University of Nevada, Reno

Subsistence, Mobility, and Intensity of Residential Site Use: Results of Flaked Stone Analysis at High Rise Village

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Arts in Anthropology

by

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ABSTRACT

The analysis of flaked stone recovered from 10 of High Rise Village's (48FR5891) 52 habitation features helps elucidate high elevation prehistoric hunter-gatherer behaviors in western Wyoming, including subsistence and settlement patterns and site occupational intensity. This investigation identified a mixed expedient-bifacial pattern, low tool and raw material source diversity, and low artifact density. Rather than a hunting-focused and/or intensive logistical-residential settlement-subsistence strategy that has come to be recognized as common throughout the Rocky Mountains and Intermountain West, High Rise Village was evidently targeted for specific resource patch(-es) by small residentially mobile family groups who foraged for predictable resources for short periods of time. This pattern thereby conforms to previous models for seasonal transhumance-based adaptations in the Rocky Mountains. Furthermore, this research provides evidence for the integral importance of high elevations to prehistoric hunter-gatherers during western Wyoming's Late Prehistoric Period.

DEDICATION

To my Mom, your support in my endeavors is all I've ever needed.

To my Polish Grandmother, who taught me to be proud of my heritage and value the diversity that exists in every community. Mojej Babci, która nauczyła mnie być dumnym z mojego dziedzictwa i cenić różnorodność która istnieje w każdej społeczności.

To my Dad, thank you for teaching me to know and love the outdoors.

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Furthermore, my esteemed committee chair, Dr. Christopher Morgan, gave me the remarkable opportunity to focus my graduate research on High Rise Village and serve as a crew chief during the 2012 Utah State University archaeology field school at this site. I learned a great deal throughout this process, and know I improved my skills as a writer and researcher from Dr. Morgan's instruction and constructive feedback.

My additional committee members, Dr.'s Geoffrey Smith and Scott Mensing, completed this invaluable process of constructive feedback. Dr. Smith led a Lithic Technological Organization course that formed the foundation of my understanding of hunter-gatherer use of flaked stone. This course ultimately comprised the foundation of the methodology I incorporated into this research. Early discussions with Dr. Mensing incited me to question research claims down the primary source regarding climatic data, and ultimately strengthened my interpretations of High Rise Village inhabitant behavior in an environmental context.

My gratitude also goes to several individuals who made this work possible. Bryon Schroder and Dr. Richard Adams gave me invaluable feedback on flaked stone availability around High Rise Village as I began my research. Stacy Goodrick, with Western Archaeological Services, Inc., and Jay Sturdevant, with the Midwest

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CHAPTER 1

Introduction

Hunter-gatherer use of high elevations in North America spans the Holocene (Bender and Wright 1988; Black 1991; Canaday 1997; Kornfeld et al. 2010). The attention paid to western Wyoming's High Rise Village (HRV) by recent research (Adams 2010; Koenig 2010; Losey 2013; Morgan et al. 2012a; Stirn 2014) and popular articles including USA Today (Dayton 2014; also see Watson 2013; Wingerson 2009), however, owes to the unique concentration of 52 cut-and-fill habitation structures, or lodge pads, at an elevation exceeding 10,000 ft in the Wind River Range. In North America, superficially similar sites beyond northwestern Wyoming are only known to occur in Nevada's Toquima Range (Thomas 1982) and eastern California's White Mountains (Bettinger 1991). Investigating HRV thereby contributes to understanding little known, high elevation adaptation(s) practiced by hunter-gatherers throughout the American West during the Late Holocene (Morgan et al. 2012a:58; Losey 2013).

Though a concentration of habitation features of this magnitude remains unprecedented in the archaeological record of Wyoming's high elevations, 18 smaller habitation sites were recently identified within the same subalpine whitebark pine (*Pinus albicaulis*) ecozone of the Wind River Range (Stirn 2014). This preliminary research suggests that HRV is perhaps less of an anomaly than initially thought, and may instead be the largest known example of a newly identified type of site. However, the motivations behind inhabiting these sites, and the settlement and subsistence behaviors associated with site occupants, remain unresolved (Adams 2010; cf., Morgan et al. 2012a, 2013).

This study aims to discern trends in subsistence, mobility, and occupational intensity among HRV inhabitants. Given the meager sample of floral and faunal remains recovered from the site (Losey 2013; Morgan et al. 2012a), this was accomplished by analyzing flaked stone debitage, tools, and cores from a sample of 10 lodge pads to test two hypotheses regarding inhabitant behavior. The results of these analyses support the hypothesis that small, residentially mobile "seasonal transhumance[-based]" family groups inhabited HRV for short durations (Benedict 1992:12; Black 1991:21). These results fail to support the hypothesis that inhabitants were engaged in a more intensive, logistical-residential 'village' pattern comprised of several family groups (see Adams 2010; cf., Bender and Wright 1988). The chapter-by-chapter breakdown of this study follows.

Following the introduction to this study in Chapter 1, Chapter 2 provides an overview of the HRV site context, including recent archaeological research and the current understanding of modern and contemporary prehistoric environmental conditions onsite. HRV is then contextualized within a regional culture history and paleoenvironmental record and discussed in reference to comparable high elevation sites in the Rocky Mountains and the Intermountain West.

Chapter 3 begins with a discussion of the incentives for and constraints upon high elevation occupation for hunter-gatherers, and the environmental and cultural conditions that may impact these incentives. Then, given the information reviewed in Chapter 2, two hypothesized behavioral patterns (above) are discussed in reference to expected distributions in the flaked stone assemblages.

Chapter 4 addresses the sampling strategy and analysis parameters applied to the flaked stone assemblage. The analysis section of this chapter defines recorded attributes and the artifact designations applied to each flaked stone category. Attributes are discussed in terms of their utility for testing the proposed hypotheses. The flaked stone categories are discussed in reference to their defining attributes and their function(s) or, in the case of debitage, the function of the artifact from which they were detached.

Chapter 5 presents the results of analysis by lodge to display the degree of comparable behaviors among the inhabitants of each habitation feature. The results include trends in utilized material types, dimensions, artifact conditions, typological designations, and frequency in artifact quantities (e.g., bifacial versus expedient tool production).

Chapter 6 includes the interpretation of the datasets presented in Chapter 5 to test the proposed hypotheses. This interpretation links the flaked stone data to hunter-gatherer behaviors regarding subsistence, settlement, and occupational intensity, ultimately revealing a long-term pattern of continuous land use by hunter-gatherers primarily based in western Wyoming. A call for additional research rests on the assumption that comparable studies may ultimately identify this pattern throughout the Wind River Range and adjacent mountain ranges.

CHAPTER 2

Research Context

High Rise Village

Site Context

Since the discovery of High Rise Village (HRV), this site has been mapped (Figure 2.1), investigated for its surface inventory, and tested for subsurface cultural deposits within and beyond the habitation features (Adams 2010; Morgan et al. 2012a). The bulk of excavation centered on 29 of HRV's 52 lodge pads, where the artifacts and radiocarbon samples discussed in this research were procured (Morgan et al. 2013).

The general consensus of these studies is that hunter-gatherer family groups seasonally occupied HRV during the Late Holocene; however, the degree of occupational intensity and the specific settlement and subsistence activities at HRV remains undetermined (Adams 2010; Koenig 2010; Morgan et al. 2012a; Stirn 2014). Radiocarbon dates obtained from hearth samples and other *in situ* charcoal deposits (Table 2.1) suggest that occupation spanned 2800 to 150 cal BP (Losey 2013; Morgan et al. 2013; but see below). Radiocarbon dates and associated temporally-diagnostic Rosegate projectile points indicate the most frequent use of the site and its lodges occurred between 2300 and 850 cal BP, with site use peaking by 1500 cal BP (Losey 2013; cf., Morgan et al. 2013). Additional dates extending beyond this time range are questionable; radiocarbon dates reaching 4500 cal BP are attributed to an "old wood problem" (*sensu* Schiffer 1986; also see Morgan et al. 2013) and younger dates reaching

150 cal BP come from organic residue on pot sherds, which have questionable temporal integrity, and from possible wooden lodge remnants that lack clear association with human activity (Losey 2013).

Table 2.1. Calibrated Radiocarbon Dates from High Rise Village. Adapted from Morgan et al. (2015).

Lodge[a]	cal BP (2σ)[b]	^{14}C Age	Context[c]	Lab	Lab No.
10	1720 – 1520 BP	1690±25	Hearth	UGAMS	13685
13	1350 – 1270 BP	1380±25	Hearth	UGAMS	13681
13	4550 – 4390 BP	3990±25	Hearth	UGAMS	13689
16	4560 – 4400 BP	4010±25	Hearth	UGAMS	9756
19	1170 – 970 BP	1150±20	Charcoal Smear	UGAMS	13683
19	1560 – 1400 BP	1590±20	Charcoal Smear	UGAMS	13688
21	1190 – 990 BP	1160±20	Charcoal Lens	UGAMS	13686
21	2080 – 1960 BP	2050±20	Charcoal Lens	UGAMS	13682
22	2360 – 2120 BP	2220±25	Burned Floor	UGAMS	8379
26	1250 – 1050 BP	1210±25	Hearth	UGAMS	8382
26	1440 – 1320 BP	1480±25	Hearth	UGAMS	8380
28	1100 – 980 BP	1130±20	Charcoal Lens	UGAMS	13687
49	4530 – 4370 BP	3960±25	Hearth	UGAMS	8381
49	4450 – 4210 BP	3880±30	Hearth	Beta	290220
49	4560 – 4400 BP	4000±40	Lodge Fill	Beta	262460
CC	360 – 40 BP	130±40	Sherd Residue	Beta	269156
CC	610 – 290 BP	420±50	Structural Timber	Beta	248565
S	870 – 670 BP	840±40	Hearth	Beta	245981
SS	1560 – 1400 BP	1570±30	Hearth	Beta	263853
SS	2030 – 1870 BP	1990±25	Charcoal Smear	UGAMS	8378
SS	2890 – 2730 BP	2700±40	Lodge Fill	Beta	262495

a) Table only includes the lodges discussed in this study (see Morgan et al. 2015).
b) Dates calibrated using CalPal 2007 (Weninger et al. 2015) and the Hulu calibration curve (Weninger and Jöris 2008).
c) Apart from Lodge CC, all samples originated from *in situ* charcoal deposits.

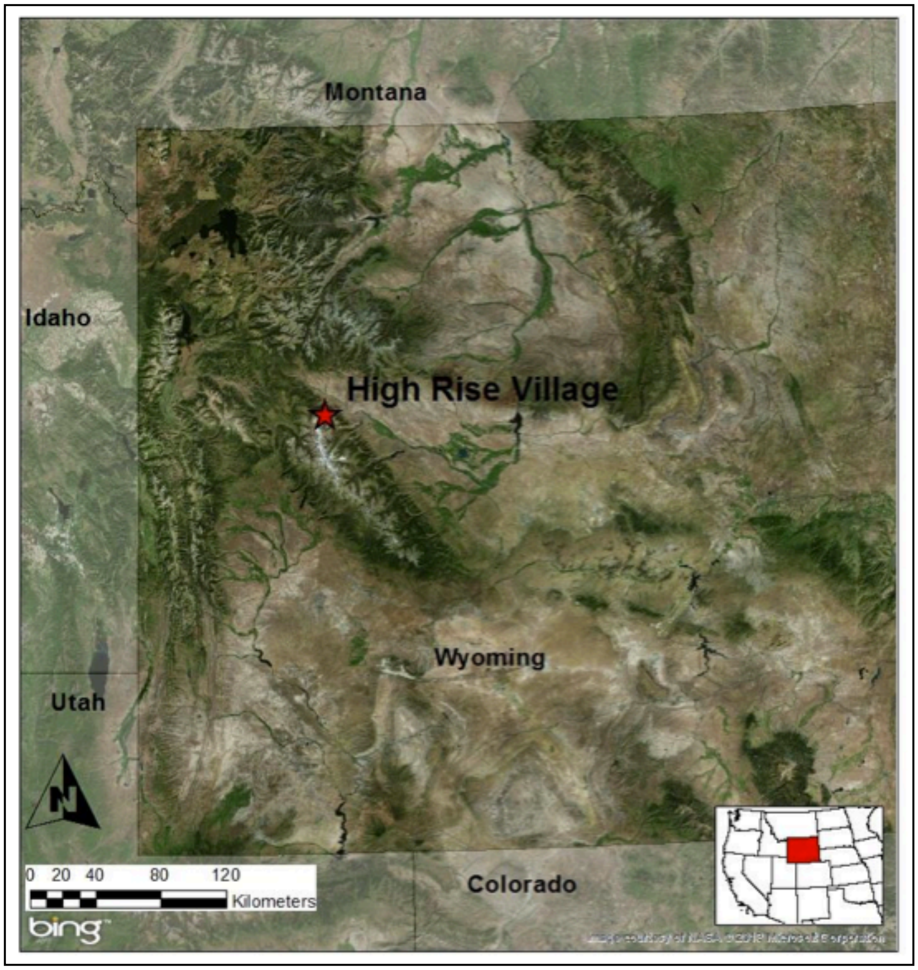

Figure 2.1. High Rise Village geographic setting.
Reproduced with permission from Losey (2013).

Preliminary interpretations of the HRV artifact assemblages determined that habitations were long-term and resembled village occupations (Adams 2010). For instance, Koenig's (2010) complete excavation of Lodge S identified a hearth feature centered within the lodge pad as well as a patterned distribution of flaked stone artifacts. These findings indicate the likelihood of habitation features, "aboveground superstructures" in particular, and thereby the likelihood of relatively long-term occupation and a potential for frequent site re-use (Koenig 2010:2; also see Adams

2010:58). Though such a detailed excavation has not been conducted at any other lodge pad, hearths were found in eight other excavated habitation features, with most located in or near the center of each feature (Adams 2010; Morgan et al. 2013:15).

Excavations led by Adams (2010) and Morgan et al. (2012a) also identified evidence for plant and animal resource procurement (also see Koenig 2010). In the absence of floral remains and the paucity of diagnostic faunal remains (Losey 2013:101), these interpretations are substantiated by the occurrence of groundstone and flaked stone artifacts. In Wyoming, groundstone is commonly associated with small animal and plant processing (Frison 1991; Kornfeld et al. 2010) whereas bifacial and expedient flaked stone artifacts, such as those found at HRV (Losey 2013), reflect hunting and animal processing (Kornfeld et al. 2001; Rapson 1990). Faunal remains, which occur mostly as charred and non-diagnostic fragments of rodents (e.g., marmots) and large mammals (e.g., artiodactyls), further suggest that HRV inhabitants engaged in hunting and animal processing.

Environmental Context

HRV is located in western Wyoming's Wind River Range (Figure 2.2). The site covers a 440 x 220 m area and spans from 10,560 to 10,880 ft (asl) along a 23 degree, south-southeast facing slope (Morgan et al. 2012a). A dense subalpine whitebark pine (*Pinus albicaulis*) forest and an alpine tundra ecotone both encompass HRV (Figure 2.2; also see Stirn 2014) and chert, quartzite, and basalt raw materials used for making stone tools occur near the site (e.g., <20 km; Surovell 2003:133).

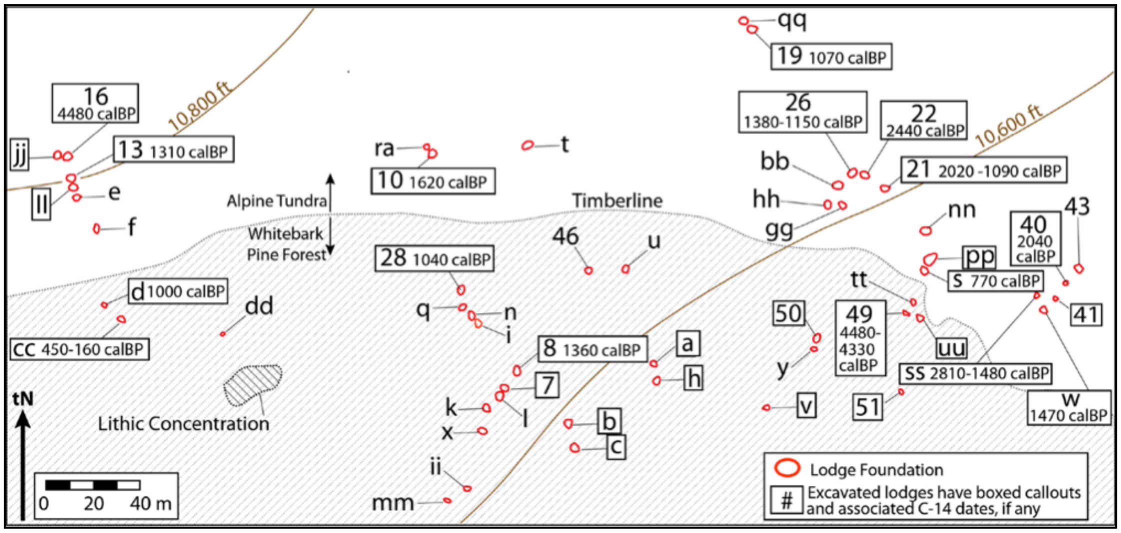

Figure 2.2. Site map indicating modern treeline and lodge distribution at High Rise Village. Reproduced with permission from Morgan et al. (2013).

In modern environmental conditions, subsistence resources associated with the whitebark pine ecozone include a variety of seasonally available mammals, geophytes, seeds and berries (Adams 2010; Reed 1976). Faunal resources include yellow-bellied marmot (*Marmota flaviventris*), snowshoe hare (*Lepus americanus*), red squirrel (*Tamiasciurus hudsonicus*), and white-tailed ptarmigan (*Lagopus leucura*) (Adams 2010; Reed 1976). Ungulates such as elk (*Cervus elephas*) and mule deer (*Odocoileus hemionus*), and fish including cutthroat trout (*Oncorhynchus clarkii*) are available in the region (Reed 1976). Additionally, a migration corridor used by one of North America's largest herds of bighorn sheep (*Ovis canadensis*) is located adjacent to HRV (Thorne 1979).

Floral resources include chenopods (*Chenopodium* spp.), currants (*Ribes* spp.), American bistort (*Polygonun bistortoides*), and geophytes such as sego lily (*Calochortus* spp.) and biscuitroot (*Lomatium* spp. and *Cymenopterus* spp.). Most of these floral and faunal resources are only available/accessible during the late spring and summer months. Additionally, onsite potable water originates from natural springs and snowmelt throughout the summer and fall months during years with high precipitation (Adams 2010; also see Aldenderfer 2006).

Prehistoric evidence for increased highland moisture and associated regional treeline advance between 1800 and 800 cal BP indicates that this whitebark pine forest encompassed HRV in its entirety during the main period of site occupation (Losey 2013; Morgan et al. 2013, 2014a; also see below). This likely promoted relatively high resource predictability during the Medieval Warm Period (ca. 1150–550 cal BP) and potentially as early as 1800 cal BP (Losey 2013:126). These coincidences suggest that patterns in HRV settlement and subsistence are related to increasingly predictable resources within whitebark pine stands. These findings complement Stirn's (2014) research, which indicates hunter-gatherers established at least 19 high elevation habitation sites, including HRV, within relatively dense stands of whitebark pine in the northeastern Wind River Range.

Sedimentary and metasedimentary rock outcrops occur throughout the Wind River Range (Branson and Branson 1941; cf. Bender and Wright 1988:630) and provide raw material types commonly used by hunter-gatherers in western Wyoming (Husted and Edgar 2002; Kornfeld et al. 2001; Miller 1991) and HRV alike (Adams 2010; Koenig 2010; Morgan et al. 2012a; also see Andrefsky 2009). Raw materials derived from outcrops in the Wind River Range include fine-grained quartzite, which naturally occurs onsite at HRV, and a variety of high and low quality locally available cherts. Basalt artifacts found at HRV likely originated from quarries in the Absaroka Range more than

20 km north of the site (Stirn 2014) although secondary clast deposits occur at least 12 km from HRV in the Wind River Valley (Adams 2010:59). Obsidian is exclusively nonlocal; sourcing data indicate that this assemblage includes a minimum of nine geochemical types ranging from 104 to 249 km from HRV (Morgan et al. 2013; also see Morgan et al. 2012a; cf., Scheiber and Finley 2011).

Western Wyoming's Paleoenvironmental Record

The following paleoenvironmental record covers climatic patterns during the Middle to Late Holocene (7500–100 cal BP) of western Wyoming. This time range encompasses the maximum possible period of HRV occupation (4500–150 cal BP). In general, the climate of the Middle and Late Holocene repeatedly oscillated between several centuries of dry and warm conditions and wetter and cooler conditions.

Kelly et al. (2013:443) cite pollen records and precipitation data from northwestern Wyoming as evidence that the region was dry and warm between 9000 and 6000 cal BP (Fall et al. 1995; Shuman 2012; Shuman et al. 2010). These conditions also characterized the climate throughout the Rocky Mountains at that time (Mensing et al. 2012). In western Wyoming, evidence includes aeolian erosion in southwestern Wyoming (Mayer and Mahan 2004), increased sand dune formation (Eckerle 1997), and increased elevations in drought-tolerant Engelmann spruce (*Picea engelmannii*) in the Wind River Range (Fall et al. 1995).

Between 5700 and 4400 cal BP, wetter conditions characterized northern Wyoming (Kelly et al. 2013). Sand dunes stabilized (Mayer and Mahan 2004) and treelines decreased to modern levels in the Yellowstone area (Whitlock 1993) but remained higher than modern levels in the Wind River Range (Fall et al. 1995).

Warmer and drier conditions predominated in western Wyoming by 4500 cal BP (Kelly et al. 2013; Mensing et al. 2012). Conditions remained arid until 1900 cal BP (Jackson et al. 2002) apart from a brief rise in effective moisture around 2600 cal BP (Kelly et al. 2013), although overall aridity and temperatures began to steadily decrease by 3800 cal BP, reaching modern levels by 3000 cal BP (Mensing et al. 2012; also see Baker 1976; Dahms 2002; Mayer and Mahan 2004; Whitlock 1993). High treelines in the Wind River Range reflected this warmer period (whereas periods of decreasing treeline elevations corresponded with the steady decreases in temperature [Fall et al. 1995; Mensing et al. 2012; cf., Morgan et al. 2014a]). The expansion of Douglas-fir forests in the Yellowstone area reflected this pattern (Whitlock 1993), as did the trends in treeline fluctuation in southeastern Wyoming's Snowy Range (Mensing et al. 2012). Indeed, evidence for a modern climate throughout Wyoming coincides with the establishment of modern treeline by 3000 cal BP (Mensing et al. 2012:746; but see Morgan et al. 2014a).

Regional trends for wetter and cooler environmental conditions spanned 1900 to 1170 cal BP, after which time temperatures increased and precipitation decreased from 1170 to 550 cal BP (Losey 2013; Kelly et al. 2013; Shuman 2012). Wetter conditions during the former period corresponded with treeline advance in the northern Wind River Range between 1800 and 800 cal BP (Morgan et al. 2014a). Decreased treeline elevations in this region coincided with several multidecadal megadroughts (Losey 2013:20; also see Gray et al. 2003; Herweijer et al. 2007), including a pronounced drought spanning 820 to 780 cal BP (Morgan et al. 2014a; also see Cook et al. 2010; Minckley et al. 2011; Shuman et al. 2010). These megadroughts occurred during the Medieval Warm Period (1150–550 cal BP); warm and dry conditions during this period are indicated by the retreat of glacial cirques in higher elevations (Benedict 1985) and the resurgence of xeric plant communities in lower elevations (Ahlbrandt et al. 1983; Mayer and Mahan 2004; Plager and Holmer 2004).

