Wood's rose (n = 2). The excavation and flotation also recovered highly fragmented and unidentifiable faunal remains in association with these features, totaling 1355 unidentifiable bone fragments and a single bird bone bead. As

explained in Chapter 5, these faunal remains are consistent with small-game and exclude big-game, based on long bone fragment size characteristics.

The excavation recovered a diverse collection of chipped-stone and ground stone tools, including five manos, one slab metate, seven quartzite bifaces or biface fragments, four non-diagnostic projectile point fragments, a well-worn scraper, a tested cobble or hammer stone, an amorphous core and 19 utilized flakes. Although, the assemblage contained 3565 flakes, only 143 quartzite and three non-quartzite flakes are larger than an estimated minimum useable length of 2.5 cm (e.g., Thomas et al. 2010; Rasic and Andrefsky 2001). Of the debitage assemblage, use-wear or edge retouch was identified on 17 quartzite and two non-quartzite flakes (less than one percent of recovered debitage).

Individual flake attribute analysis of the entire 3565 flake assemblage provides evidence that at 5GN1.2 Late Prehistoric lithic reduction activities were dominated by bifacial tool production of mostly locally procured quartzite but also a small amount of non-local raw materials. To identify tool-production trajectories this research employed three fundamentally different debitage analysis interpretive methods: SRT/MRST flake completeness typologies (Prentiss 1998, 2001; Sullivan and Rozen 1985), Patterson's (1990) size-graded log-linear model, and flake platform attributes. All three methods identified bifacial reduction as the primary tool-production trajectory for quartzite and non-quartzite debitage at this site. Additionally, the quartzite debitage possibly represent the entire bifacial reduction sequence, minus initial edging and cortex removal that may

have occurred elsewhere. Non-quartzite flakes are dominated by late-stage bifacial reduction, probably representing tool maintenance debitage.

The artifact and feature assemblage at 5GN1.2 is not consistent with specialized procurement of any particular subsistence resource. Nonetheless, dense accumulations of quartzite debitage and the close proximity of sources of quartzite raw material may indicate an emphasis on lithic procurement bifacial tool production. Prehistoric site occupants almost exclusively focused on the production of formal bifacial tools made from quartzite raw material. Archaeological research generally considers formal and curated technologies (e.g., bifacial technology) as an adaptation to the needs of highly mobile hunter-gatherers (see Gramly 1980; Kelly 1988; Thomas 2012). The benefits of bifacial technology principally rests in that bifaces can serve many functions, can be reshaped into a number of forms and reduction produces minimal material waste (e.g., Cowan 1999; Kelly 1988). The preponderance of bifacial technology at 5GN1.2 suggests Late Prehistoric site occupants may have geared up on bifaces in anticipation of an extended stay, perhaps seasonal, in the mountainous environments of the UGB (see Thomas 2012).

Archaeological evidence effectively rules out this site as a specialized location or station site (Binford 1980; Metcalf and Black 1997). The site contains all the hallmarks of a residential site, including constructed hearths, rock art, plant processing, small-game procurement, high tool diversity, high proportion of locally available lithic raw materials, late-stage tool manufacture and tool maintenance debitage. These data support the view that site 5GN1.2 served as a residential site, possibly a short-term base camp, during the

Late Prehistoric. The Late Prehistoric occupation of site 5GN1.2 represents a more diverse adaptive pattern than envisioned by Stiger's (2001) Late Prehistoric hypothesis. Stiger's interpretation of the Late Prehistoric may accurately describe occupations made by some groups of hunter-gatherers within the UGB; however, at 5GN1.2 this is simply not the case. As a single site archaeological case study, characterizing land use or settlement mobility patterns for the region or for the Late Prehistoric is beyond the scope of this project. However, this project does provide evidence for several conclusions.

After 3000 B.P. and prior to the Ute (ca. 1300 B.P. [Reed and Metcalf 1999]), hunter-gatherers residentially occupied 5GN1.2. This site likely served as a residential base camp for whole family groups of hunter-gatherers who procured local quartzite raw material, small-game and floral resources including small seeds. Site 5GN1.2 contains evidence of an organization of technology geared toward bifacial tool production and use. Taken together, site 5GN1.2 does not represent a logistical big-game hunting-related site as expected within Stiger's (2001) view of the basin's cultural history.

This research on lithic technology represents the first comprehensive debitage analysis of a site component from 5GN1.2 or 5GN1. The results and data generated from this project can serve as a database for later archaeological research in the UGB. Finally, owing to the limited amount of Late Prehistoric archaeological research, particularly organization of technology research, this comprehensive analysis of a Late Prehistoric chipped-stone assemblage alone provides a meaningful contribution to UGB archaeology.

Without additional archaeological research within the basin at other Late Prehistoric sites, it is unclear whether site 5GN1.2 represents a unique or typical site type

for this time period. Therefore, additional archaeological research is sorely needed to understand Late Prehistoric settlement-subsistence patterns in the UGB. Only a small fraction of the deposits within 5GN1.2 were test excavated and it is highly likely that several additional hearth features and associated archaeological materials exist at the site. Since the discovery and test excavation of site 5GN1.2, NPS archaeologists working for the CURE have identified several more rockshelters above the shores of the Blue Mesa Reservoir (Forest Frost, personal communication 2012). Test excavations at these sites may prove to be particularly fruitful.

Archaeological comparisons between site 5GN1.2 and younger Ute sites may generate data important in addressing unresolved cultural history questions (Reed and Metcalf 1999). For example, this research may address the historicity and timing of the proposed initial ancestral Ute migration (e.g., Baker et al. 2008; Reed and Metcalf 1999). Furthermore, additional paleoenvironmental research is needed to understand climatic changes in the UGB during all periods of prehistory, especially during the last 3000 B.P. Existing paleoenvironmental data, albeit fragmentary and coarse-grained, provides no evidence of abrupt climatic shifts at 3000 B.P. (e.g., Emslie et al. 2005; Fall 1997; Reed and Metcalf 1999). Still, higher resolution paleoclimatic and environmental research is needed to understand past resources and conditions in the UGB.

Since the majority of archaeological sites within the UGB consist of quartzite dominated surface lithic scatters, continued quartzite sourcing research may prove to be beneficial (e.g., Pitblado et al. 2013). While conducting this lithic analysis project, I observed a high degree of variability in quartzite raw material characteristics including

color and graininess (Seong 2004). Future archaeological research projects employing lithic analysis methods would greatly benefit from experimentally produced and analyzed quartzite assemblages of raw materials from multiple source locations from the UGB. By comparing quartzite fracture mechanics and flake attributes, lithic analysts may generate more robust methods and debitage interpretive techniques tailored to these local quartzite raw materials.

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