From 560 to 100 cal BP, a time span referred to as the Little Ice Age, cooler and generally wetter conditions returned to western Wyoming, as did a heightened degree of decadal and sub decadal-scale climatic variability (Losey 2013; Kelly et al. 2013; Whitlock et al. 2002). These conditions are indicated by tree ring data (Gray et al. 2003; Watson et al. 2009), glaciation in the Wind River Range (Davies 2011), and a rebound of mesic plant communities in lower elevations (Hadley 1996).

High Elevation Context

Large habitation sites containing clear evidence for residential structures above 10,000 ft are uncommon in the American West (Figure 2.3; Bettinger 1991; Canaday 1997; Stirn 2014). Beyond the Wind River Range, superficially comparable alpine habitation sites are only known to occur in two locations in the Intermountain West: these include the White Mountain villages in California’s White Mountains (Bettinger 1991), and Alta Toquima Village in Nevada’s Toquima Range (Thomas 1982). Similar to the archaeological record of HRV (Morgan et al. 2013), the habitation pattern at these sites were summer seasonal and emerged in the Late Archaic or Late Prehistoric periods from a less intensive pattern produced by short-term hunting parties (see Canaday 1997;

Grayson 1991; Janetski 2010:17-18; McDonald 2000; cf., Morgan et al. 2012a, 2013; Stirn 2014:530).

The aforementioned Intermountain sites are referred to as villages because they contain habitation structures, hearth features, midden deposits comprised of substantial floral and faunal remains (Grayson and Canaday n.d.), and a high diversity of flaked and groundstone and ceramic artifacts. Collectively, these data indicate long-term or intensive occupations typical of village occupations at lower elevations in the American West. Floral and lithic resources procured from lowland contexts for use at these high elevation habitations evidence the investment placed in returning to these particular sites for relatively long durations (Scharf 2009; Thomas 2012).

Comparable high elevation residential sites occur in “high mountain” contexts (i.e., above 8,858 ft, per Morgan et al. 2012b:27) but below 10,000 ft throughout Utah (Morgan et al. 2012b; Janetski 1985, 2010), California’s Sierra Nevada Range (Morgan 2006; Stevens 2005) and western Wyoming’s Absaroka Range (Eakin 2005; Scheiber and Finley 2010, 2011). In general, these sites are similar to HRV in regards to site structure and site age (i.e., Late Archaic and/or Late Prehistoric period occupations), although the Absaroka habitation sites occur in “clear postcontact archaeological” context (Eakin 2005; Scheiber and Finley 2011:373). These sites also occur in areas otherwise reserved mainly for short-term hunting as well as plant processing forays in the preceding Archaic period(s) (e.g., Grayson 1991; Morgan et al. 2012a; also see Canaday 1997; Kornfeld et al. 2010; McDonald 2000; Pitblado 2003; Thomas 1981, 2014b). These sites differ in that they are located within a subalpine environmental context characteristic of denser forests and/or have greater access to water and fisheries (Janetski 2010).

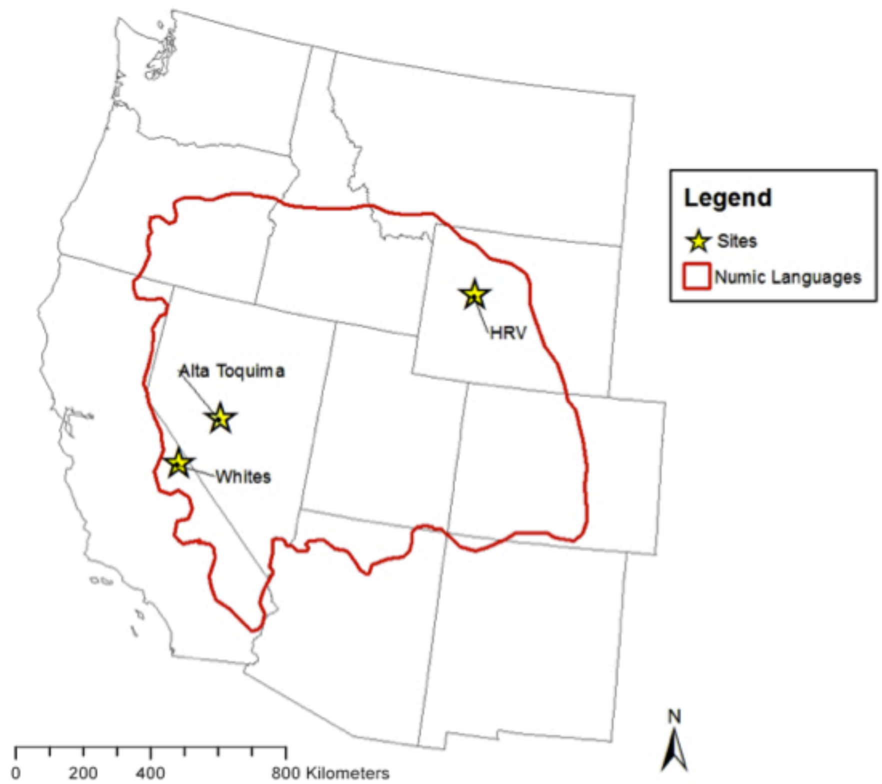

Figure 2.3. Ethnographic and geographic extent of Numic-speaking groups, and geographic context of North America's prehistoric alpine/subalpine villages, including High Rise Village, Alta Toquima Village, and the White Mountain villages.

From east to west, high elevation habitation sites in the American West generally trend from older to younger (Morgan et al. 2012a; but see Thomas 2014b), with HRV representing the easternmost known site. However, settlement and subsistence patterns among these sites are incongruous or unknown. Bettinger (1991:660) argues that increased population density in the lowlands adjacent to the White Mountain villages in eastern California forced a seasonal occupation of the adjacent "marginal" high elevations (cf. Morgan et al. 2012b). Similarly, Janetski (2010:117) notes that a transition to residential occupations in the high elevations of central Utah's Fishlake Plateau corresponds with "a broad pattern of resource intensification across the Great Basin after 1,500 years ago." On the other hand, Morgan et al. (2012a) and Thomas (2014a) find the current evidence does not clearly indicate whether increased population density or population migration contributed to the settlement and reuse of Alta Toquima Village or HRV.

Environmental conditions may have played a significant role in the settlement and occupational intensity of high elevation habitation sites. A peak in effective moisture in the northern Wind River Range between 1800 and 800 cal BP roughly overlaps with the main period of HRV occupation between 2300 and 850 cal BP, which peaked by 1500 cal BP (Losey 2013; cf., Morgan et al. 2013). Predictive models demonstrated that HRV and similar Wind River habitation sites occur in the area's most productive whitebark pine stands (Stirn 2014), which thrived during this period of increased precipitation (Morgan et al. 2014a). Thomas (2014a), however, is equivocal regarding the effect of climate change on this matter at Alta Toquima Village, though he notes that initial occupation at this site, and occupational intensity there and in nearby high elevation contexts, correlate with "periodic xeric intervals" (Thomas 2014c:37).

In short, within the past 2,800 years, hunter-gatherers began settling and reoccupying residential sites in high elevations throughout the Rocky Mountains and Intermountain West (Morgan et al. 2012a). Of particular focus is the pattern seen above 10,000 ft in Wyoming's Wind River Range at HRV and the 18 similar, albeit smaller, sites that remain under investigation (Stirn 2014), as well as above 10,000 ft in Nevada's Toquima Range (Thomas 1982) and California's White Mountains (Bettinger 1991; also see Morgan et al. 2014b). These high elevation habitation patterns emerged from short-term, hunting-dominated activities that characterized high elevation use during the preceding millennia (Morgan et al. 2012a; cf., Canaday 1997; Grayson 1991; Janetski 2010:17-18). However, the motivation(s) behind this transition remain largely unsettled (Bettinger 1991; Morgan et al. 2012a; Thomas 2014a, 2014b). Models for high elevation use are helpful for determining settlement and subsistence activities and the degree of occupational intensity at these residential sites, and thereby contribute to discussions on what influenced these Late Holocene innovation(s).

Models for High Elevation Use

Several models of regional highland adaptations in the Rocky Mountains exist, including Black's (1991) Mountain Tradition and Frison's (1991, 1992, 1997) foothill-mountain adaptation. These models are based on data derived from a small sample of stratified sites (Husted and Edgar 2002; Kornfeld et al. 2001; Kornfeld et al. 2010) and are discussed in reference to the behaviors associated with Binford's (1980) concepts of residential and logistical mobility.

Within the context of western Wyoming and the surrounding Rocky Mountains, hunter-gatherer mobility and subsistence strategies have been modeled as residential and mixed residential-logistical (Bender and Wright 1988; Binford 1980; Black 1991; Frison 1991). Residentially mobile hunter-gatherer family groups 'map onto' and situate their habitation sites, or residential bases, in desirable resource patches to forage (Binford 1980:10; Black 1991). Hunter-gatherer family groups practicing a mixed logistical-residential strategy prolong occupation at habitation sites, or base camps, by pursuing a broader array of floral and faunal resources at a greater distance from the base camp through a combination of residential foraging and logistical forays (e.g., Bender and Wright 1988; Binford 1980).

As argued by Black (1991:20), the Mountain Tradition is a high elevation, Rocky Mountain adaptation that encompassed western Wyoming between ca. 8000 and 4500 cal BP (also see below). During this period, hunter-gatherers practiced a seasonal transhumance, or residentially mobile, settlement and subsistence strategy between the foothills and the subalpine and alpine ecozones. While spring and winter habitation sites within more protected foothill settings were occupied for relatively long durations, summer and early fall habitation sites reflected shorter-term residential occupations of montane valleys. Settlement and subsistence pursuits followed the seasonal availability of plants and migrating game (Black 1991:7). Frison (1991) identified a similar transhumance subsistence-settlement pattern, deemed a foothill-mountain adaptation, in north-central Wyoming and southern Montana between 11,500 and 9000 cal BP.

Lastly, Benedict (1992) describes two transhumance patterns of high elevation and foothill seasonal use in southern Wyoming and north-central Colorado. One is a so-called up-down system, which arguably occurred during the Early Archaic Period and is characterized by longer stays at high elevation hunting grounds compared to that of the second transhumance pattern, known as the rotary system. The rotary system relates to the models presented by Black (1991) and Frison (1991) and arguably occurred during the Late Prehistoric Period. While the up-down system is expected among newcomers to a region who conservatively or unknowingly focus on fewer resource patches, the rotary system characterizes hunter-gatherers who are more familiar with "the full range of [seasonally] available" resource patches (Benedict 1992:12). The rotary system thereby involves frequent moves between more resource patches.

Black (1991:20) identifies the end of the Mountain Tradition within western Wyoming as corresponding to the cultural 'interruption' associated with the arrival of the McKean complex by 5000 cal BP (Kornfeld et al. 2010; also discussed below). However, additional research of high elevation adaptations indicates comparable adaptations also occurred in the millennia following the arrival and use of this complex, which ceased around 3000 cal BP. First, Benedict's (1992) rotary system occurred in late prehistory, indicating that a pattern similar to Black's (1991) Mountain Tradition reappeared in the central Rocky Mountains several millennia later. Similarly, Bender and Wright's (1988:626, 635) research in northwestern Wyoming's high elevations led them to regard the beginning of the McKean complex (ca. 4500–3000 cal BP, regionally; Black 1991; cf., Husted and Edgar 2002) as the origin of a comparable broad-based "seasonally scheduled" strategy that developed out of an "already successful adaption." Bender and Wright (1988), however, also found that hunter-gatherers in this region incorporated a mixed logistical-residential strategy into their high elevation subsistence pursuits. This pattern thereby differed from the transhumance patterns described by Black (1991), Frison (1991), and Benedict (1992) for indicating greater resource intensification, more complex settlement organization, and longer-term site occupations.

In sum, data derived from previous studies propose that hunter-gatherer behaviors at high-altitude should either correspond to a transhumance settlement-subsistence strategy practiced by residentially mobile groups who mapped on to specific resources as they became seasonally available (Benedict 1992; Black 1991; Frison 1992, 1997) or to a more intensive and broad-based subsistence strategy practiced by groups who simultaneously focused on hunting and foraging to prolong occupations within fewer resource patches throughout the year (Bender and Wright 1988; Binford 1980). Either strategy can be modeled to identify high elevation settlement-subsistence strategies or determine whether high elevation sites represent their own pattern.

Western Wyoming Culture History

Given that the occupation of HRV spans a maximum period of 4500 to 150 cal BP, focus will only be given to the culture history of the latter half of the Holocene in the nearby Wyoming Basin. Between 6000 and 300 cal BP, sites in the Wyoming Basin fell within five phases and related culture-historical developments (Metcalf 1987). These include the Early Archaic Opal Phase, the McKean technocomplex of the Middle Plains Archaic, the Late Archaic Pine Spring and Deadman Wash phases, and the Late Prehistoric Uinta and Firehole phases. Each phase is demarcated by peaks and drops in radiocarbon date frequencies, which Metcalf (1987) interprets as a proxy for high and low hunter-gatherer population densities, respectively (also see Kelly et al. 2013). Trends in settlement and subsistence strategies and environmental conditions also tended to correspond with cultural adaptations that occurred during each phase.

Early Archaic

The Opal Phase (6000–3700 cal BP). The second phase of the Early Archaic is known as the Opal Phase (or Green River Phase [Metcalf 1987]). This is delineated by a marked peak in radiocarbon dates (Metcalf 1987; Smith 2003) and high population density between 6100 and 4500 cal BP, followed by a steady decrease in population and radiocarbon dates between 4500 and 3800 cal BP (see Kelly et al. 2013). This phase encompasses a peak in housepit utilization between 6000 and 4000 cal BP (Larson 1997; Smith and McNees 2011). Larson (1997) suspects that housepits served as places to process and store predictable resources and to ultimately return to on a seasonal basis (also see Johnson and Pastor 2003). Resources patches associated with housepit construction and site re-use indicate a persistent use of dependable geophyte and seed-bearing resource patches during the Opal Phase (Smith and McNees 2011; Thompson and Pastor 1995). Although the use of plants intensified during this phase, hunter-gatherers retained broad-based subsistence strategies (Black 1991:20). This pattern is also interpreted from the diverse assemblages from non-housepit sites from this period, including the Early Archaic component of the Helen Lookingbill Site (Kornfeld et al. 2001), Mummy Cave (Husted and Edgar 2002), and the Medicine Lodge Creek site (Frison and Walker 2007). Slab-lined fire pits associated with preparing a variety of floral and faunal food resources were also most common during this phase than other times (Kornfeld et al. 2010:359). Collectively, these sites indicate that hunter-gatherers pursued a greater diversity of faunal, and particularly floral resources during this phase when compared to the preceding Early Archaic (Black 1991:13, 20).

Middle Plains Archaic

The McKean Technocomplex (5000–3000 cal BP). A “cultural interruption” known as the McKean technocomplex appeared in western Wyoming contemporaneous with the Middle Plains Archaic (Kornfeld et al. 2010; Mulloy 1954) ca. 4500 to 3000 cal

BP (Black 1991:3; Husted and Edgar 2002; Metcalf 1987). In many ways paralleling patterns of intensification that occurred during the Opal Phase, the arrival of a diverse complex marked by distinctive McKean projectile points signals the diversification of mountain-adapted hunter-gatherers in the northwestern Plains.

The McKean complex is associated with three projectile point types that may represent a strategic convergence of differing hunting techniques (Davis and Keyser 1999:251) during a period when hunter-gatherers evidently increased their focus on large mammal procurement (Lubinski 2000:181, 183; Metcalf 1987:251). Evidence for an unprecedented increase in plant procurement and processing also occurs in association with this complex (Frison 1978). Such evidence includes roasting pits/ovens found with roasted plant remains and commonly associated with McKean points in both high and low elevation contexts (Bender and Wright 1988; Black 1991). Although the McKean complex falls out of use in western Wyoming by ca. 3000 cal BP (Kornfeld et al. 2010), the associated intensive adaptive strategy arguably formed "the basis for later cultural developments over a broad area of the West," which continued into the Historic Period (Husted and Edgar 2002:125).

Late Archaic

Pine Spring Phase (3700–2900 cal BP). Metcalf (1987:245) characterizes the Late Archaic Pine Spring Phase as having "fluctuating but constant occupation," with low population density compared to that of the Opal Phase (Kelly et al. 2013). Hunting became the primary subsistence focus during this period, while the reliance on plants diminished (Lubinski 2000; Smith 2005a; Smith and McNees 2011).

Deadman Wash Phase (2900–1800 cal BP). The Deadman Wash Phase is essentially a cultural continuation of the Pine Spring Phase. Although hunter-gatherers continued to focus on large game, "large corner-notched points" phased out the McKean technocomplex and subsistence pursuits became more evenly focused on hunting and foraging (Husted and Edgar 2002:124; Metcalf 1987). Population density remained low during this phase "except for a brief …increase" around 2600 cal BP (Kelly et al. 2013:443).

Late Prehistoric

The Uinta Phase (1800–900 cal BP). The first phase of the Late Prehistoric Period, the Uinta Phase, followed an increase in radiocarbon dates by 1900 cal BP marking the most densely populated phase in western Wyoming's prehistory (Metcalf 1987:236). After 1170 cal BP, however, populations began to decline (see Kelly et al. 2013). This phase also entailed a return to a relatively broad-based diet and a peak in housepit utilization comparable to that of the Opal Phase (Larson 1997; Kornfeld et al 2010; Smith 2005a; Smith and McNees 1999). Communal bison hunting became common (Metcalf 1987) and bighorn sheep hunting increased (Husted and Edgar 2002; Kornfeld et al. 2001). By 1500 cal BP, the bow and arrow was adopted in western Wyoming (Husted and Edgar 2002; Kornfeld et al. 2010) and Rosegate projectile points became common (Metcalf and McDonald 2012). By the end of the Uinta Phase, ceramics were used in western Wyoming (Metcalf 1987).

The Firehole Phase (1000–250 cal BP). The second phase of Late Prehistoric Period, the Firehole Phase, began between 1000 (Metcalf 1987) and 700 cal BP

(Middleton et al. 2007) and overlapped with a 'rapid decline' in population density between 1170 and 560 cal BP (Kelly et al. 2013:443). There were "no remarkable changes in the prehistoric record" during this phase, including the continued use of bow and arrow technology and ceramics (Metcalf 1987:249). The types of arrow points, however, were replaced during this phase with small side-notched and triangular points (Metcalf 1987; Metcalf and MacDonald 2012), and the focus on bighorn sheep procurement continued to increase (Husted and Edgar 2002; Kornfeld et al. 2001; Rapson 1990). Also, while ceramic use increased, spreading to northwest Wyoming by 500 cal BP (Kornfeld et al. 2010:62), ceramic quality decreased (Metcalf 1987; Middleton et al. 2007; Reed and Metcalf 1999). This phase ended with the Protohistoric Period, which was characterized by increased communal hunting. This period also encompassed the introduction of European technology and the horse into the region by "at least the early 1700s" (Scheiber and Finley 2010:132).

Culture History and the Paleoenvironmental Record

In general, the latter half of the Holocene encompasses two cultural trends that repeated within the past 6000 years. First is the pattern observed during the Opal Phase (6000–3700 cal BP) and the Uinta Phase (1800–900 cal BP). These phases correspond to peaks in housepit construction and reuse and increased population density, and largely encompass wetter and cooler environmental intervals. Hunter-gatherers subsisted on a diverse array of floral and faunal resources, with the pattern of housepit utilization indicating a focus on resource intensification at predictable resource patches. Second is the pattern observed during the Pine Spring and Deadman Wash phases (3700–1800 cal

BP) as well as the Firehole Phase (1000–250 cal BP). "Low effective moisture and high temperatures" spanning "long timescales" during these phases correspond with predictable decreased population densities (Kelly 2013:443, 445). Hunter-gatherers also moved more frequently between greater quantities of resource patches while focusing primarily on migratory game animals. Therefore, while groups continued to pursue a broad array of resources throughout the latter half the Holocene, it appears that environment played a role in conditioning patterns in subsistence and site use and reoccupation as well as population density (see Kelly et al. 2013).

Western Wyoming Cultural Continuity and the Arrival of the Eastern Shoshone

Ethnographic and historical accounts indicate that the historic inhabitants of western Wyoming were the Eastern Shoshone (Fowler 1965; Shimkin 1947), Numic speakers within the larger Uto-Aztecan language family (see Figure 2.3). Evidence points to different estimates for the arrival and emplacement of the Eastern Shoshone: one by ca. 5000 cal BP and one by the beginning of the Late Prehistoric Period (1500 cal BP).

Proponents of a more longstanding presence of the Eastern Shoshone in western Wyoming cite evidence for cultural continuity going back several thousand years. For instance, Husted and Edgar (2002:146) note a "similarity in archaeological sequences in the Basin and the Northwestern Plains [including western Wyoming]" going back to 5000 cal BP, which they explicitly argue to be indicative of a deep-rooted Numic presence (also see Francis and Loendorf 2004). Additionally, Bender and Wright (1988:634) describe a "consistent occupation sequence" in high and low elevations of northwestern

Wyoming's Teton Range, which they suspect began with the arrival of McKean-using Plains Archaic immigrant groups by at least 4000 cal BP (Bender and Wright 1988:634; cf., Black 1991). Bender and Wright's (1988:626-627) argument for a routine, long-term pattern of high and low elevation seasonal use compares to ethnographic data regarding the seasonal rounds of the Eastern Shoshone, who were also known to occupy the mountains during summer and early fall and the adjacent lowlands during winter and spring (Hultkrantz 1961:34-35; Shimkin 1947:247). Ethnographic accounts of the Eastern Shoshone of western Wyoming's mountains also deemed these groups the Mountain Shoshone, or Sheepeaters, for their specialized focus on bighorn sheep procurement (Hulkrantz 1961; Norris 1880). The northwestern Wyoming record indicates that this regional emphasis on bighorn sheep extends well into the middle Holocene (Black 1991:17; Frison et al. 1990; Husted and Edgar 2002), whether in "short-term hunting camps" such as the Helen Lookingbill site (Kornfeld et al. 2001:320, 322) or substantial residential sites such as the Bugas-Holding site (e.g., Rapson 1990).

On the other hand, glottochronological (Lamb 1958) and commonly cited theoretical arguments (Bettinger and Baumhoff 1982) complement data that indicate Eastern Shoshone cultural continuity extends no earlier than 1500 cal BP (cf., Wright 1978). For instance, western Wyoming's hunter-gatherers began using artifacts considered to be Shoshonean by the onset of the Late Prehistoric Period. Such artifacts include Intermountain Ware ceramics and Desert Side-Notched and Cottonwood triangular points, which are generally attributed to a widespread cultural trend with a Great Basin origin (Frison 1991; Kornfeld et al. 2010; but see Larson and Kornfeld 1994). Furthermore, Scheiber and Finley (2011) discuss temporal patterns in obsidian conveyance zones for northwestern and southwestern Wyoming; both regions retained consistent settlement strategies and/or exchange networks from the Protohistoric Period onward through at least the beginning of the Late Prehistoric period (Scheiber and Finley 2011:389). Lastly, bioarchaeological evidence derived from nasal sill analysis (Gill and Deeds 2008) and cranial vault data (Stuart and Gill 2008) also indicate that "significant migration and gene flow" occurred within western Wyoming by the onset of the Late Prehistoric Period (Kornfeld et al. 2010:544, 546). Clearly, the question of the Eastern Shoshone's first arrival to Wyoming remains unsettled.

CHAPTER 3

Theory and Expectations

Hunter-gatherers' high elevation settlement and subsistence behaviors vary due to environmental constraints and foraging opportunities (Adams 2010; Aldenderfer 1999; Benedict 1992; Stirn 2014), regional and annual settlement and subsistence dynamics (Aldenderfer 2006; Bender and Wright 1988; Black 1991), and variation in lowland population densities (Bettinger 1991). Theoretical and empirical data have been used to associate these generalized behaviors with patterned distributions in archaeological flaked stone assemblages (e.g., Andrefsky 1994; Bamforth 1991; Keeley 1982). This association is discussed here in relevance to residential sites to contextualize the interpretation of the settlement and subsistence behaviors of HRV inhabitants.

Hunter-Gatherer Behaviors and Flaked Stone Use in High Elevations

Constraints and Opportunities at High Elevation

Archaeologists frequently view high elevations as "marginal for human occupation" (Aldenderfer 2006; Benedict 1992; Bettinger 1991:660). Humans do not respond well physically to the extreme environmental conditions of high elevations (Bettinger 1991). High elevations can also be difficult to access (Aldenderfer 2006:363). Furthermore, conditions that facilitate high elevation hunter-gatherer occupation, including resource availability and tolerable weather conditions, are seasonally limited to the late spring through early fall in the Intermountain West (Tausch et al. 2004:38;

Thomas 2014a) and western Wyoming (Thorne 1979). Predicting the location of primary food sources, including migratory mammals, within this time-constrained summer-seasonal timeframe can depend on factors that vary “from year to year” (Benedict 1992:13). These aforementioned conditions, or ‘limiting factors,’ would have necessitated a flexible and adaptive survival strategy for hunter-gatherers attempting to occupy high elevations for any length of time (Grove 2009; Morgan 2009).

Despite these constraints, resources found at high-altitudes may be relatively appealing under certain conditions related to push and pull factors (*sensu* Aldenderfer 2006:364; also see Morgan et al. 2012a:64; Walsh et al. 2006). Xeric conditions in the lowlands, for instance, may not only decrease lowland resource productivity, but can simultaneously increase the duration of the growing season, and in turn the quantity of resources, at high elevations (cf., Morgan et al. 2012a:64). Increased effective moisture in high elevations correspond with expanding forest colonization and/or increased treeline (Kelly et al. 2013; Mensing et al. 2012; Morgan et al. 2014a), thereby increasing the density and productivity of associated resource patches. Zeanah (2000) also argues that the xeric conditions during the Middle Holocene of the Intermountain West were favorable for expanding bighorn sheep (*Ovis canadensis*) populations. Under such conditions, negotiating the aforementioned high elevation ‘limiting factors’ may have been a worthwhile endeavor if successfully planned (cf., Bender 1983).

Group Size and Occupational Intensity

Important to the pursuit of high elevation resources is a consideration of group size in relation to available resources, all other things being equal. High elevation faunal and floral resources generally occur in "patches" during the annual growing season (Binford 1980:5). Hunter-gatherers may advantageously place a camp within or adjacent to a resource patch (Binford 1980:9) from which predictable resources could readily be gathered year after year (Bender and Wright 1988). As discussed below, hunter-gatherers may prolong their occupations within a resource patch when accounting for their group size (Bettinger and Baumhoff 1982:486; Kelly 1992:47).

Groups of family units comprised of 5-10 individuals may spread out in high elevations and operate out of residential or mixed logistical-residential bases. Without the social pressure to share that comes with living among larger bands (Kelly 2007), these smaller, "independent foraging households" would have the "economic and adaptive incentive" to intensively procure a surplus of resources for their use alone (Thomas 2014a:in press; also see Steward 1938:230-231). Residentially mobile groups practicing a 'transhumance' subsistence strategy move more frequently between targeted resource patches as they become seasonally available (Binford 1980). Though no less mobile, family groups practicing a mixed logistical-residential strategy move less frequently between resource patches. Instead, they practice a more intensive and broad-based subsistence strategy, gathering a greater variety of resources located closer to their residential base and/or going on increasingly distant resource procurement forays to prolong occupation in a resource patch (i.e., a mixed logistical-residential strategy [Bender and Wright 1988]). In either case, ethnographic accounts indicate that small family groups of 5-10 individuals "collapse…the division of labor" and collectively procure resources (Binford 1980:7; also see Kelly 2007:131, 133). Therefore, while heterogeneous artifact assemblages should be present at such residential and logistical-residential sites, indicating multiple subsistence pursuits (Bender and Wright 1988:629), evidence for a "gendered [division of] space" within such sites should not (*sensu* Adams 2010:55).

The occurrence of larger groups of more than 10 individuals (Binford 1980:7) likely represents a collective of family units requiring a mixed logistical-residential strategy to make the most efficient use of available resources in high elevations (Bender and Wright 1988). Larger groups have greater moving costs in terms of energy expenditure as well as faster resource patch depletion rates than do smaller groups (cf., Kelly 1992:47). Therefore, large groups face the challenge of determining whether it is less costly to move camp frequently to new resource patches or remain at a particular base camp/resource patch for longer. Longer occupations would require increasingly intensive resource procurement "relatively close to base camp" (Bender and Wright 1988:630; cf., Jochim 1976:54) and increasingly longer logistical forays for resources (Bender and Wright 1988). Additionally, among larger groups, hunting and foraging subsistence tasks are generally divvied among specific demographics (Binford 1978), leaving behind evidence for "gendered [division of] space" (*sensu* Adams 2010:55).

Flaked Stone Evidence for Subsistence-Settlement Organization and Occupational Intensity

High elevation mobility and subsistence strategies in the Rocky Mountains have been modeled as residential and logistical-residential (Bender and Wright 1988; Binford 1980; Black 1991; Frison 1992). These strategies are discussed here in relevance to associated patterns in flaked stone assemblages (Table 3.1). First, occupants of short-term residential bases generally use curated (*sensu* Bamforth 1986), or recycled, multifunctional, bifacial tools to complete foraging tasks in desirable resource patches (Bamforth 1986:40; Black 1991; Cowan 1999; Kelly 1988; Shott 1986:20). Compared to expedient tools (see below), bifacial tools have a longer use-life and a more durable working edge (Kelly 1988; but see Prasciunas 2007), making them better for mobile hunter-gatherers and/or hunter-gatherers lacking local toolstone (<20 km [*sensu* Surovell 2003:133]). Because bifacial tools were often used and discarded away from residential bases, this pattern should primarily be reflected in the debitage assemblage as bifacial tool production and rejuvenation flakes. However, biface fragments evincing retooling (e.g., broken tool replacement [Keeley 1982]) or manufacture error during tool production and/or resharpening should also be found onsite. At longer-term residential bases, on the other hand, an expedient technology comprised of edge-modified flakes and amorphous cores/debitage should predominate (Parry and Kelly 1987). This pattern should also be prevalent at any site where toolstone is locally available for expedient raw material replacement (Andrefsky 1994; Parry and Kelly 1987:301), as is the case at HRV (Koenig 2010:77). When toolstone is locally available, cortex should also be common in the flaked stone assemblages (Beck et al. 2002; Elston 1992). Lastly, flaked stone assemblages at most short- and long-term residential bases should exhibit low source diversity relative to logistical-residential habitation sites (Binford 1980:18), reflecting a greater distribution of land covered (and sources encountered) by logistically-organized hunter-gatherers operating out of a given habitation site.

Table 3.1. Summary of Flaked Stone Patterns and Associated Hunter-Gatherer Behaviors.

	Residential	Logistical-Residential
Subsistence	- Minimal tool diversity - Short occupation: formal foraging tools (bifacial tools/cores/debitage) predominate - Long occupation: informal foraging tools (expedient pattern) predominate	- High tool diversity - Hunting/processing tools (formal) and foraging tools (both formal and informal)
Settlement	- Lower source diversity	- Higher source diversity - Expedient tools/cores/debitage predominate - Cortex common
Intensity of Site Use	- Low artifact density (per cubic meter)	- High artifact density (per cubic meter)
Group Size	- Small group occupation: lack of gendered space - Large group occupation: gendered space	- Small group occupation: lack of gendered space - Large group occupation: gendered space

Family groups practicing a mixed logistical-residential strategy prolong occupation in their habitation sites by pursuing a broader array of resources at a greater distance from home (Bender and Wright 1988). So long as raw material of any quality is locally available, these subsistence pursuits should be reflected in the lithic assemblage by: (1) a prevalent expedient/informal pattern exhibited in cores, tools, and debitage (Andrefsky 1994; Bamforth 1991; Benedict 1992:12) reflecting foraging activities similar to those conducted at certain residential sites; and (2) a substantial focus on hunting and animal processing. Processing activities and "gearing up" and retooling for off-site hunting activities are associated with a high diversity of formal and informal tool types, ranging from edge-modified flakes and scrapers to drills and projectile points base and tip fragments (Binford 1979:268; Keeley 1982; Kornfeld et al. 2001). Similar to short-term residential sites, the debitage assemblage at logistical-residential base camps should also reflect the production and rejuvenation of these tools. Base camps should also exhibit a relatively higher density of artifacts (see Bettinger 1991; Thomas 1982) and "within-assemblage diversity" of tool types and raw material sources to that of residential bases (Binford 1980:18; 1983:330).

Regardless of subsistence strategy, residential sites that are repeatedly occupied or occupied for a long duration should at a minimum comprise dense artifact assemblages (Bender and Wright 1988:629; Kelly 1992:56). Evidence for gendered space (i.e., a spatial division or co-occurrence of artifacts associated with foraging and hunting activities; Kelly 1992:46, 2007:131, 133) should also assist with determining the relative group size of these occupations (Binford 1980:7). When sites lack the temporal resolution to distinguish palimpsest accumulations, multiple short-term occupations may be distinguished from multiple long-term occupations with corresponding evidence for group size and artifact diversity. These details thereby assist with discerning occupational length (Schiffer 1987).

Summary of Expectations for High Elevation Use at High Rise Village

In sum, data derived from previous studies indicate that hunter-gatherer behavior at high-altitude should either correspond to: (1) a transhumant settlement-subsistence strategy practiced by hunter-gatherer groups who mapped on to specific resources for short durations as they became seasonally available (Benedict 1992; Black 1991; Frison 1992; 1997); or (2) a more intensive and broad-based subsistence strategy practiced by groups who simultaneously focused on hunting and foraging operating out of residential bases for longer durations (Bender and Wright 1988).

The former might be expected if residentially mobile hunter-gatherers used high elevations to "map on" to predictable resources patches for short durations (*sensu* Binford 1980; also see Stirn 2014). At HRV, a period of increased moisture and whitebark pine treeline gain corresponds with the main period of site occupation; therefore, the period when this whitebark pine patch became more predictable and productive – conditions that Adams (2010) argued attracted a village occupation – may have instead driven a short-term residential pattern. Alternatively, the latter might be expected at HRV in light of increased lowland population density (Kelly et al. 2013) that corresponds with peak site use at HRV (Losey 2013; Morgan et al. 2013), when increased housepit construction suggests lowland resource intensification – a pattern that hunter-gatherers may have been forced to exert in high elevation contexts despite potential limiting factors.

Hypotheses

An in-depth analysis of the HRV flaked stone assemblage should confirm preliminary conclusions that this site was seasonally inhabited by small residentially mobile family groups (Morgan et al. 2012a:51), or instead by hunter-gatherers engaged in a logistical-residential "village" pattern (Adams 2010).

Should the former hypothesis be verified this analysis will conclude that residential occupations of HRV were short-term, conforming with Black's (1991:21) and

Benedict's (1992:12) conclusions of high elevation use within a "seasonal transhumance[-based]" adaptation. Alternatively, the flaked stone analysis will support the hypothesis for a longer-term and more intensive settlement-subsistence strategy described in high elevation contexts elsewhere in northwestern Wyoming (Bender and Wright 1988) and the Intermountain West (Bettinger 1991; Thomas 1982). This pattern would indicate that intensive foraging was routinely practiced in both high and low elevations during this period (Kornfeld et al. 2010; Larson 1997).

Expectations for the Flaked Stone Assemblage

Residentially Mobile Expectations

Characteristic of foraging activities at a short-term residential base, the flaked stone assemblage at HRV should evince a reliance on bifacial technology (Kelly 1988, cf., Prasciunas 2007), although this pattern should be mixed with an expedient pattern owing to the local availability of raw materials and the expectation that individual occupations lasted longer than only a couple of days (Bamforth 1991; Parry and Kelly 1987). The bifacial technological pattern should be evidenced in the debitage assemblage by biface thinning flakes, retouch chips, and pressure flakes, and by broken and discarded bifaces (Keeley 1982). The expedient pattern should be indicated by amorphous core reduction and the production of edge-modified flakes (Bamforth 1991; Parry and Kelly 1987). Furthermore, cortex should be commonplace among the expedient assemblage, considering that raw toolstone occurs within 10 km (Elston 1992; Koenig 2010:77; also see Beck et al. 2002). Lastly, the flaked stone assemblage should also reflect minimal occupational intensity with a low density of artifacts and a low evenness and diversity of artifact types and raw materials (Table 3.1). The definitions of these attributes and the methods used to test these expectations are presented in Chapter 4.

Logistical-Residential Expectations

Contrary to the short-term residential pattern, the more long-term and/or intensive logistical-residential pattern at HRV should evince a predominant expedient pattern in the debitage assemblage, owing to the local availability of raw materials and the expectation for longer-term occupations (Bamforth 1991; Parry and Kelly 1987). The assemblage should therefore be dominated by evidence for expedient core reduction and tool production (Bamforth 1991; Parry and Kelly 1987). Cortex should be more commonplace among expedient assemblage considering the local availability of raw lithic materials, in addition to long-term occupations promoting the procurement and/or storage of cortex-bearing raw materials in anticipation for future need (Beck et al. 2002; Binford 1979:263; Elston 1992). The flaked stone assemblage should also evince high occupational intensity with a high density of artifacts, comparable to that of high elevation logistical-residential base camps in the Intermountain West (Bettinger 1991; Thomas 1982) and in lower-elevation contexts in Wyoming (Kornfeld et al. 2001; Rapson 1990). Finally, diversity of artifact types should also be high, comparable to that of these logistical-residential sites, in addition to raw material source evenness and diversity being relatively high (Table 3.1).

Chapter 4

METHODS

Sampling

The flaked stone sample comprises debitage, tools and cores derived from the excavations of 10 lodge pads (Table 4.1). Within each lodge, artifacts were procured from subsurface deposits within 1 x 1 m and 1 x 0.5 m excavation units, each typically excavated in 5 cm intervals in controlled 50 x 50 cm quadrants per level. Excavated lodge fill was screened through 1/8" (3 mm) mesh. All artifacts were sampled within this provenience (Tables 4.2; also see Appendices, Tables A-2, A-3, and A-4). Lodges selected for sampling and analysis met the criteria of having relatively large assemblages ideal for sampling (>30 flakes per provenience per lodge; see Drennan 2010:105-106). An exception was made with the Lodge 28 debitage assemblage (n=31) for comparative purposes (Table 4.1).

Debitage Sampling Strategy

The sampling strategy applied to the debitage assemblage was based on an equation developed by Milne (2003, 2009; also see Cannon 1991:50; Yamane 1967:88). After discrediting random sampling as ignoring potential variability in flake categories,

Table 4.1. Quantities of Available Non-Obsidian Debitage Incorporated Into Analysis.

Lodge	Sampled Unit	Unit Size (square meters)	Total Flakes per Lodge	Amount of Flakes Applied to Milne Equation	Amount of Flakes Applied to Milne Equation (Percentage)	Ultimate Analyzed Sample Per Lodge	Ultimate Analyzed Sample Per Lodge (Percentage of Flakes From Column 5)	Ultimate Sample Size/Lodge
10	Unit 1 (of 1)	1x1	958	828	86%	615	74%	64%
13	Unit 1 (of 2)	1x1	1,003	552	55%	453	82%	45%
16	Unit 1 (of 1)	1x1	2,781	678	24%	380	56%	14%
19	Unit 1 (of 1)	1x1	866	627	72%	498	79%	58%
21	Unit 2 (of 2)	100x50cm	493	459	93%	316 / 459 (see Figure 4.1)	69% / 100%	64% / 93%
22	Unit 1 (of 1)	1x1	2,390	934	39%	756[a]	38%	15%
26	Unit 1 (of 2)	1x1	1,826	91	5%	91[b]	100%	5%
28	Unit 1 (of 1)	1x1	31	31	100%	31	100%	100%
49	Unit 2 (of 2)	1x1	666	420	63%	375	89%	56%
SS	Unit 3 (of 3)	1x1	657	495	75%	399	81%	61%
Grand Total		9.5 m^2	11,671	5,161	44%	4,057	79%	35%

a) Note that for Lodge 22, the Milne (2009) sampling equation called for 354 flakes altogether. However, the unorthodox collective excavation of Lodge 22, level 1 (0-15 cm below surface) resulted in a low sample size relative to the average proportion of flakes sampled within the first 15 cm below surface within Lodge 10. Lodge 10 was excavated in the typical method of 5-cm intervals, and had a similar quantity of flakes set aside for sampling (above). Therefore, in order to minimize potential sampling bias introduced by the unorthodox excavation of Lodge 22, the Lodge 10 sampling proportions from levels 2 and 3 (5-15 cm below surface) were applied to Lodge 22, level 1 (0-15 cm below surface), bringing the collective sample of analyzed flakes from Lodge 22 flakes up to 756.
b) The Lodge 26 sample size was experimentally small. Analysis results demonstrate that even this smaller sample size remained comparable to the lodges with significantly larger quantities of sampled and analyzed debitage (see Figure 5.6; cf., Figure 4.2).

Milne developed an equation that calculates a sample size using *a priori* knowledge of the variability present within an assemblage. The results of analyzing a sample from her original population are "entirely consistent" with the results of analyzing the entire population (Milne 2009:40).

Once flakes were size-sorted into "meaningful categories" (Milne 2009:45) (increments consistent with screen mesh dimensions [i.e., <6 mm, 6-12 mm, >12 mm]), flakes within each size category were quantified per excavated provenience. Then, "a continuous variable or attribute," such as weight or dorsal scar count, was selected (Milne 2009:46). To minimize inconsistencies associated with variables such as dorsal scar count (Ingbar et al. 1989:122-123; Shott 1994:80), each flake was weighed, the logic being that weight provides the most objective and unbiased measure of flake variability (Amick et al. 1988; Shott 1994). The next step involved determining a population statistic such as mean, median, or variance. I selected mean, which, similar to weight, is simple to calculate. Once the mean and standard deviation of the flakes' weight per size grade were determined, the coefficient of variation (cv) was calculated. The cv "expresses the standard deviation as a percentage of the mean value and allows comparison of the variability of different attributes" (Milne 2009:47; Norusis 1997:64), and is calculated as standard deviation/mean. A 95 percent confidence level was used to be consistent with Milne's study. Finally, with the information determined above, the formula for sample size needed can be used:

$$N_{req}= (N(c * cv)^2)/(N(p)^2 + (c*cv)^2)$$

"Where $\mathbf{N_{req}}$ is the [requisite] sample size, **N** is the total number of flakes in the size grade category, **c** is the reliability of the estimate [this will be estimated at the 95 percent confidence interval of two standard deviations, therefore the value of **c** is 2], **cv** is the coefficient of variation and **p** is the desired level of precision [95 percent confidence results in a level of precision of .05; Healey 1996:156-157] " (Milne 2009:48; also see Cannon 1991).

Once this equation was applied to each flake size category within a given provenience, the appropriate sample size was determined per flake size category. This quantity of flakes was then selected based on a numeric interval determined by dividing the total number of flakes from each provenience by the number of flakes to be sampled as determined by Milne's (2009) equation. Although Milne (2009:49) warns that this numeric interval method is biased and suggests to instead use an objective sampling device known as a two-way soil-sample splitter, representative samples were ensured in the absence of this device by taking no fewer than 30 flakes per flake size category within each provenience. For instance, Drennan (2010:105-106) considers a batch, or a related set of measurements of a particular artifact class of "more than about 30" to be a "relatively large sample size." Large sample sizes are more likely to represent a "normal distribution" of batch data, which means that a sample size numbering 30 flakes or greater is representative of a batch of flakes from a given provenience (Drennan 2010:59). In short, increasing sample size reduces bias that may have been introduced by systematic sampling. Therefore, if the Milne sampling equation happened to call for 17 flakes, this number was automatically rounded to this set minimum of 30 flakes, as long as this quantity was available. When less than 30 flakes were available for sampling within a provenience, all flakes were analyzed.

Sampling Bias

An arbitrary goal was set to analyze no less than 400 flakes per lodge in anticipation of this being representative of the collective non-obsidian debitage assemblage. This was accomplished by sampling one complete quadrant at a time until surpassing this minimum sample size. As a result, six of the 10 lodge pads contain one or more quadrant(s) that were not sampled (see Appendices, Table A-3, and cf. Table A-4). When an entire level was collectively excavated due to inconsistent excavation strategies, the quadrants are referred to as ALL (e.g., Table A-3), which was sampled when the ALL level spatially overlapped with sampled quadrant(s) from accompanying levels in a given unit.

Exceptions from the goal of analyzing 400 flakes or more include Lodges 26 and 28 (Table 4.1). Lodge 28 excavators only recovered 31 flakes, and Lodge 26 contains a large sample (n=1,826), but only five percent were analyzed (n=91). These smaller datasets were included in this analysis to compare trends in sample size.

Additionally, flakes originating from the top 5 cm of excavated fill were excluded from sampling. In several lodges, surface artifacts had been impacted by bighorn sheep (*Ovis canadensis*) grazing activities, as well as erosion, which particularly impacted "the part of the site most affected by forest fire" (Morgan et al. 2013:40; also see Losey 2013:101). These conditions likely affected the distribution and edge characteristics of surface artifacts; therefore, analysis focused on *in situ* deposits originating at least 5 cm below surface. One exception was made at Lodge 22, however, where Level 1 was atypically excavated en masse 0-15 cm below surface. Because this assemblage included debitage that would have been associated with levels 2 (5-10 cm below surface) and 3 (10-15 cm below surface) per the typical excavation strategy at HRV, artifacts from the top 5 cm below surface in this lodge were incorporated into sampling and analysis. Judging from the consistent results in flaked stone debitage among every lodge (Figures 4.1, and 4.2), these sampling biases had no impact on attaining a representative sample.

Verifying Debitage Sampling Representation

To account for potential vagaries in sampling among the sampled debitage assemblage, measures were taken to verify the accuracy of the modified Milne (2009) sampling equation among the first lodge to be sampled and analyzed: Lodge 21. An experimental 100 percent analysis of the Lodge 21 debitage assemblage (n=459) demonstrated that the modified Milne equation elicited a representative sample size for that lodge (n=316); either sample size resulted in comparable frequencies of flake types (Figure 4.1). In hindsight, using this equation to only sample a single quadrant per excavation unit would have also been representative of each lodge's flaked stone assemblage (Figure 4.2).

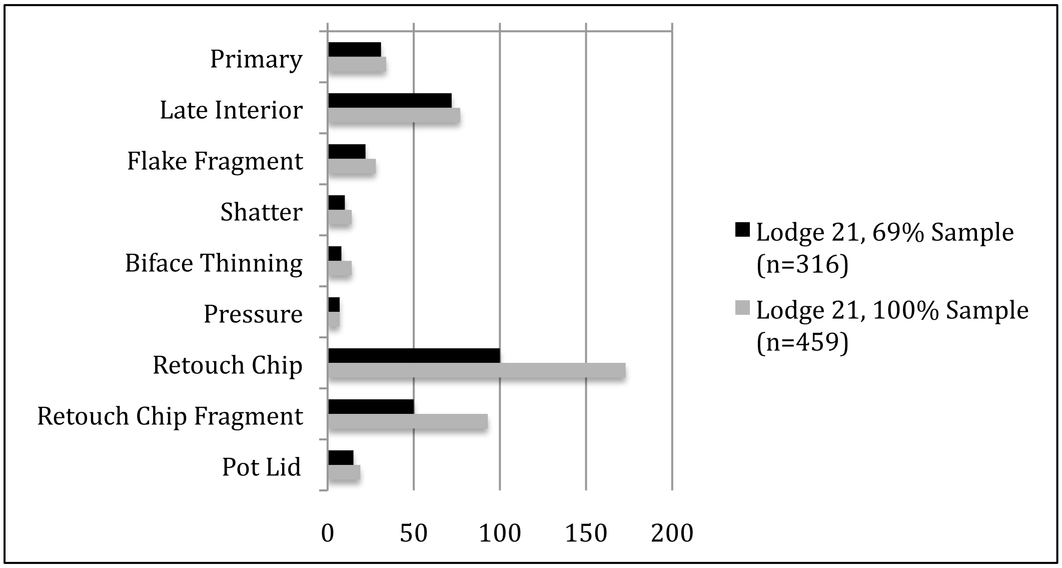

Figure 4.1. Comparison between the 100 percent analysis of available Lodge 21 flakes versus the sampled proportion of Lodge 21 flakes per the modified Milne (2009) sampling equation.

Debitage Sample

Of 11,636 chert, quartzite and basalt flakes, 5,161 were set aside for sampling. Per the modified Milne (2009) sampling equation, the calculated sample size resulted in 4,057 flakes (Table 4.1, column 7). One hundred percent of the obsidian debitage was sampled, however, as this material type constitutes a small sample (n=144) and is the only material type that is definitively nonlocal.

Tool and Core Sample

The total tool and core assemblage (n=138) numbers less than 30 artifacts per excavated provenience (cf., Drennan 2010:105-106). To gain a representative sample, analysis consisted of all bifaces (n=68) and cores (n=2) identified during excavation and all edge-modified flakes (EMFs) identified during debitage analysis (n=68; Table 4.2).

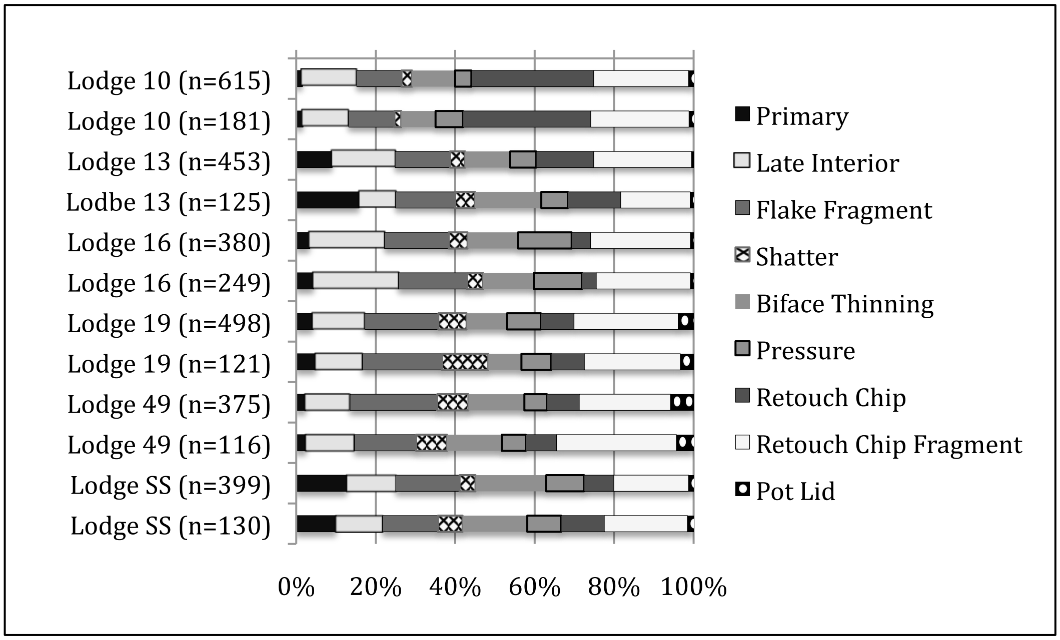

Figure 4.2. An inter-lodge comparison between the quantity of flakes analyzed per lodge versus the quantity of flakes analyzed from a single quadrant within each lodge. Please note, however, that the four lodges omitted from this figure were excavated in a manner that prohibited the extrapolation of these data for comparison.

Table 4.2. Available Sample of Flaked Stone Tools.

Lodge	Projectile Points	Bifaces	EMFs	Total Tools	Cores
10	1	2	26	48	0
13	0	6	13	26	0
16	4	2	2	10	1
19	1	6	4	18	0
21	1	3	13	25	1
22	1	6	4	14	0
26	8	10	1	19	0
28	0	0	1	1	0
49	2	3	1	7	0
SS	3	9	3	18	0
Total	21	47	68	136	2

Analysis

Macroscopic flaked stone analysis was conducted to identify variability in debitage and tool categories per lodge. Sampled artifacts were analyzed for a set list of variables, which constitute the following flake and tool categories defined in this section. All identified categories were associated with tool manufacture, expedient core reduction, or indiscernible fragments. These technological patterns then informed interpretations of settlement, subsistence, and occupational intensity discussed in Chapter 6 (also see Table 3.1).

All artifacts are discussed in terms of proximal, distal and lateral/side margins. Among flakes, the proximal margin is the platform, or the point of contact upon which a flake is struck from a core. The distal margin is the end opposite to the proximal margin, where the flake terminated. Among tools with the following elements, proximal refers to the base or the haft element and distal refers to the tip. Furthermore, among flakes and EMFs, surfaces were designated as ventral or dorsal. The ventral surface is the interior surface produced via removal from a core or tool. The dorsal surface is the exterior surface, which retains cortex and/or flake scars exhibiting the negative impressions of previously removed flakes.

Debitage Analysis

The debitage assemblage was analyzed for weight (g), material type, length, or maximum linear dimension, maximum width perpendicular to length, maximum thickness between the ventral and dorsal surfaces, presence or lack of cortex, and platform preparation characteristics. Weight was recorded to calculate the Milne (2009) sampling equation (also see Shott 1994:75) and material type assisted with identifying source diversity and evenness (Beals et al. 2000; Binford 1980:18; O'Connell 1977; Torrence 1983; also see Chapter 3). Otherwise, these attributes were used to differentiate between flaked stone reduction strategies (i.e., core reduction and/or tool production or maintenance [Cowan 1999]) as well as tool production strategies associated with the availability of local versus nonlocal raw materials (Bamforth 1991; Beck et al. 2002; Elston 1992).

The debitage analysis accounted for: (1) discarded flakes associated with tool production and bifacial technology, including biface thinning flakes, pressure flakes, and retouch chips; (2) discarded flakes associated with expedient core reduction, including early (i.e., primary) and late interior flakes; and (3) non-diagnostic fragmented flakes. The following paragraphs include the definitions of these flake types, demonstrating how these flakes were identified among the HRV assemblage. Additional flake types were considered including prismatic blades (Crabtree 1968), bipolar flakes (Cotterell and Kamminga 1987), and burin spalls (Inizan et al. 1999) but were not identified in the HRV assemblage.

Biface Thinning Flakes. Biface thinning flakes are detached during bifacial tool or core production and shaping/resharpening, with the intent of tool trimming or thinning (Andrefsky 2005:123), and/or core production or reduction for a useable flake blank (*sensu* Kelly 1988:718). Biface thinning flakes have some combination of the following attributes: (1) multifaceted platforms and multiple flaking scars, which are arguably the best indicators of bifacial reduction debitage (Amick et al. 1988; Magne and Pokotylo 1981); (2) lipped platforms; ground/rounded platforms to decrease the chance of a flaking implement from sliding off during tool production and maintenance, as evinced by micro-flaking/shearing (Crabtree 1972); (3) feathered terminations; and/or (4) dorsal flaking scars originating from opposing directions on late-stage bifaces (Andrefsky 2005; Callahan 1979; Frison 1968; Whittaker 1994:185-187). Little to no cortex is expected on late stage bifaces (per Callahan 1979) whereas early stage bifacial tools and bifaces as cores may frequently retain cortex (Patterson 1981). Flake size was not considered for identifying early versus late stage biface reduction (see Patterson 1990:556).

Pressure Flakes. Pressure flakes result from bifacial and unifacial tool production or rejuvenation (Crabtree 1972; Towner and Warburton 1990:317). Neither reduction strategy is clearly distinguishable from one another in an assemblage but both typically result from late stage tool production (Towner and Warburton 1990:315). These flakes were characterized as having: (1) simple platforms and/or abraded platforms; (2) pronounced bulbs of percussion; (3) a maximum linear dimension under 1 cm (cf., Gryba 2006:62); (4) minimal to no cortex; and/or (5) a clam-shell shape (Ahler 1989; Towner and Warburton 1990**;** see Andrefsky [2005:118] for a brief discussion on pressure flake size, and cf., Bamforth [1991:225], Novick [n.d.], and Smith [2005b]).

Retouch Chips. Similar to pressure flakes, retouch chips result from bifacial or unifacial tool production and maintenance (Andrefsky 2005:125). Retouch chips retain little to no cortex, possess simple platforms, and are small in size (<1 cm; cf., Bamforth 1991:225). Retouch chips were distinguished from pressure flakes and biface thinning flakes by their lack of diagnostic features possessed by these latter flake types and for having broad, less pronounced platforms. Broad platforms were quantified by measuring platform width (**pw**) between either lateral margin, and then measuring the widest point of the flake parallel to the platform (**fw**): broad platforms (**pw**) are ≥ (0.9***fw**). This technique was devised for this study to quantify a distinct type that would otherwise be classified as a pressure flake (e.g., Buck et al. 2002; Smith 2005b), given that small flakes that lack cortex are primarily associated with late stage tool production and retouch (Andrefsky 2005:125; Shott 1994; Sullivan and Rozen 1985:758).

Retouch Chip Fragments. Retouch chip fragments constitute a catchall category for flakes with at least one broken margin, no platform or cortex, and a measurement of <1 cm in maximum linear dimension (cf., Smith 2005b). These flakes may be remnants of retouch chips but typological designation(s) could not be assigned with confidence; the missing fragment(s) could contain contrary diagnostic characteristics including cortex or a multi-faceted platform, or bring flake length over a maximum linear dimension of 1 cm (see Sullivan and Rozen 1985:756-757).

Core Reduction Flakes. Debitage associated with expedient core reduction include primary/decortication and late interior core reduction flakes (Crabtree 1972; Sullivan and Rozen 1985). Primary flakes are those containing any amount of cortex on the dorsal surface (Shott 1994:80; cf., Stafford 1979:111) while late interior flakes lack cortex. Either flake has a bulb of percussion but otherwise lacks diagnostic attributes of the bifacial tool or core production/reduction flakes (above; also see Cotterell and Kamminga 1987:686-687; Andrefsky 2005:26). Additionally, late interior flakes have a minimum linear dimension of ≥1 cm (cf., Dibble and Pelcin 1995; Novick n.d.; Smith 2005b).

Flake Fragments. Flake fragments are produced from expedient cores, lack at least one intact margin, and have a maximum linear dimension of ≥1 cm (cf., Novick n.d.). Flake fragments with cortex were recorded as broken primary flakes.

Shattered Flakes. Shattered flakes lack intact margins. Though they cannot be assigned to a particular type, these flakes are likely a byproduct of core reduction via freehand percussion (Crabtree 1972), which involves a forceful striking motion to detach flakes using a hammerstone, billet, or antler rod. This striking motion is more likely to cause shattering than more controlled/direct methods of flake reduction (e.g., pressure flaking or bifacial thinning with an antler tine, or the more precise method of indirect percussion that involves using a hammerstone/billet to strike another implement placed on a precise location on a core for flake detachment; Crabtree 1972; also see Amick and Mauldin 1997; Andrefsky 2005:12). Shattered flakes with cortex were recorded as broken primary flakes.

Tool Analysis

The tool assemblage was analyzed for weight (g), length, or maximum linear dimension, maximum width perpendicular to length, maximum thickness between the both surfaces (e.g., ventral and dorsal when discernable), the presence or lack of cortex, and material type. Similar to the debitage assemblage, these variables accounted for tools that are differentially associated expedient and formal tool categories (Kelly 1988; Parry and Kelly 1987), including expedient edge-modified flakes (EMFs) and early and late stage bifaces. Identifying material type also assisted with calculating source evenness and diversity (Binford 1980:18; O'Connell 1977; Torrence 1983) as well as potential association(s) between preferred material type and tool function (McPherson et al. 1981:649-657; also see Binford 1979). The following section outlines the attributes used to identify these tool types.

Edge-Modified Flakes. EMFs are expediently produced flake tools (Lothrop 1988; Patterson 1987; Perry and Kelly 1987; also see Prasciunas 2007) that retain their original morphology but have modification(s) along one or more margin(s) that do not extend more than halfway across either face of the flake (cf., Andrefsky 2005:229). This distinction segregated EMFs from bifaces (discussed below) and potential unifaces (although no unifaces were identified in the HRV assemblage). To identify the potential range of tool-use behaviors, EMFs were analyzed for: (1) the type of modification (deliberate retouch, use-wear, or both); (2) the location of modification, including the surface (dorsal face, ventral face, alternated, or bifacial) and the edge (proximal, distal or lateral); (3) the number of modified margins (i.e., Employable Units per Knudson [1983], defined as a modified edge of a lithic tool lacking a functional determination); and (4) the characteristics of the lateral, proximal and/or distal modified margin(s) (i.e., convex, concave, sinuous [convex and concave], straight, irregular, pointed, or serrated).

EMF modification may be deliberate via retouch or pressure flaking, or unintentional as a result of use-wear. Deliberate edge modification results from forming an intended edge shape or from preparing an edge for pressure flaking. Intentional edge shaping is associated with patterned pressure flaking scars along one or more margins(s) (Andrefsky 2006; Clarkson 2002; Kuhn 1995) and edge-shearing/micro-flaking. Shearing is a process of ‘wiping’ any implement along a tool margin to quickly produce a desired edge shape or prepare an edge for pressure flaking (Crabtree 1972). This action results in patterned micro-flaking, where flake scars are smaller than those produced from pressure flaking. Although established size designations for pressure flakes are not specified (Andrefsky 2005:118), here micro-flaking flake scars were considered to average 3 mm in length (cf., Andrefsky 2005:197; Vaughan 1985). Larger patterned flake scars were associated with pressure flaking, while smaller patterned flake scars were associated with post-depositional wear (see below).

Edge-shearing as well as edge-dulling may also result from preparing an edge for additional pressure flaking. Intentional dulling was identified by a smooth and/or rounded edge, with or without striations, which resulted from grinding modification (Crabtree 1972). Striations are linear markings that result from friction along a tool margin during edge modification (Kooyman 2000).

EMFs associated with unintentional use-wear resulting from repetitive, patterned tool use (Crabtree 1972, 1974; Kooyman 2000) also contain evidence for sheering/micro-chipping (Odell 1975; Vaughan 1985), striations (Kooyman 2000; Vaughan 1985), and polish use-wear (Keeley 1980). Shearing may result from impacting any hard materials (Wylie 1975) whereas striations can result from working wood, bone, plants, or hides (Keeley 1980) via repetitive grinding, cutting, sawing or drilling motions (Andrefsky 2009; Semenov 1964). Edge-shearing typically results from intentional use-wear and is best associated with utilized flakes only when there is accompanying evidence for uniform striations or polish (Crabtree 1974). Polish is a smoothness or luster that results from processing wood, bone, or hides (Keeley 1980). Polish use-wear should be confined to pronounced features on a tool (where friction had the greatest impact) including the margin(s) and/or the elevated arrises between flake scars where friction occurred.

Care was given to discount: (1) artifacts with superficial edge modification that can result from weathering; and (2) margins with inadvertent damage from recent excavation. Such modification was identified on margins exhibiting unpatterned wear and/or a newer (less dull) luster evincing recent damage. Signifiers of "trampling or post-depositional damage" included flake scars <3 mm in width and "isolated …flake scars" (Andrefsky 2005:197). Margins with patterned flake scars <1 mm in length but lacking use-wear were evident of unintentional impacts from "excavation techniques [or] …bag wear" (Andrefsky 2005:197).

EMFs were ultimately given a functional designation based on their morphological characteristics (i.e., end scraper, side scraper, notched flake, graver, or some combination thereof; cf., Husted and Edgar 2002). End scrapers are those with a modified proximal and/or distal margin whereas side scrapers are those with at least one modified lateral margin. Scraping activities include hide and meat processing (Frison 1968; Keeley 1982) as well as scraping or cutting wood (Terry et al. 2009). Notched flakes are characterized by one or more localized concavities along flake margin(s) and are typically associated with a functional use as spokeshaves used to shape wooden shafts (Crabtree 1973). Gravers are characterized by one or more purposely pronounced points along flake margin(s), which may have been used to incise hide, bone, or soft stone (Crabtree 1972; Keeley 1982). All of these EMF types can be used to make wood, bone, and antler tools (Kelly 1988:723; Kelly and Todd 1988:238) as well as accomplish animal processing activities (Beck and Jones 1997:206).

One potential EMF category, flakes with a concave modification along the dorsal edge of the platform, was excluded from this study (Figure 4.3). These artifacts may not be EMFs as their morphology could have also resulted from previous flake detachment during platform preparation (see Andrefsky 2005:12; Kelly 1988:724; Towner and Warburton 1990). Edge preparation is particularly common prior to detaching biface thinning flakes (Andrefsky 2005; Crabtree 1972). Therefore, only definitive EMFs were incorporated in this study.

Bifaces. Bifaces are tools that are modified to have two conjoining surfaces and flake scars on the ventral and dorsal surfaces that extend at least halfway across both faces. These tools are used either as "cores; as resharpenable, long use-life tools; or as shaped, function-specific tools which are part of a reliable technology" (Kelly 1988:731).

Figure 4.3. Examples of the modified concave dorsal surface of chert (left) and quartzite (right) late interior flakes that indicate possible platform preparation. Note: platforms are oriented towards top of this figure.

Bifaces from HRV were analyzed for flake scar characteristics and a width/thickness ratio to classify them into several stages of manufacture (Andrefsky 2005:187-192; Callahan 1979) to identify the range of biface stages produced and/or used at HRV. Andrefsky (2005:187-189) divides biface manufacture into five stages. The first stage is the blank, which is simply a "flake, cobble, or chunk of raw material." Therefore, only the final four stages of biface production were included in the HRV analysis: (1) stage two (edged biface), when bifaces are bifacially and irregularly worked along the edges and some flakes may extend across either face; (2) stage three (thinned biface), where "humps, ridges, and previous step fractures are removed" to thin the biface. Some flake scars may reach or exceed the middle of either face; (3) stage four (perform), where flake scars are patterned, and preparation for "striking platforms …by grinding or beveling" is evident along the edges. Flake scars should cover nearly every portion of either face; (4) stage five (finished biface), which is characteristically thinned, patterned, often symmetrical, and with regular edges. The 'width/thickness ratio' of bifaces assists with determining biface stage. This ratio should increase from a ratio of 2-4 for stage two bifaces, to 3-4 for stage three bifaces, to 4.1-6 for stages four and five bifaces (Callahan 1979 in Andrefsky 2005:187-188; Whittaker 1994).

Biface condition (i.e., broken or complete) assisted with determining the extent of manufacture error during tool production and onsite tool discard after break(s) that resulted from use (i.e., 'retooling;' see Keeley 1982). Perverse and impact fractures reflect damage caused from use (Crabtree 1972; Davis and Keyser 1999); perverse fractures may also indicate manufacture error (Crabtree 1972; also see Cotterell and Kamminga 1987).

Bifaces were given the functional designations of morphologically comparable tool types described from Mummy Cave by Husted and Edgar (2002; Andrefsky [2005] and Kornfeld et al. [2001] were also referenced). These categories included gravers, spokeshaves and scrapers (defined above), projectile points (see below), and drills, which are used as "carving tools," with the purpose of perforating organic and inorganic materials (Andrefsky 2005; Binford 1979:263; Crabtree 1972).

Projectile Points. Projectile points are the hafted tip of hunting implements and weapons (Keeley 1982; Kelly 1988; Thomas 1982). Great Basin and Plains point typologies were used to classify HRV points using morphological characteristics (Justice 2002; Kornfeld et al. 2010; Thomas 1981; Thompson and Pastor 1995). Diagnostic projectile points helped to place HRV within a regional and chronological context and indicated the degree of hunting practiced by HRV inhabitants (cf., Bettinger 1991; Kornfeld et al. 2001; Rapson 1990; Thomas 1982).

Core Analysis

Cores are lithic nodules from which decortication and/or interior debitage are detached (Andrefsky 2005). Cores in the HRV assemblage were analyzed to identify the percent of cortex (0 percent, 1-50 percent, or 51-100 percent), the number of surfaces exhibiting flake reduction, and the degree of (un)standardized patterning in flake detachment (Parry and Kelly 1987:285). Cortex aids in determining early or late stage core reduction sequences (Beck et al. 2002; Elston 1992) and the number of reduced surfaces indicates the extent of core reduction (cf., Smith 2006). The degree of core standardization indicates the relative degree of formal versus expedient technological organization (Kelly 1988; Parry and Kelly 1987; Andrefsky 1988; also see Prasciunas 2007). For instance, "unstandardized" cores (*sensu* Parry and Kelly 1987:285), should retain an amorphous morphology with multiple striking platforms and reduced surfaces (e.g., Beck and Jones 1997:200; Crabtree 1972; Kelly and Todd 1988; cf., Andrefsky 2005:16). On the other hand, formal cores are intentionally shaped prior to producing useable flake blanks (*sensu* Kelly 1988:718). Cores were ultimately designated as either having a formal/standardized or an expedient/unstandardized morphology (Parry and Kelly 1987:285).

Chapter 5

RESULTS

Flaked Stone

The Flaked Stone Sample

Among the 10 excavated lodge pads, 11,671 chert, quartzite, basalt, rhyolite and quartz flakes were available for sampling and analysis. Using the sampling methods described in Chapter 4, a sample of 4,057 flakes was analyzed (see Table 4.1, column 7). Obsidian was the only definitively nonlocal material type identified (Morgan et al. 2012a; also see Koenig 2010 and Scheiber and Finley 2011) and owing to the small amount of obsidian debitage in the assemblage (n=144) all obsidian artifacts recovered from the site were analyzed (see Appendices, Table A-2).

Debitage

Debitage was marked by a low diversity and evenness of raw materials (Figure 5.1) and nearly equal amounts of flakes resulting from bifacial and expedient core reduction (Figure 5.2). Among the sampled debitage, 95.2 percent was chert (n=3,862), 4.5 percent was quartzite (n=184), and the remaining 0.3 percent consisted of quartz (n=6) and basalt (n=5) (Figure 5.1). Source diversity was low among the chert and quartzite assemblages; nearly all chert appeared to have originated from local sources between 1.5 and 8 km from HRV (Koenig 2010:77). Less than 1 percent (n=33) visually corresponded with SiO_2 "opalitic" chert (Figure 5.3), which originates from sources such as southwestern Wyoming's Bridger Basin near Lonetree, Wyoming 250+ km from HRV, and the Jack Morrow Hills 150 km from HRV (Kornfeld et al. 2010:590). This chert type is also chemically and visually similar to another southwestern Wyoming chert outcrop south of Wamsutter, also 250+ km from HRV, as well as the Knife River Flint of western North Dakota, located 600+ km from HRV (Kornfeld et al. 2010:558; also see Ahler and Christensen 1983). Additionally, participants of the 2010–2012 Utah State University field schools noted that small nodules of similar chert naturally occurs nine km east of HRV at the base of Torrey Creek Canyon. Despite difficulties in sourcing, this chert is likely not local to HRV (see discussion, below; also see Chapter 6). Quartzite debitage originate from raw materials that are present onsite (Koenig 2010; Losey 2013) and quartz and basalt are available in and near the Wind River Range. Quartz is one of the minerals that comprise granite, common to the Wind River Range (Adams 2010), and basalt occurs as secondary clast deposits ≥12 km from HRV (Adams 2010:59). In contrast, source diversity was relatively high within the obsidian assemblage (Figure 5.4; Morgan et al. 2012a). As indicated by 137 sourced artifacts, the obsidian assemblage represented a minimum of nine geochemical types ranging from 104 to 249 km from HRV (Morgan et al. 2013).

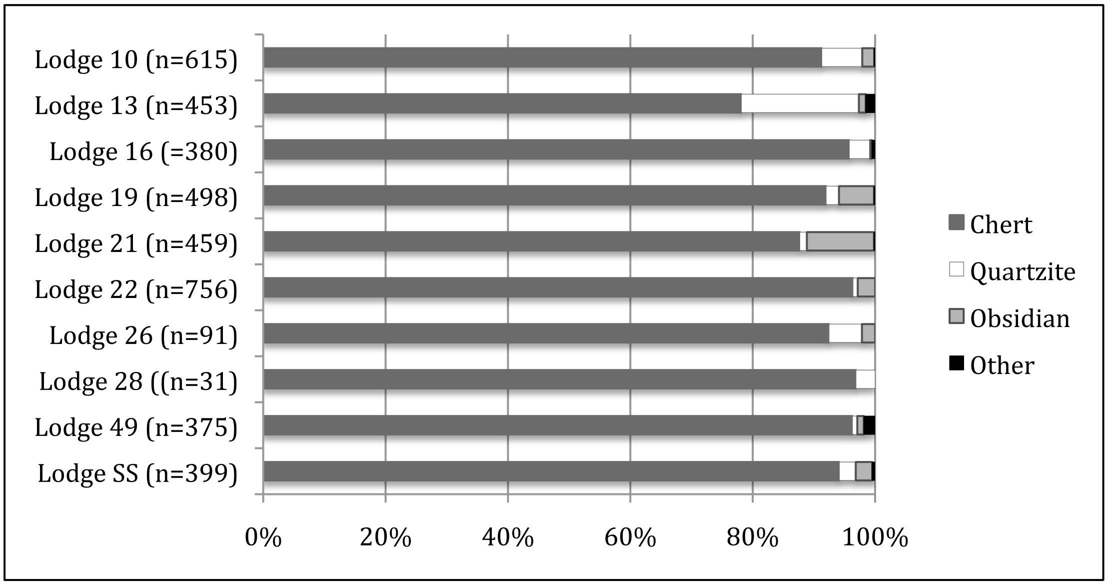

Figure 5.1. Frequencies of debitage material type per lodge.

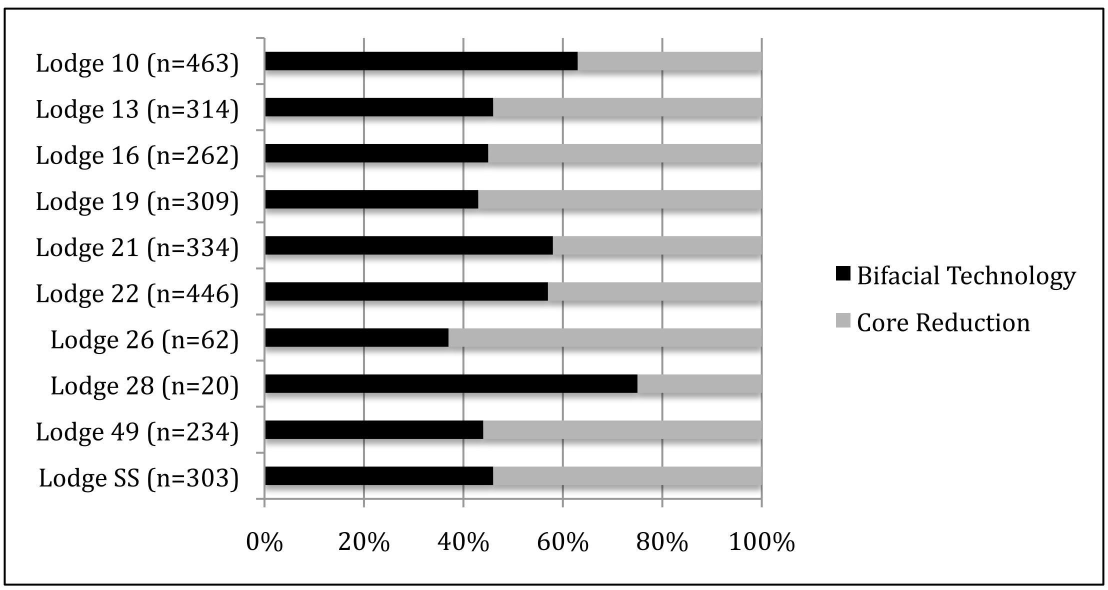

Figure 5.2. Inter-lodge relative frequencies between bifacial and core reduction categories among the non-obsidian debitage assemblage.

Figure 5.3. Example of possible Bridger Basin/opalitic chert. From left to right: the ventral surface of a retouch chip; the ventral surface of a retouch chip fragment; and the dorsal surface of a biface thinning flake.

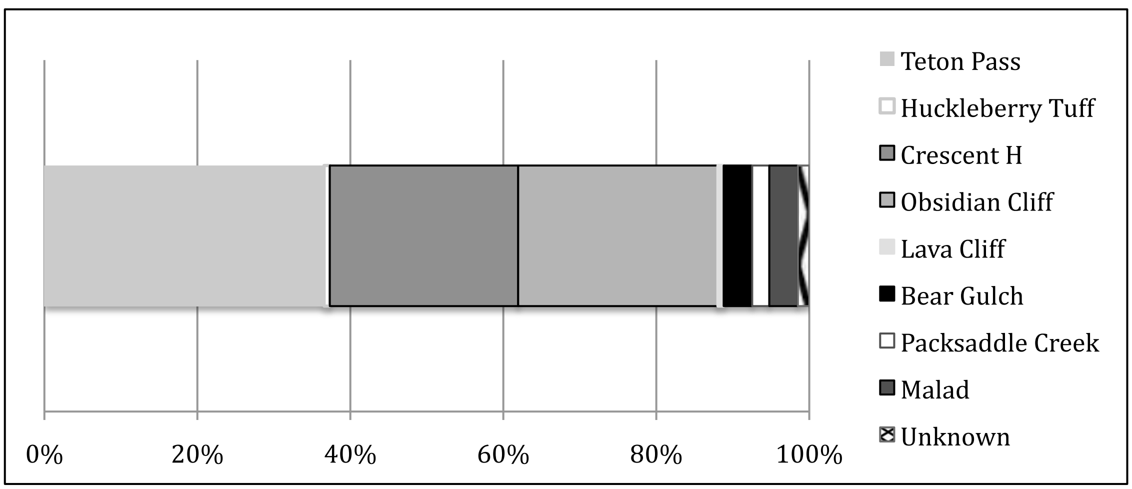

Figure 5.4. High Rise Village obsidian sources (n=9).

Expedient core-flake technology and formal bifacial technology were nearly equally represented among non-obsidian debitage. Expedient flakes comprised 51 percent of the assemblage (Figures 5.5; also see Figure 5.2) and flake types associated with bifacial technology constituted 49 percent of the assemblage. The proportion of unretouched expedient flakes (*sensu* Parry and Kelly 1987:288) spanned 25 to 63 percent per lodge, however, and 37 to 75 percent of formal bifacial flakes per lodge (Figure 5.2). In short, the co-occurrence of either technology was typical within HRV lodges, although in varying degrees per lodge.

The majority of debitage associated with core reduction and bifacial tool (or core) production and maintenance indicated that hunter-gatherers prepared and reduced most cores and tools prior to arriving to HRV. Among expedient flakes, late interior flakes and flake fragments were common to all lodges (Figure 5.6). Compared to late interior flakes, primary flakes occurred in relatively low quantities in all but Lodges 22, 26, and SS (Figure 5.7). Primary flakes only comprised 18 percent of the expedient assemblage (Figures 5.8 – 5.10) compared to 6.6 percent of the total debitage assemblage, ranging from 2 to 14 percent per lodge. The low quantity of primary flakes indicated that HRV inhabitants mainly reduced late stage cores. Lodges with higher quantities of primary flakes, including Lodges 22, 26 and SS, indicated that their inhabitants reduced early stage cores at HRV slightly more often (cf., Cowan 1999; Elston 1992; Parry and Kelly 1987). Nonetheless, late stage core reduction was the prominent expedient pattern in every lodge (Figure 5.7).

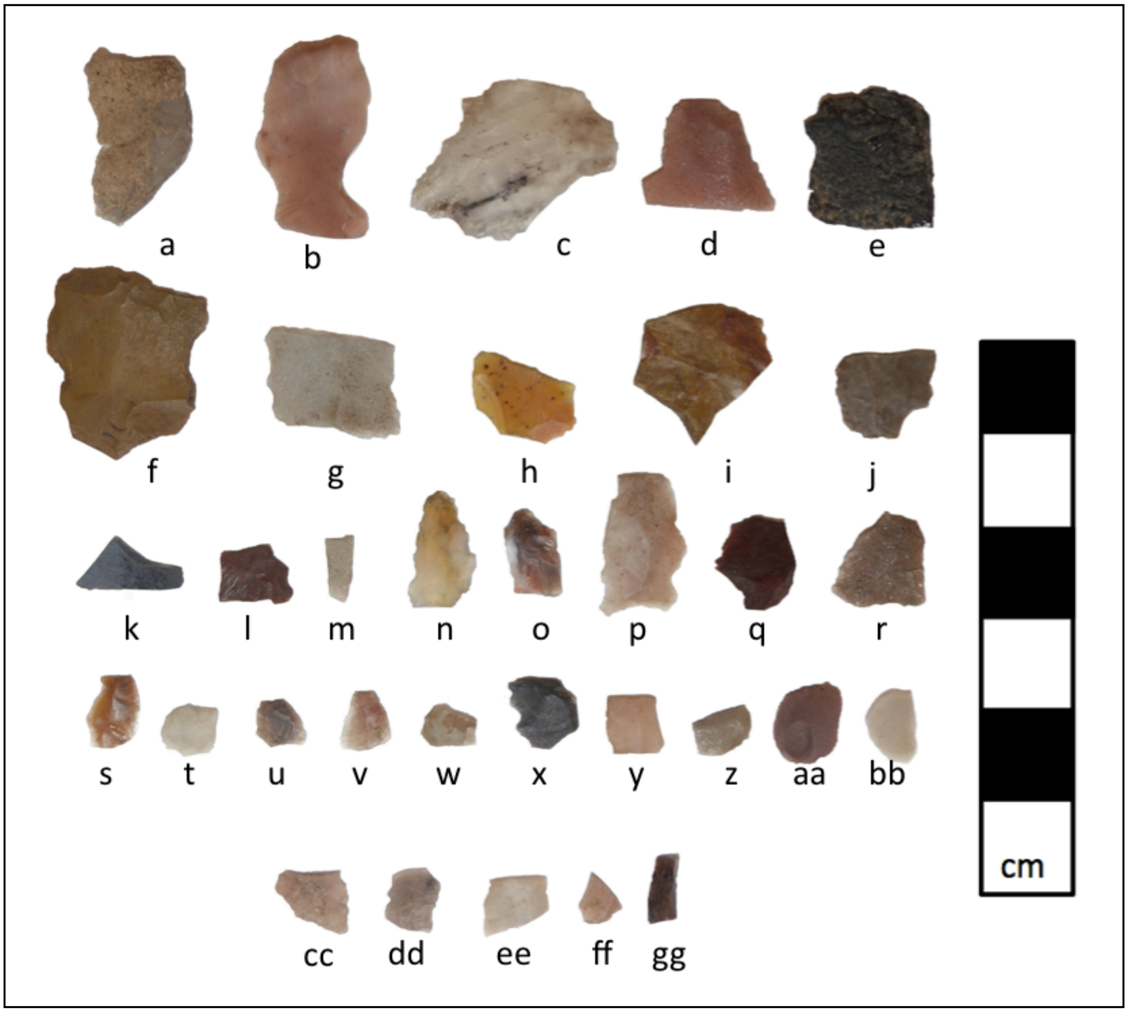

Figure 5.5. Example of identified debitage categories: (a) primary flake (chert); (b-e) late interior flakes (chert, chert, quartzite, basalt); (f-j) flake fragments (chert, quartzite, chert, chert, chert); (k-m) shatter (chert); (n-r) biface thinning flakes (chert, chert, chert, chert, quartzite); (s-v) pressure flakes (chert); (w-z) retouch chips (quartzite, chert, chert, chert); (aa-bb) pot lids (chert); (cc-gg) retouch chip fragments (chert). Note: flakes are oriented with the platform towards the top and distal end towards the bottom of figure. The dorsal surface is exposed on every flake except one late interior flake (b) and both pot lids (aa-bb), which exhibit the (original) ventral surface of these flakes.

Three categories of bifacial debris occurred in varying frequencies among lodges but collectively indicated that inhabitants of each lodge regularly engaged in late stage bifacial production and maintenance (Figure 5.2). Among each lodge's bifacial debitage, biface thinning flakes occurred in frequencies spanning 7 to 51 percent and average 34 percent per lodge. Because less than 1 percent of biface thinning flakes exhibited cortex (Figure 5.9), these data indicated that inhabitants mainly worked late-stage bifaces (see Elston 1992; Kelly 1988). Retouch chips were also common to every lodge, averaging 45 percent of all bifacial debitage and ranging 15 to 86 percent of each lodge's bifacial debitage assemblage. The production and rejuvenation of late-stage bifacial tools was thereby a common activity among HRV inhabitants (see Andrefsky 2005:125; Shott 1994; Sullivan and Rozen 1985:758). Pressure flakes were common at six lodges: 13, 16, 19, 26, 49, and SS (Figure 5.11), indicating that inhabitants of these lodges spent more time carrying out the final steps of late stage bifacial tool manufacture, refinement (Towner and Warburton 1990:315), and rejuvenation (Towner and Warburton 1990:314).

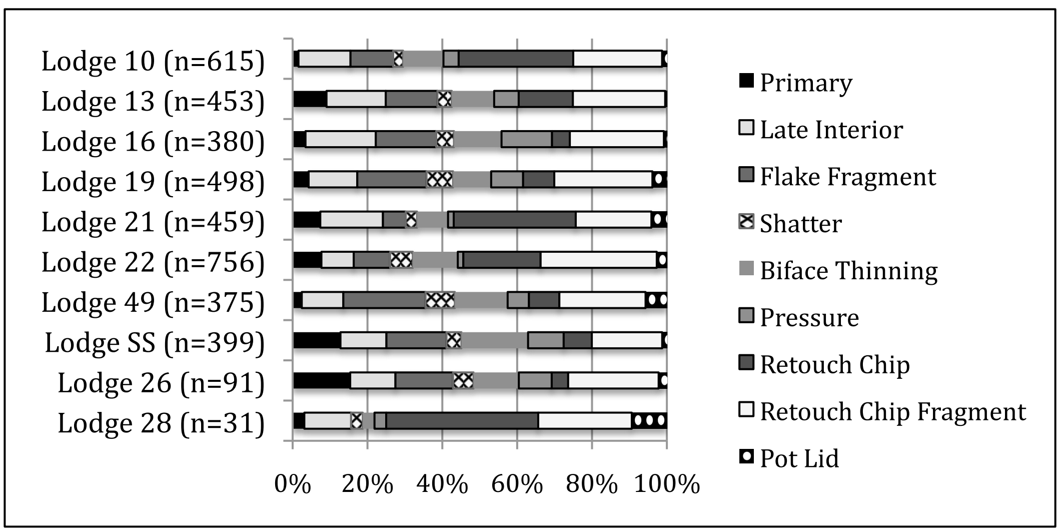

Figure 5.6. Inter-lodge comparison of non-obsidian debitage categories.

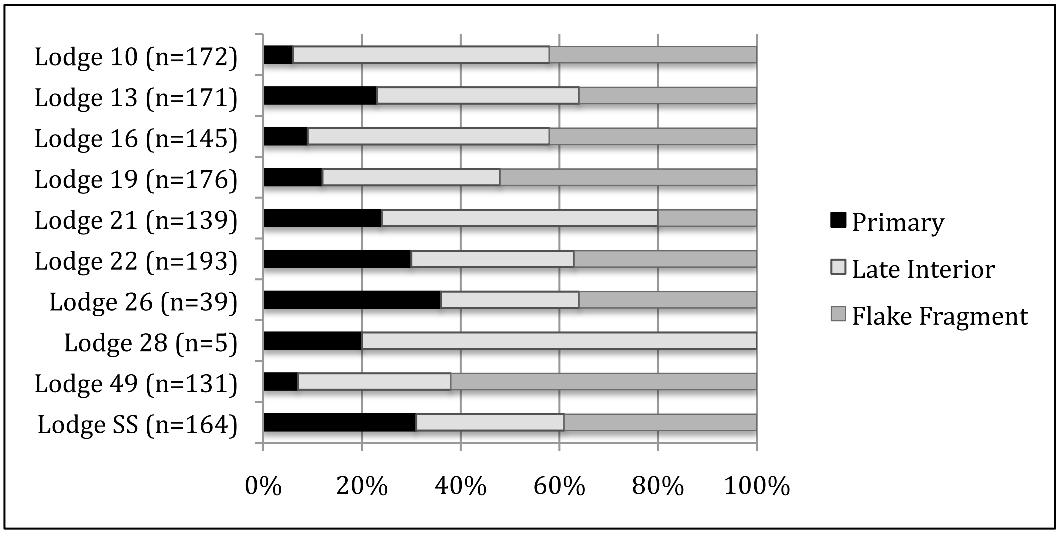

Figure 5.7. Inter-lodge comparison of non-obsidian debitage resulting from expedient core reduction.

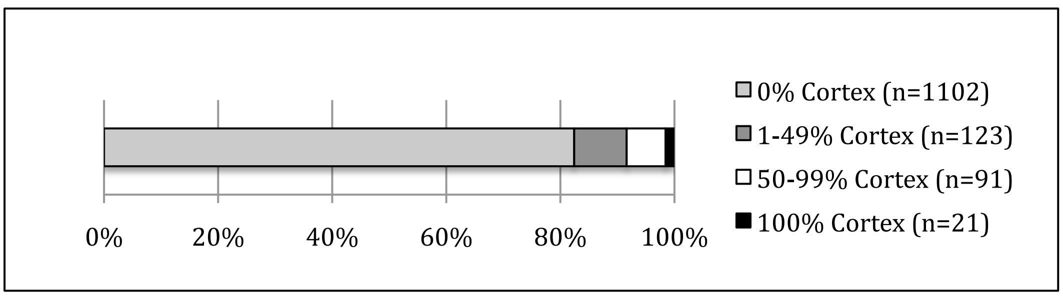

Figure 5.8. Frequency of cortex on expedient flakes.

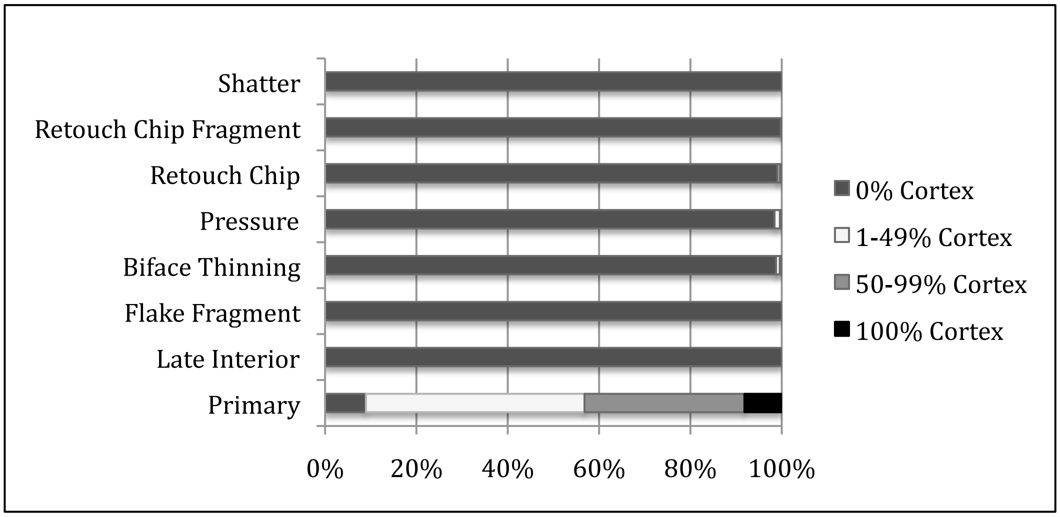

Figure 5.9. Frequency of dorsal cortex per debitage category.

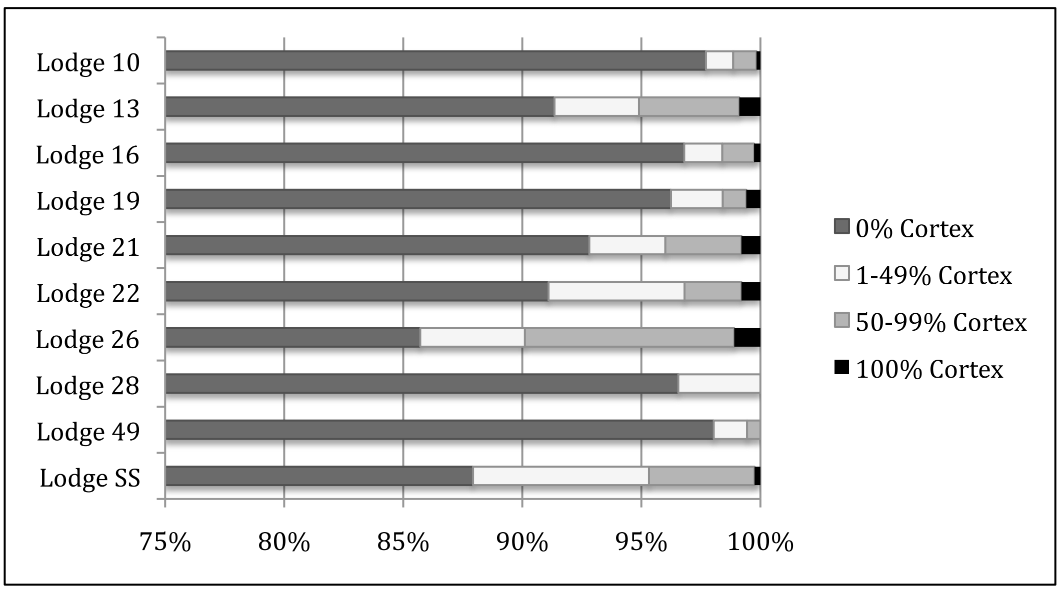

Figure 5.10. Frequency of flakes with dorsal cortex per lodge.

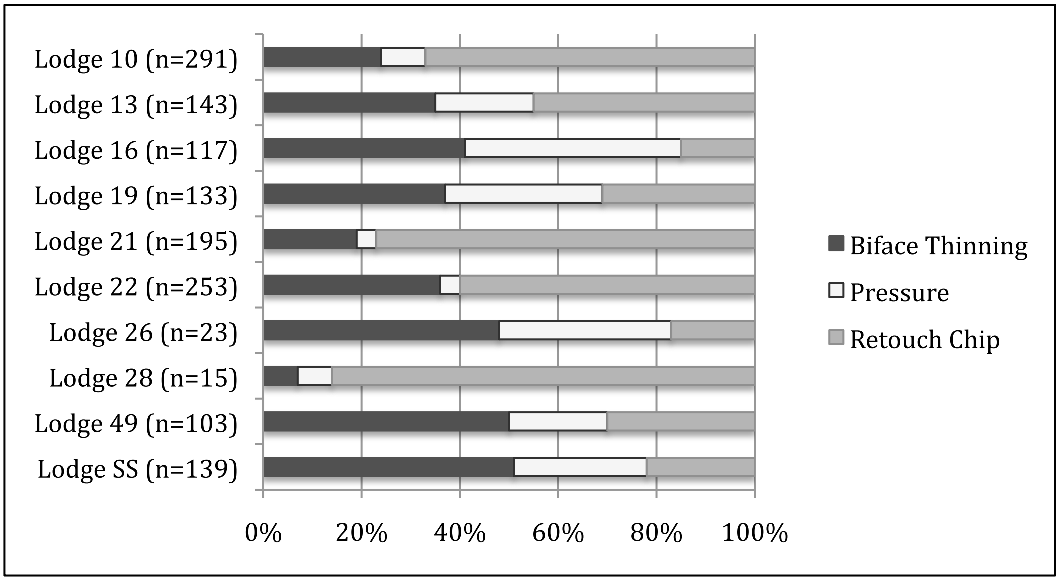

Figure 5.11. Inter-lodge comparison of non-obsidian bifacial debitage.

Lodges with the fewest retouch chips, Lodges 16, 19, 26, 49, and SS, contained the most pressure flakes and biface thinning flakes. The reverse was true of lodges with the highest quantities of retouch chips, including Lodges 10, 21, and 22, where pressure flakes and biface thinning flakes were least common. This suggested a contrasting pattern or technique in late stage production and maintenance among either set of lodges. However, production and rejuvenation activities could not be distinguished within the pressure flake and "retouch" flake assemblages (Towner and Warburton 1990:315; also see Buck et al. 2002), preventing an assessment for the degree of production versus maintenance in these lodges.

The trend towards smaller flakes further evinced late stage biface and expedient core reduction in every lodge. Among bifacial and expedient flakes (excluding broken flakes), distributions in flake weight, width, and length consistently trended towards smaller dimensions. Flakes weighing ≤0.1 g comprised 60 to 78 percent of each lodge's debitage assemblage (Figure 5.12). Among the bifacial assemblage alone, 94 percent of flakes weighed ≤0.1 g (Figure 5.13). Flake widths of the total debitage assemblage spanned 0.9 to 58 mm, but 69 percent of the assemblage, or 60 of 74 percent of each lodge, was ≤7.5 mm in width (Figure 5.14). Similarly, among 73 percent of the total assemblage, or 56 to 80 percent of each lodge, the maximum flake length was ≤12.5 mm, with flake lengths otherwise spanning 2.5 to 68.7 mm (Figure 5.15). While each lodge's flake assemblage trended towards smaller lengths, widths, and weights, Lodge 26's bifacial and expedient assemblages both possessed larger dimensions (Figures 5.12 – 5.15). This exception indicated that larger and potentially earlier staged bifaces or a greater quantity of expedient cores were reduced in this lodge (Carr and Bradbury 2001; Shott 1994). This was also the case in Lodge 28, where the average weight of expedient flakes was relatively large (Figure 5.16).

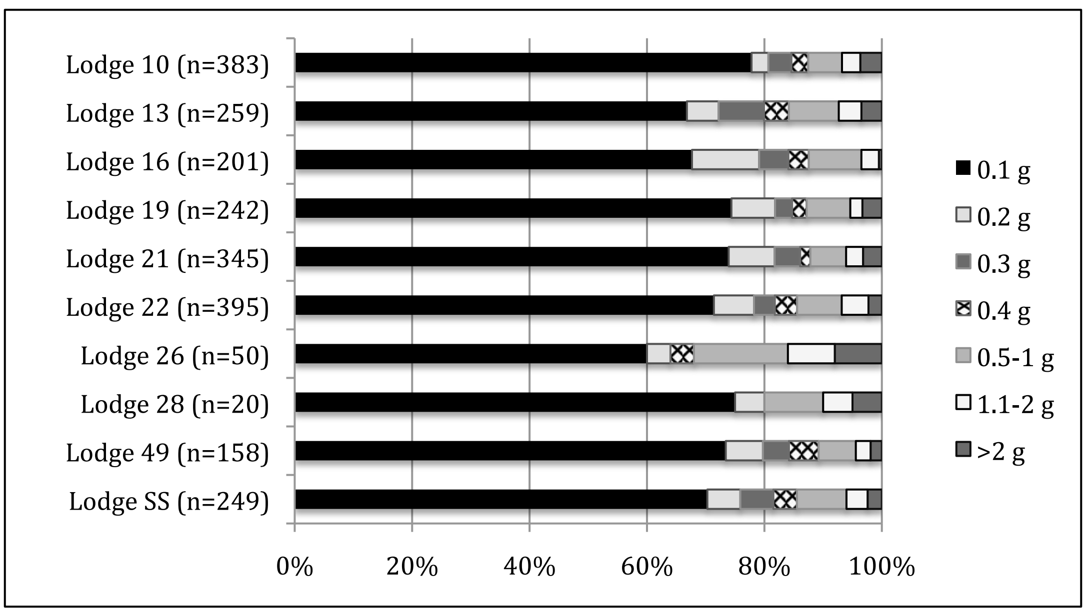

Figure 5.12. Frequency of individual flake weight per lodge, broken flakes excluded.

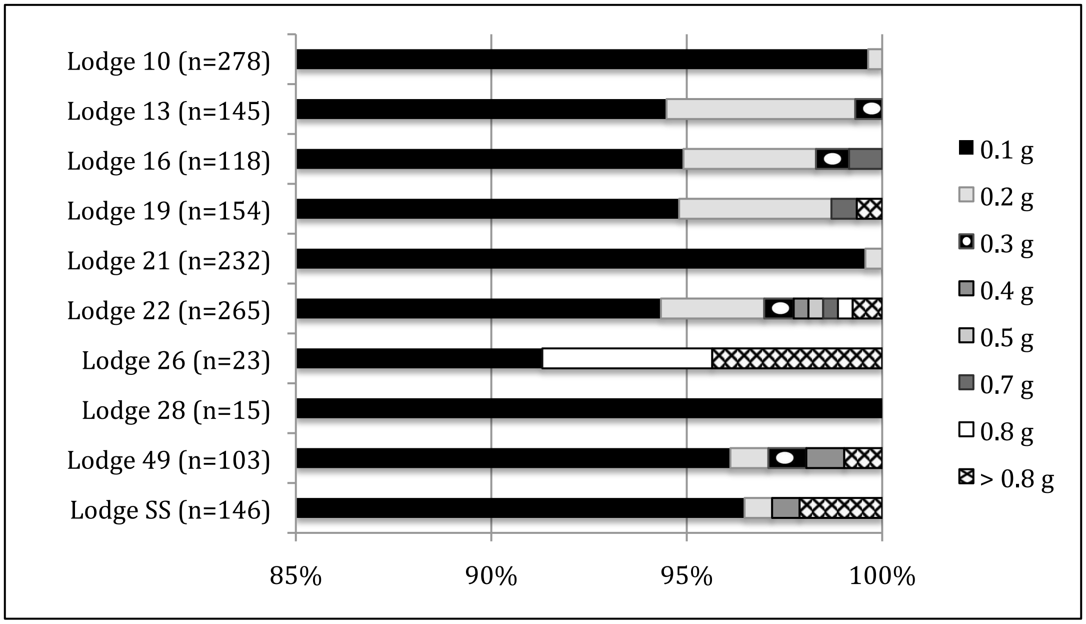

Figure 5.13. Frequency of individual flake weight among bifacial debitage, broken flakes excluded.

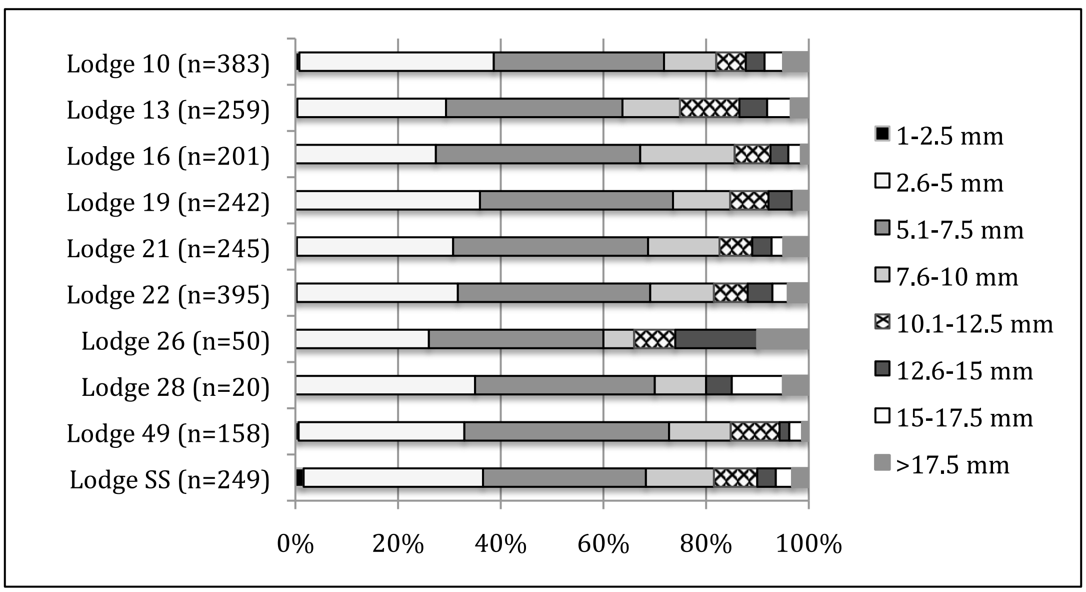

Figure 5.14. Frequency of individual flake width per lodge, broken flakes excluded.

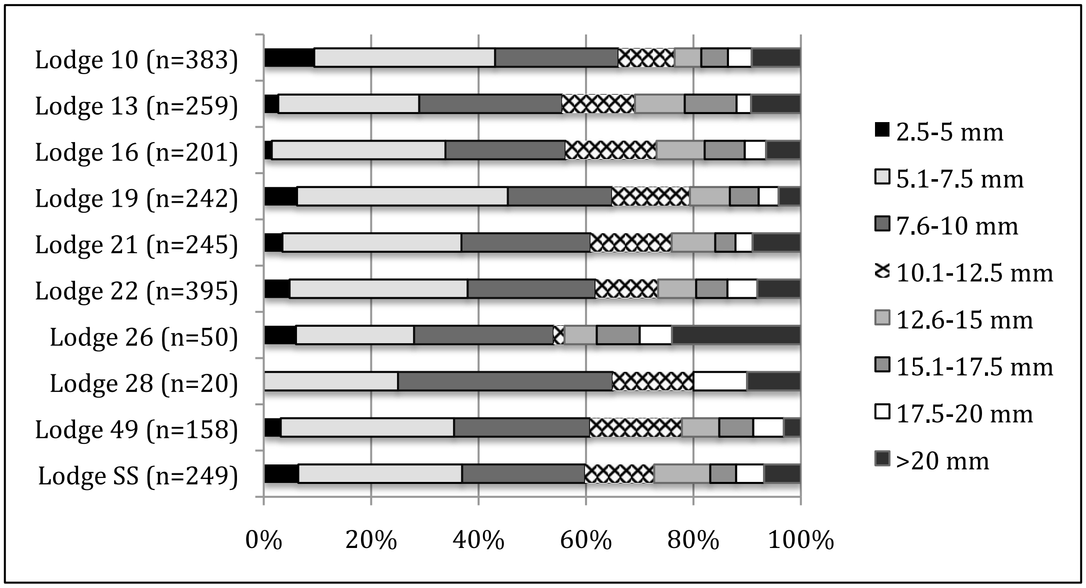

Figure 5.15. Frequency of individual flake length per lodge, broken flakes excluded.

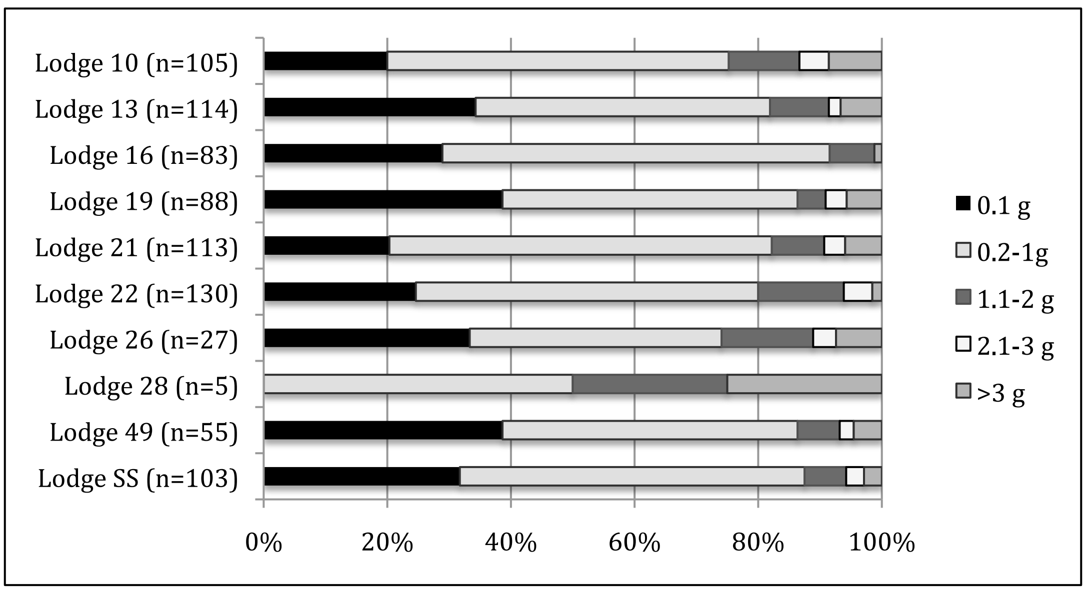

Figure 5.16. Frequency of expedient flake weight per lodge.

Lastly, among the nonlocal obsidian (n=144) and possible Bridger Basin debitage (n=33; Figure 5.3), the trend towards bifacial technology was especially pronounced (Figures 5.17 and 5.18; cf., Figure 5.19). Ninety percent of diagnostic obsidian flakes (n=90) were associated with late stage bifacial tool production and maintenance while the remaining 10 percent (n=10) were core reduction flakes. Forty-six percent of diagnostic obsidian flakes were retouch chips, 29 percent were biface thinning flakes, and 15 percent were pressure flakes (Figure 5.17). The retouch chips and pressure flakes collectively indicated that HRV inhabitants mainly produced obsidian bifaces off site and further reduced and maintained these tools onsite (Andrefsky 2005:125; Shott 1994). For instance, the particularly small dimensions of obsidian bifacial flakes, which range from 2.5 to 14 mm in length (and 2.5 to 34.6 mm including expedient flakes) compared to the non-obsidian bifacial assemblage (n=1388), which range from 2.5 to 44.8 mm, indicated that most biface thinning flakes were struck from small and late stage obsidian bifaces. Also, among the obsidian expedient assemblage, all but one flake lacked cortex and that primary flake contained less than 50 percent dorsal cortex (quantified in intervals of 1-50 percent, 50–99 percent, and 100 percent). Lastly, the four indeterminate flakes (Figure 5.17) were too fragmentary to be classified as a result of destructive hydration analysis (also see Morgan et al. 2015). These flakes were clearly small in length and width, however, and were likely bifacial or fragmentary.

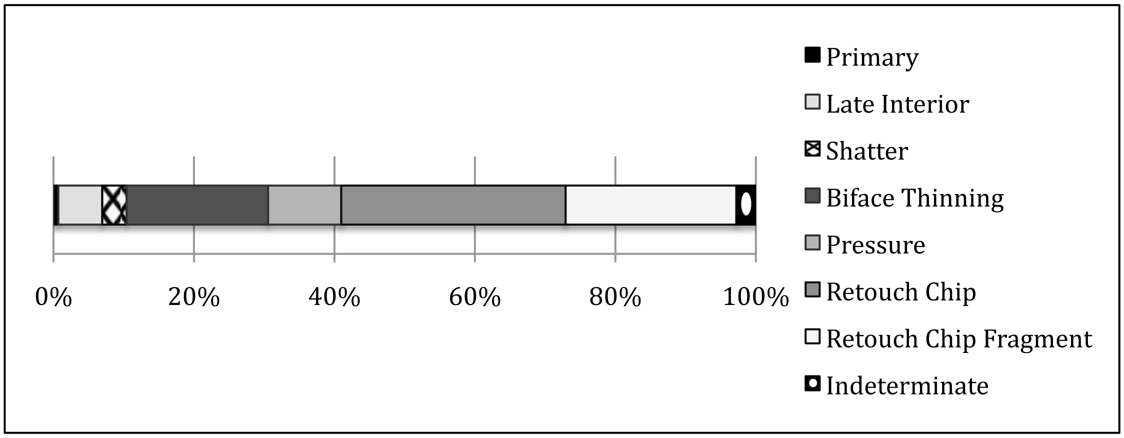

Figure 5.17. Frequency of flake categories within the obsidian assemblage. Note: indeterminate flakes are those that were analyzed following destructive hydration analysis.

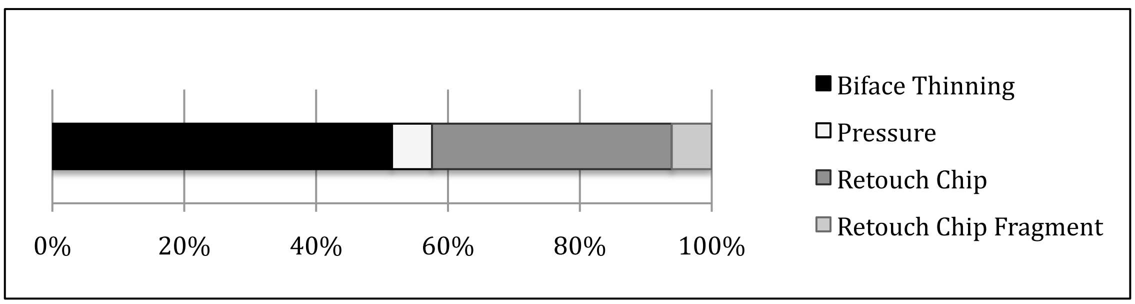

Figure 5.18. Frequency of flake categories within the Bridger Basin/opalitic chert assemblage.

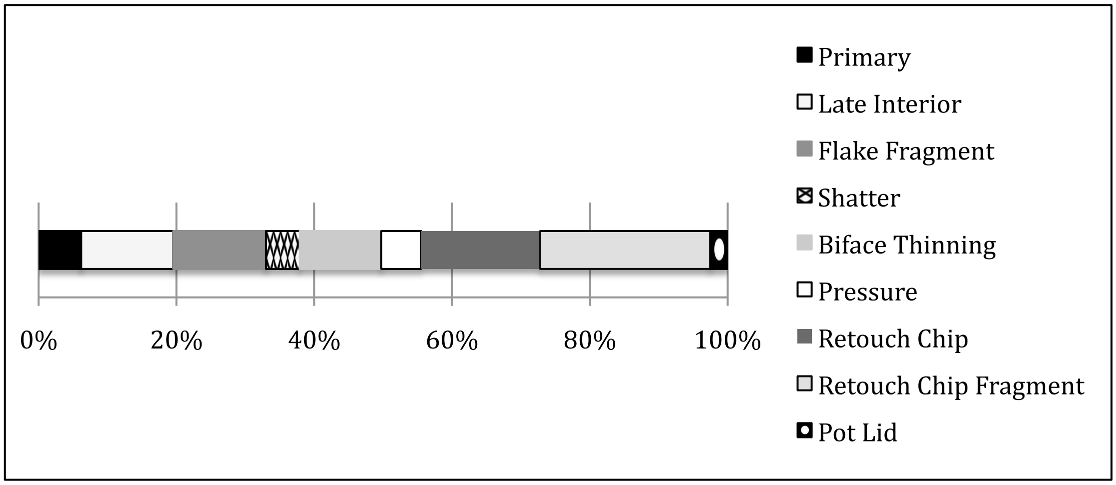

Figure 5.19. Frequency of flake categories within the non-obsidian assemblage (including the Bridger Basin/opalitic chert assemblage).

Among the possible Bridger Basin chert flakes (n=33), all represented bifacial technology. Excluding retouch chip fragments (n=2), 55 percent were biface thinning flakes, 39 percent were retouch chips, and 6 percent were pressure flakes (Figure 5.18; also see Figure 5.3). This distribution resembled the obsidian assemblage. Furthermore, length for all 33 flakes ranged from 4.8 to 14.6 mm; these relatively small dimensions supported the notion that hunter-gatherers indeed procured this raw material from nonlocal sources (e.g., the Bridger Basin as opposed to Torrey Creek Canyon) (also see Brantingham 2006; Carr and Bradbury 2001; Shott 1994).

The Stone Tool Sample

Few stone tools were recovered from the site, which prompted an analysis of all available tools from the 10 lodges discussed in this study (n=136; see Appendices, Tables A-12 and A-14). All tools were either expedient edge-modified flakes (EMFs) or formally produced bifaces.

Edge-Modified Flakes

Expedient and formal tools co-occurred in all but one lodge, but there was substantial variability in the proportions of these tool types per lodge (Figure 5.20). EMFs (n=68) dominated Lodges 10, 13, 19, 21 and 28 whereas bifaces dominated Lodges 16, 26, 49 and SS. This contrast may reflect a differential preference in the expedient production (and replacement) of tools (Parry and Kelly 1987) versus a preference for using bifacial tools with more durable working edges and longer use-lives (Kelly 1988:720–721).

Although the frequency of formal and informal tools varied by lodge, the overall diversity of tool types was low for either category (see Chapter 6). Among the EMF assemblage, only three basic tool types were identified: scrapers, gravers, and notched flakes (Figures 5.21 and 5.22). Scrapers comprised more than 96 percent of the EMF assemblage. Morphologically, scrapers were categorized as end and/or side scrapers (Frison 1968; Keeley 1982; Terry et al. 2009). The additional 4 percent of the EMF assemblage included one graver and two notched flakes, with one of either category also

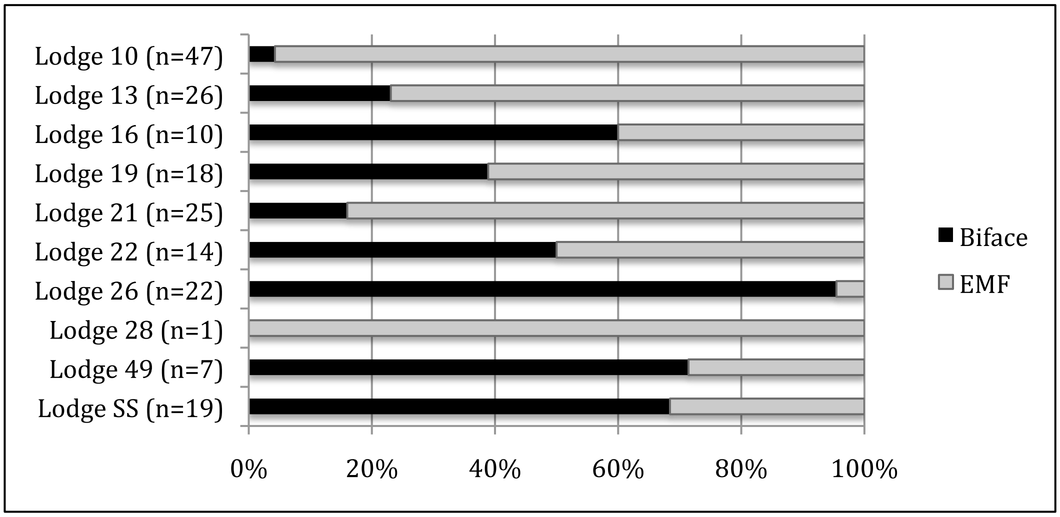

Figure 5.20. Frequency of bifaces versus edge-modified flakes per lodge.

having a scraping component (Figure 5.21). Additionally, raw material diversity and evenness was low among the expedient tool assemblage. Among EMFs derived from the excavation units incorporated into the debitage analysis (n=61), 80 percent were made from local chert, 10 percent were made from possible Bridger Basin chert, 7 percent were made from obsidian, and 3 percent from quartzite (Figure 5.23). EMFs made from materials other than local chert only occurred in Lodges 10, 19, 21 and 49. Lodge 10's EMF assemblage (n=26) comprised 4 percent quartzite and 23 percent possible Bridger Basin chert. Obsidian constituted 50 percent of Lodge 19 (n=4), with one quartzite and one local chert EMF also in this lodge. Obsidian also made up 12.5 percent of the Lodge 21 EMF assemblage (n=8) and the entire Lodge 49 EMF assemblage (n=1). These trends suggest that some inhabitants preferred certain material types or incorporated them when available for expedient activities. Nonetheless, locally available chert was used for the same tasks as those conducted using other raw materials (Figures 5.21 – 5.24).

Macroscopic analysis identified that EMFs were produced either from deliberate retouch (n=35), use-wear (n=13), or both (n=20; Figures 5.21, 5.24, and 5.25). EMFs with deliberate retouch occurred in every lodge whereas use-wear only occurred on EMFs from half of the analyzed lodges (Figure 5.24). Deliberate retouch was associated with the notched flakes and graver while use-wear was most common on scrapers (Figure 5.25).

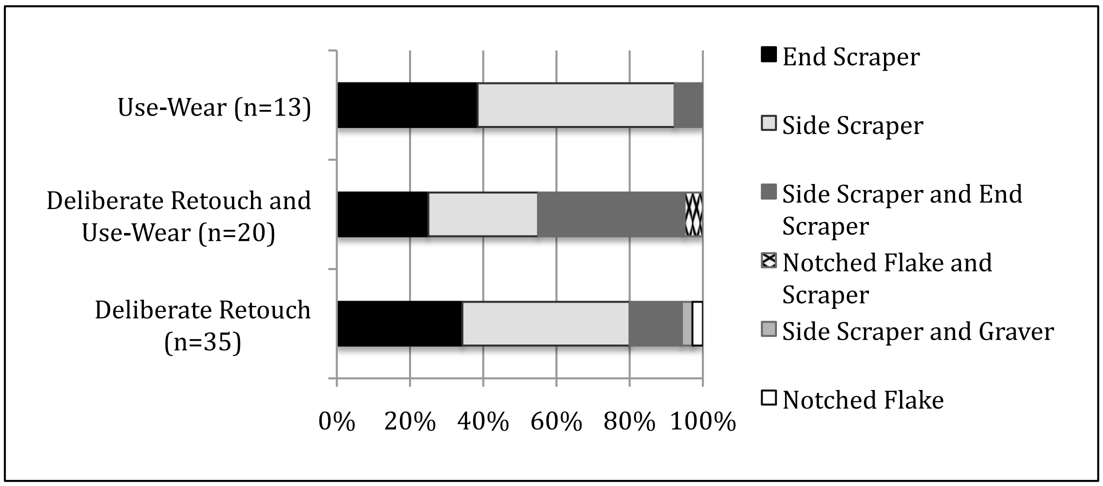

Figure 5.21. Relation between edge-modified flake function and the mode of edge-modified flake production.

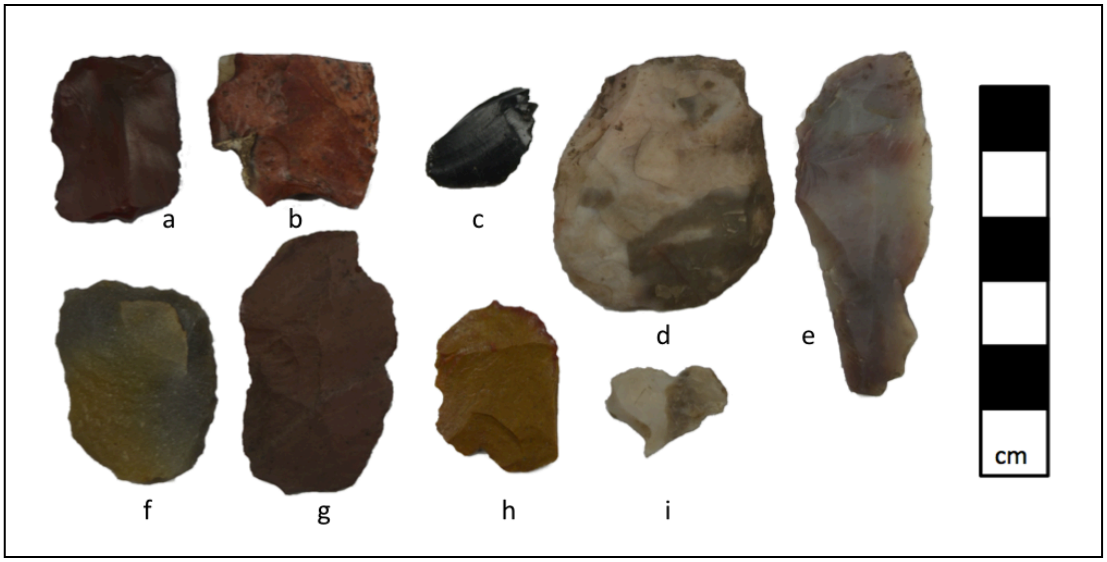

Figure 5.22. Examples of each edge-modified flake category: (a) end scraper (chert); (b-c) side scrapers (chert and obsidian); (d-f) end and side scrapers (chert, chert and quartzite); (g) notched flake and scraper (chert); (h) side scraper and graver (chert); (i) notched flake (chert). When distinguishable, platform is at top of figure, distal end is at bottom of figure.

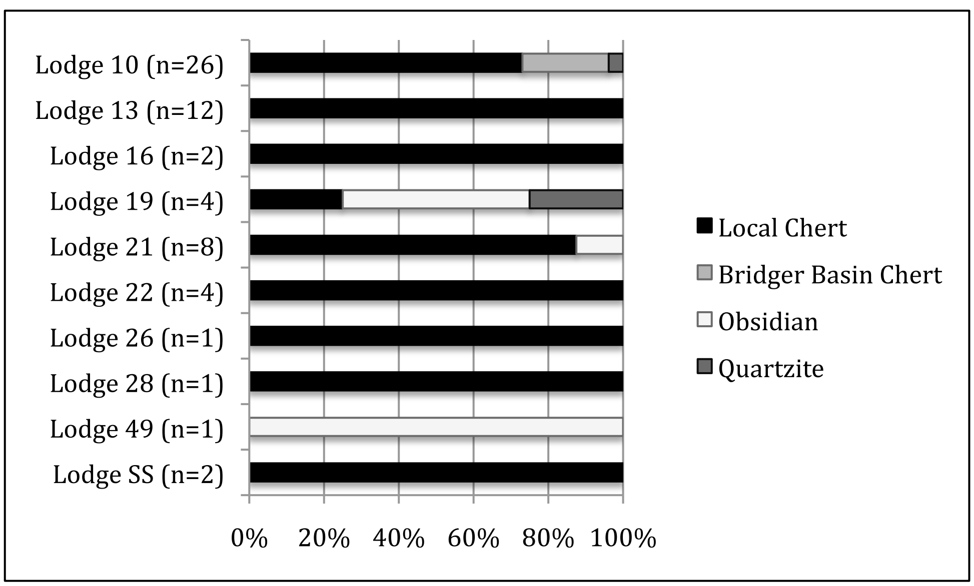

Figure 5.23. Edge-modified flake material type per lodge (excluding EMFs that originate from units not incorporated into debitage analysis).

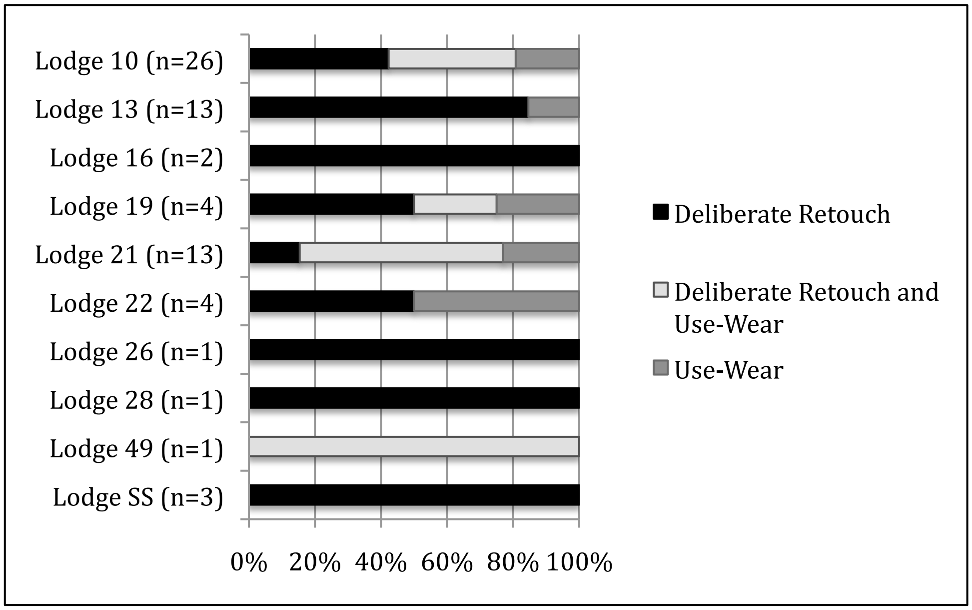

Figure 5.24. The manner of edge-modified flake edge modification per lodge.

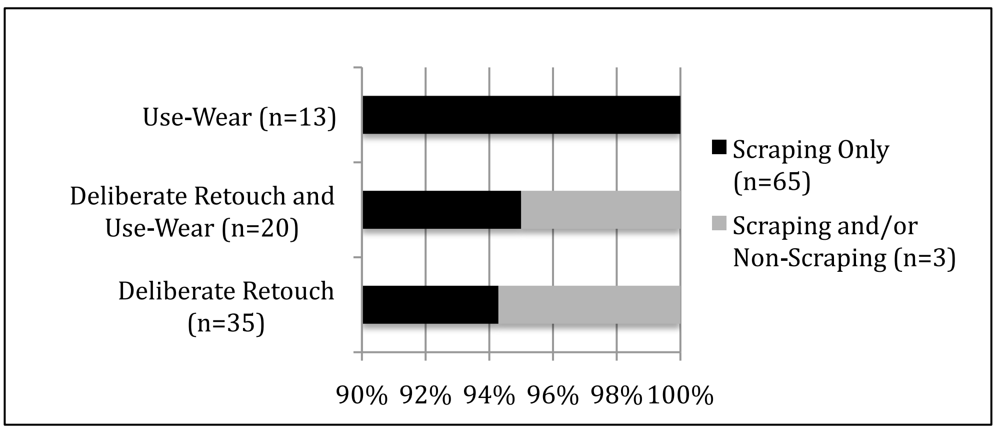

Figure 5.25. Relationship between mode of edge-modified flake production and generalized edge-modified flake function.

Bifaces

Diagnostic projectile points (n=22) exhibited minimal typological diversity. Twenty projectile points were a continuum of corner notched variants with only one side notched and one triangular concave-based projectile point (Figure 5.26; cf. Husted and Edgar 2002:204, 206). Furthermore, all points were made from locally available chert and every lodge contained points in relatively low counts (≤4) apart from Lodges 26, 28, and 13 (Figure 5.27). Lodge 26 contained eight projectile points while Lodges 13 and 28 contained none.

The additional 47 bifaces (Figures 5.28 and 5.29) trended towards the stage 4 and stage 5 categories (per Andrefsky 2005:187-188) in nearly every lodge (Figure 5.30). Exceptions included Lodge 16, which lacked late-stage bifaces, and Lodge 28, which lacked bifaces altogether. The biface assemblage consisted of: (1) the tip, tang and medial fragments of projectile points (n=25), which occurred in all but Lodge 16; (2) unknown/exhausted fragments (n=15) identified in every lodge except Lodges 10 and 21; and (3) drills and gravers (n=7) in Lodges 19, 49 and SS. Also indicative of the low variability among bifaces is that 94 percent were made of chert (Figure 5.32) and 91 percent were broken (Figure 5.33). Non-chert bifaces included a quartzite drill, an obsidian projectile point tang fragment, and an unidentifiable quartz biface fragment (Figure 5.28, d, h, and m). Among broken bifaces (n=43), all but two were broken by at least one step fracture while the two remaining fragments (both drills) were broken by a perverse fracture or a shattered edge (Crabtree 1972; also see Jennings 2011). The four complete bifaces included a graver and three teardrop-shaped bifaces ranged from 41.2 to 21.3 cm in maximum linear dimension. These contained dimensions and distal ends that

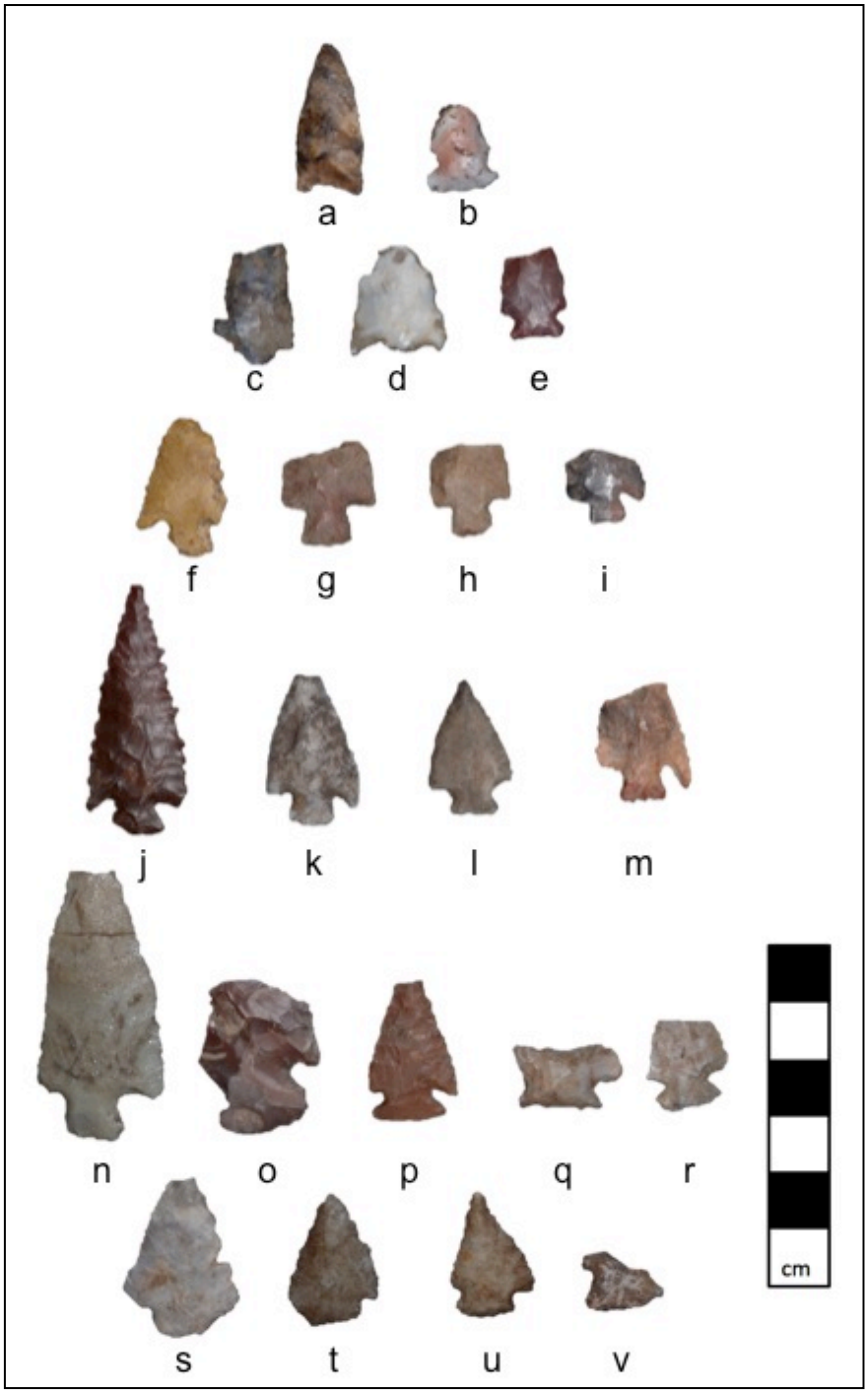

Figure 5.26. Projectile points: (a) concave-based triangular point; (b) side-notched; (c-m) Rosegate Corner-notched; (n-v) unknown corner-notched.

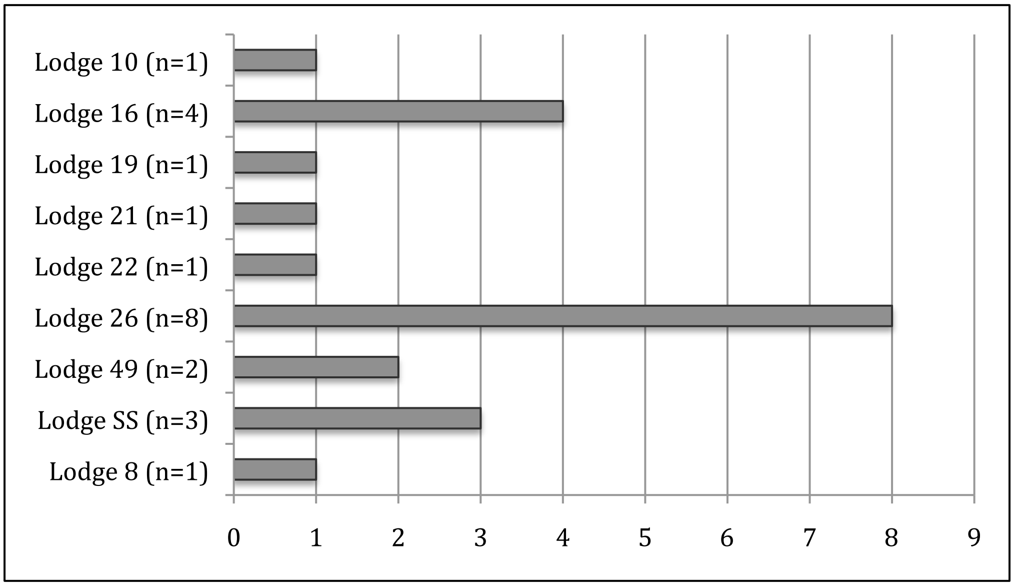

Figure 5.27. Frequency of projectile points per lodge. Lodge 8 included for comparative purposes.

compare morphologically to artifacts designated as drills (Husted and Edgar 2002, page 204, plate 34, l) in Mummy Cave. Also, those Mummy Cave artifacts were recovered from a stratum occupied within the period of HRV occupation (Losey 2013; Morgan et al. 2013; also see Husted and Edgar 2002:26). Despite these biface categories occurring in varied frequencies within each lodge, there were prevalent trends in material type and biface condition as well as projectile points and projectile point fragments in nearly every lodge (Figures 5.27 and 5.29).

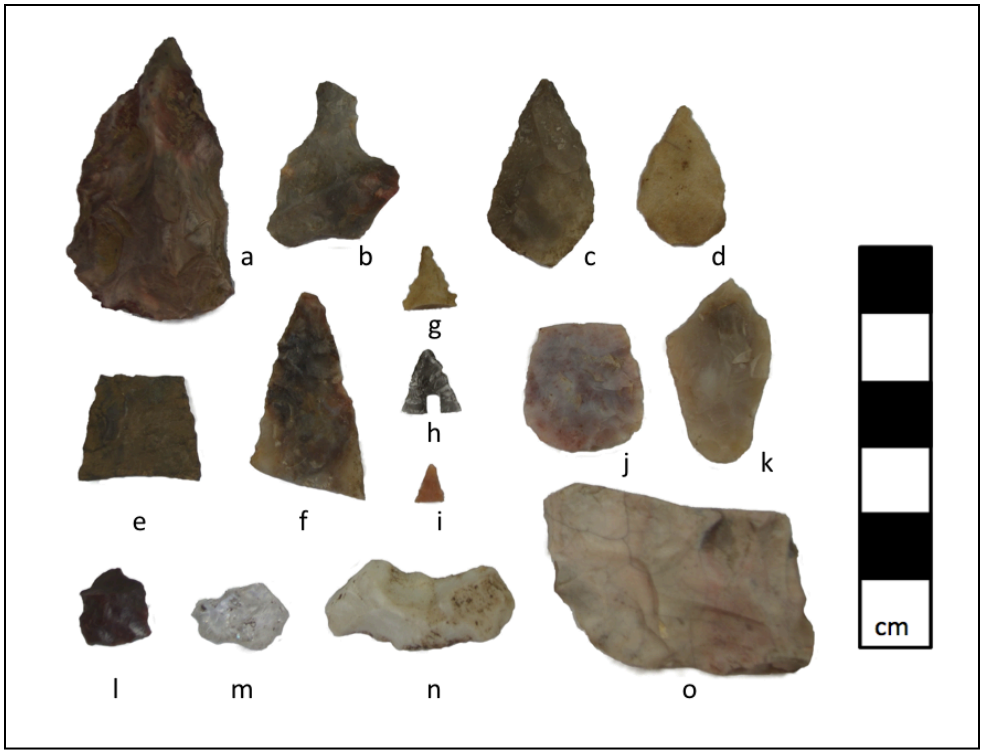

Figure 5.28. Example of each biface category, excluding projectile points: (a) graver (chert); (b) drill (chert); (c-d) teardrop-shaped drills (chert and quartzite); (e) medial fragment (chert); (f-h) tip fragments (chert, chert and obsidian); (i) tip or tang fragment (chert); (j-k) base fragments (chert); (l-o) unknown fragments (chert, quartz, chert, chert).

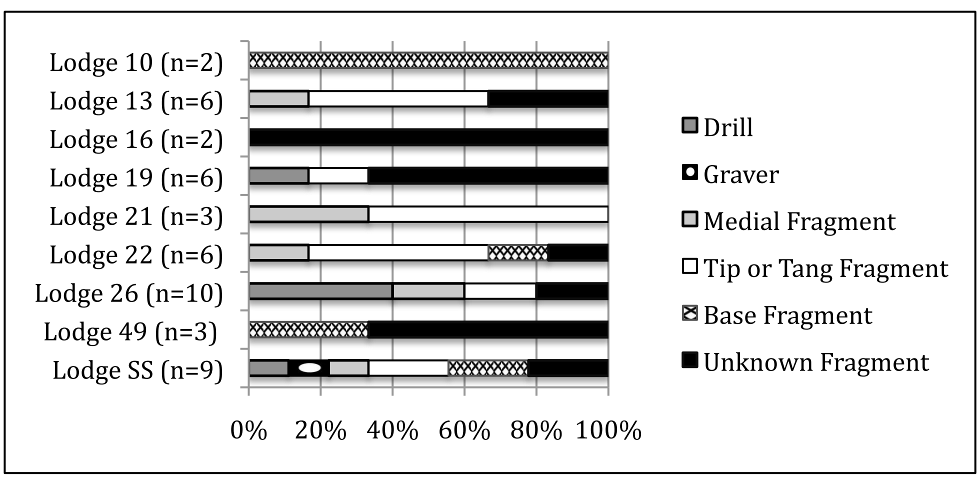

Figure 5.29. Distribution of bifaces per lodge, excluding projectile points.

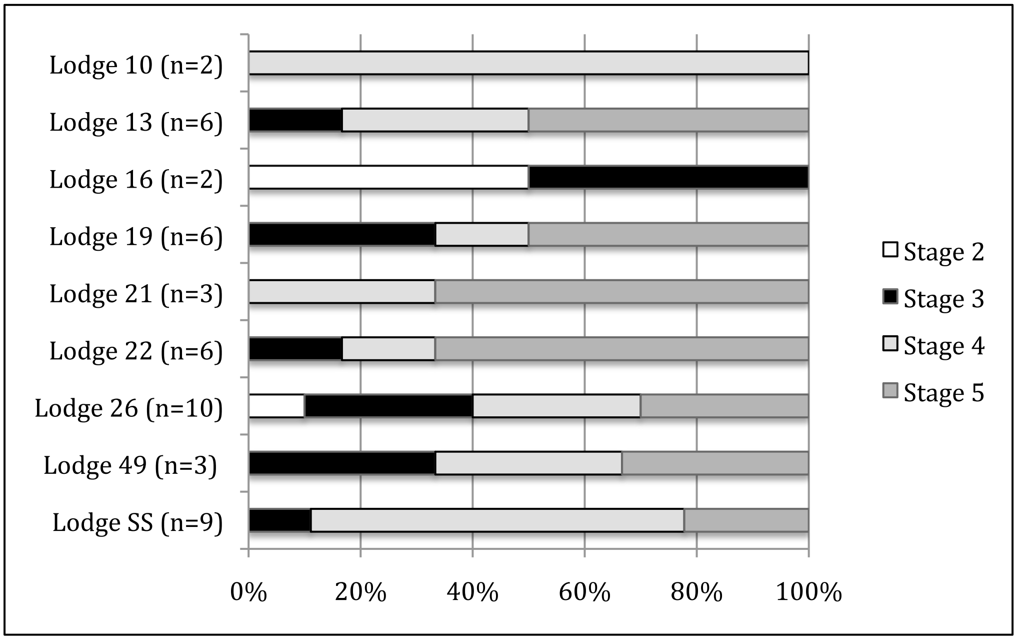

Figure 5.30. Biface stage per lodge, excluding projectile points.

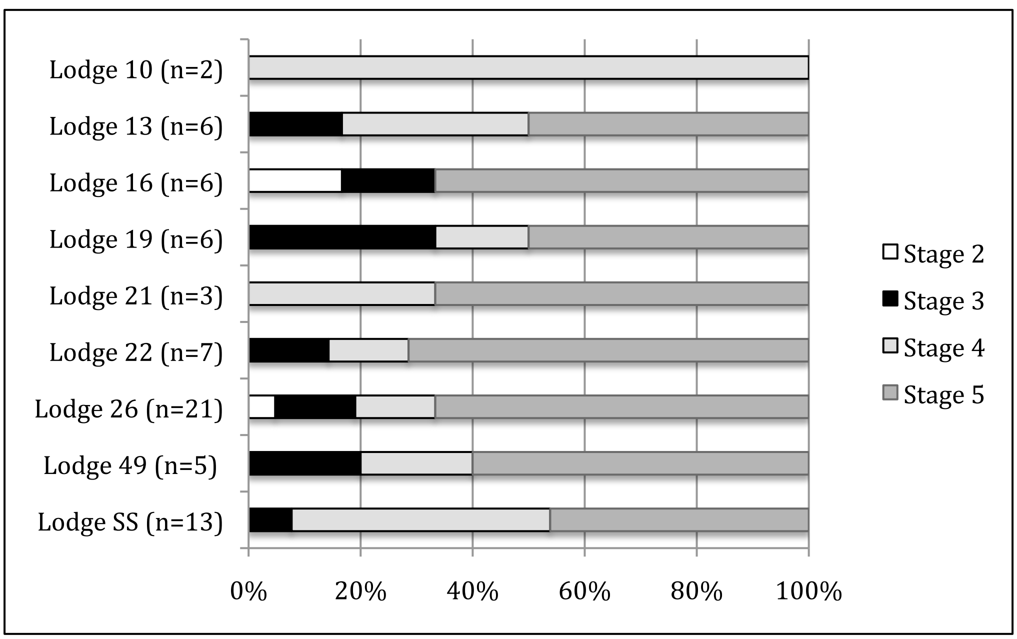

Figure 5.31 Biface stage per lodge, including projectile points.

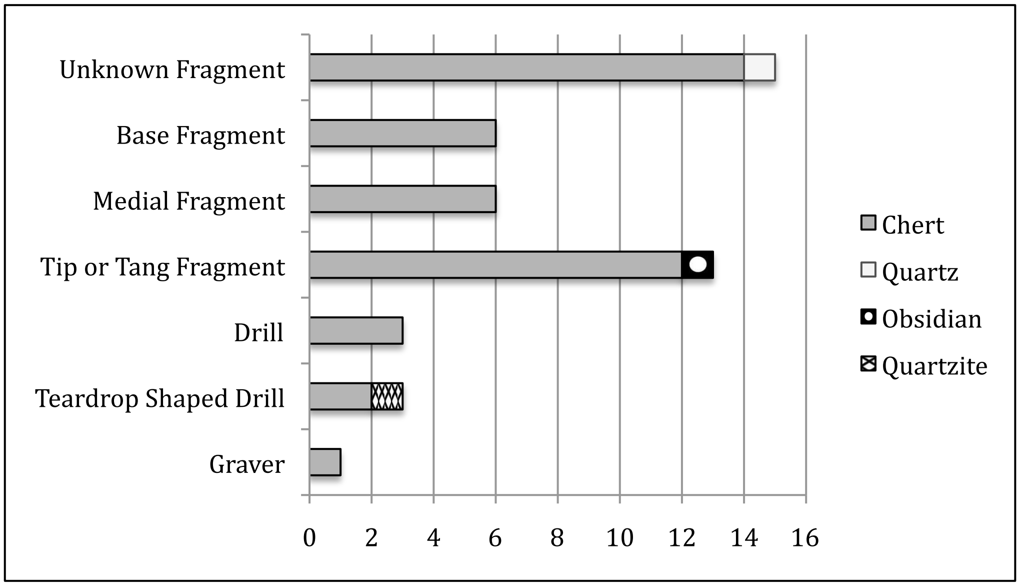

Figure 5.32. Biface morphology and corresponding material type, excluding projectile points.

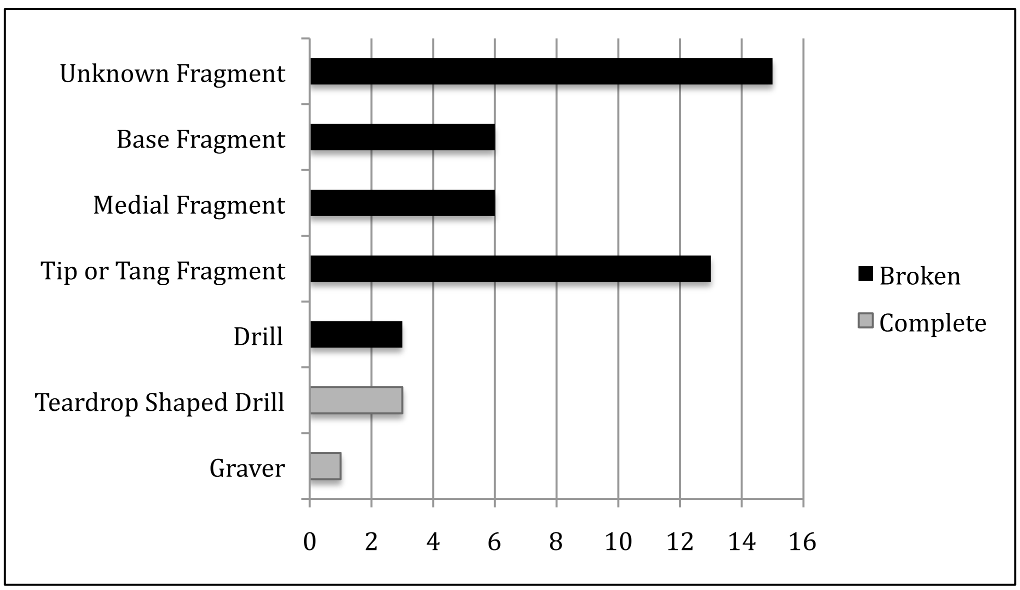

Figure 5.33. Complete and incomplete bifaces and corresponding typology, excluding projectile points.

Relating tool dimensions to bifacial debitage dimensions revealed that the only obsidian biface was not representative of obsidian tools reduced onsite, whereas non-obsidian bifaces were representative of those that were retouched and produced onsite. The obsidian biface was probably a projectile point tip (Figure 5.28, h). It measured 10.5 x 8.5 mm compared to obsidian flakes associated with bifacial tool and core technology, which ranged from 2.5 to 34.6 mm in length. The obsidian assemblage thereby indicated that larger obsidian bifaces were resharpened but not discarded at HRV. On the other hand, non-obsidian bifaces ranged from 4.2 to 44.8 mm in length and 4 to 42.8 mm in width compared to non-obsidian flakes associated with bifacial technology, which ranged from 3.1 to 27.1 mm in length. These data suggested that the non-obsidian bifaces found in the HRV assemblage represent those that hunter-gatherers typically produced and retouched onsite.

Cores

Both cores recovered during excavation were expedient and unstandardized, with unprepared platforms and irregular, multi-directional flaking (Figure 5.34). The paucity of cores was indicative of the low artifact diversity that characterized the tool assemblage (see below) and the fact that core manufacture and reduction generally occurred off-site (Bamforth 2002:81-82).

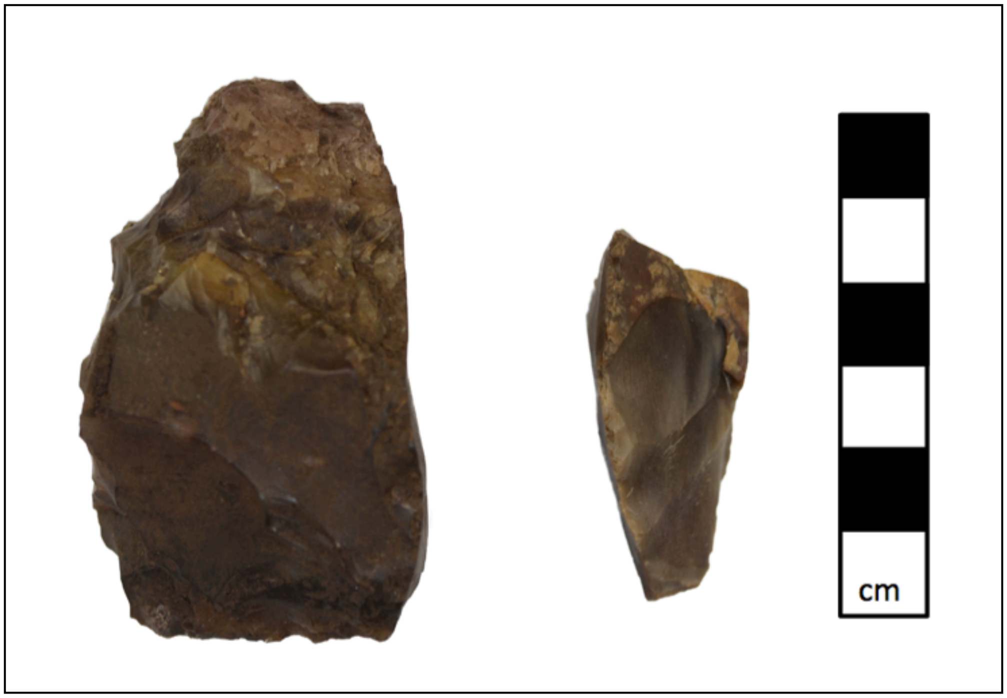

Figure 5.34. Cores from High Rise Village.

Both cores were made from chert and have a maximum length and perpendicular width of 65 x 47.8 mm and 18.5 x 14.8 mm, respectively – or size values (*sensu* Andrefsky 2005:145-146) of 623 and 5. The larger core exhibited three reduced surfaces, three platforms, and no cortex. The smaller core contained four reduced surfaces, two platforms, and <5 percent cortex. Unlike the smaller core, the larger core could have provided additional flakes comparable in size to those used to produce EMFs and bifaces at the site. Core reduction thereby was moderately wasteful; a characteristic of expedient technology (Parry and Kelly 1987). Additionally, the larger core exhibited edge-shearing and battering along one platform margin, either indicating edge preparation for flake reduction (Andrefsky 2005:12; Crabtree 1972; Kelly 1988:724; Towner and Warburton 1990) or potential secondary use as a handheld "chopping and rough scraping" tool

(Keeley 1982:800; e.g., Husted and Edgar 2002, page 212, plate 42). Such tools were reportedly used for expedient woodworking in the ethnographic record (e.g., Gould 1980:127-129).

Comparatively, the expedient chert flake assemblage ranged from 4 to 68.7 mm in maximum flake length, with eight flakes from five lodges exceeding the maximum length of the largest core (65 mm). This indicates that site inhabitants transported some cores to HRV that were originally larger than the two recovered during excavation in at least five lodges. Nonetheless, the dimensions of these cores mostly reflected the range of expedient flake dimensions, indicating these two amorphous, multi-directional cores were representative of the other cores that inhabitants reduced onsite but carried away.

Artifact Density

Tool frequency was low within the HRV assemblage. Among an average of 2,956.9 flakes per excavated m^3, EMFs constituted 18.8 tools/m^3 and bifaces comprised 16 tools/m^3 (Table 5.1). Between lodges, however, EMFs ranged from 2.5 to 74.3 EMFs/m^3 and bifaces ranged from five to 40 artifacts/m^3 (excluding Lodge 28).

Table 5.1. Tool Density Per Lodge.

Lodge	Excavated Volume (m^3)	Total Bifaces	Total EMFs	Bifaces/m^3	EMFs/m^3
10	0.35	2	26	5.7	74.3
13	0.4	6	12	15	30
16	0.55	6	2	10.9	3.6
19	0.25	7	4	28	16
21	0.2	1	8	5	40
22	0.45	7	4	15.6	8.9
26	0.4	16	1	40	2.5
28	0.2	0	1	0	5
49	0.4	5	1	12.5	2.5
SS	0.4	11	2	27.5	5
Total	3.6 m^3	61	61		
Average				16/m^3	18.8/m^3

Table 5.2. Debitage Density and Relative Tool Frequency Per Lodge.

Lodge	Excavated Volume (m^3)	Total Flakes	Flake Density/m^3	Total Tools	Percent of Tools per Total Artifacts[a]
10	0.35	958	2,737.1	28	2.8%
13	0.4	1,003	2,507.5	18	1.7%
16	0.55	2,781	5,056.4	8	0.3%
19	0.25	866	3,464	11	1.3%
21	0.2	493	2,465	9	1.8%
22	0.45	2,390	5,311.1	11	0.5%
26	0.4	1,826	4,565	17	0.9%
28	0.2	31	155	1	3.1%
49	0.4	666	1,665	6	0.9%
SS	0.4	657	1,642.5	13	0.2%
Total	3.6 m^3	11,671		122	
Average			2,956.9/m^3		1.0%

a) Tool:debitage frequency calculated using the tools that originated from the excavation units incorporated into debitage analysis (Table 4.1, column 2; also see Appendices, Tables A-3 and A-4). Therefore, eight bifaces and seven edge-modified flakes were excluded from this table (cf., Tables 4.2 and 5.1). The volume excavated thereby also refers to units incorporated into this debitage analysis (cf., Appendices, Table A-1).

Alternatively, EMFs recovered from the units/quadrants that were incorporated in the debitage analysis (n=61) constituted only 1.9 percent of all flakes ≥6.7 mm in length (n=3,138), which represented the shortest length of any flake determined to be edge-modified (Figure 5.35, cf., Figure 5.36; Koenig 2010:79; Kuhn 1994:433). Bifaces (n=69) constituted 0.6 percent of the entire flaked stone assemblage collected during excavation (n=11,741 bifaces, cores, and [edge-modified] flakes; see Tables 4.1 and 4.2). Collectively, expedient and formal tools comprised 1 percent of the artifact assemblage and ranged in frequency from 0.2 to 3.1 percent of each lodge (Table 5.2). In short, there were few formal and expedient tools.

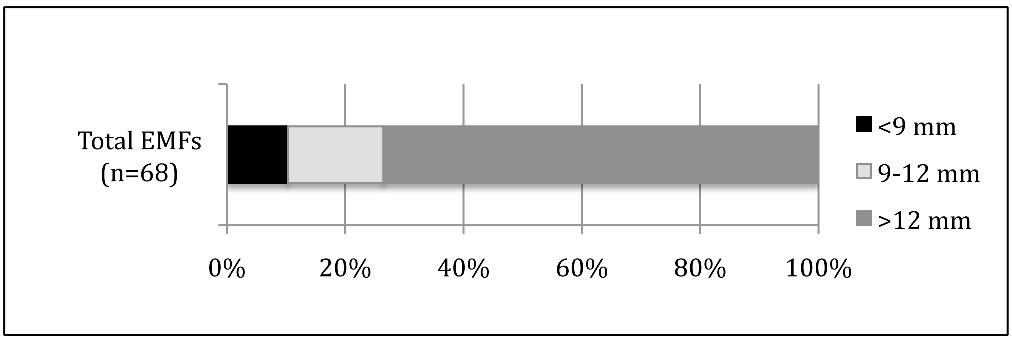

Figure 5.35. Frequency of size class among the edge-modified flake assemblage.

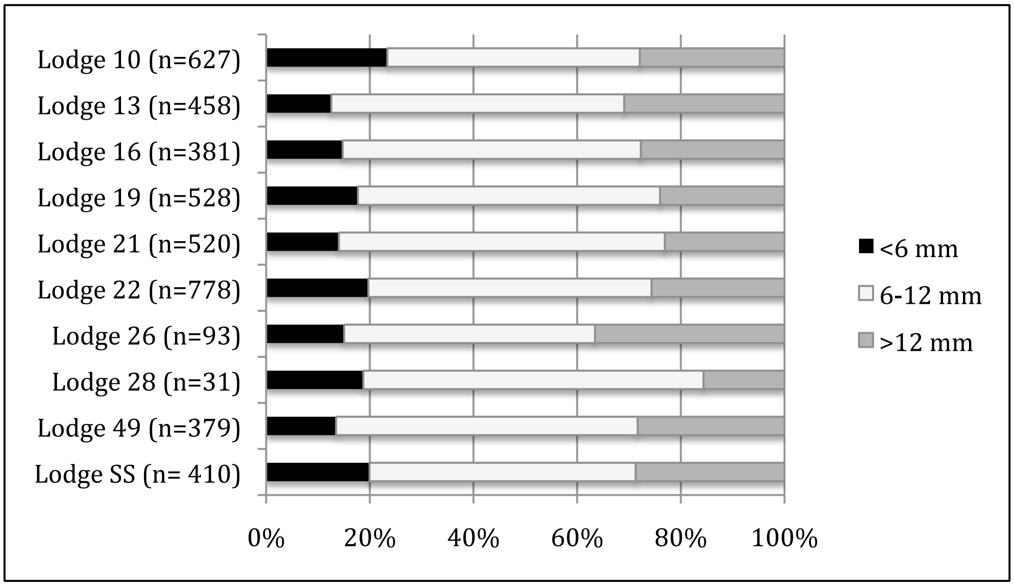

Figure 5.36. Frequency of flake size per lodge among all analyzed flakes.

Summary

Despite variability in the frequency of tool types per lodge, consistent patterns were observed. For instance, 95+ percent of the debitage was made from locally available chert. Expedient flakes constituted 25 to 63 percent of each lodge's diagnostic debitage assemblage versus 37 to 75 percent bifacial debitage. The remaining 5 percent of local materials in the assemblage included quartzite, quartz, and basalt. Nonlocal obsidian and possible Bridger Basin chert comprised less than 1 percent of the total assemblage and both reflected bifacial technology. All flakes regardless of material type indicate that the main trend in stone tool use involved transporting early stage cores and bifaces to HRV for further reduction, tool production, and maintenance. The small quantity of cores further evinced that most cores were discarded off site (e.g., Bamforth 2002:81-82).

Bifaces and EMFs supported the tool use patterns interpreted from the debitage assemblage. Both categories trended towards late stage reduction: EMFs largely lacked cortex (58 of 68) and bifaces were predominately late stage specimens. Additionally, tools from either assemblage showed minimal variability in material type and tool function. Eighty-six percent or more of either assemblage was made from locally available chert. Quartz, quartzite, obsidian, and Bridger Basin chert were used to make a minority of either assemblage although no specific material was exclusively reserved for making any given tool type. Furthermore, while activities varied by lodge, nearly every lodge retained minimal evidence for hunting and animal, wood, and/or soft stone processing activities.

Lastly, tools constituted a tool to debitage ratio of 1:100, and a debitage frequency of 2,956.9 flakes/m^3. In the following chapter, these debitage and tool frequencies are elaborated upon and compared to superficially similar habitation sites in northwestern Wyoming and the Intermountain West to identify the relative degree of occupational intensity at HRV; the next chapter also includes interpretations of the flaked stone analysis for patterns in HRV inhabitant settlement and subsistence.

CHAPTER 6

DISCUSSION

The goals of this study were to reconstruct subsistence-related behaviors, mobility patterns, and occupational intensity at HRV. The results from the flaked stone analysis support the hypothesis that small, residentially mobile family groups inhabited HRV for short durations. Here, this interpretation is contextualized using datasets derived from the high elevation environmental and archaeological records of the American West.

Subsistence-Related Behaviors

All lodges contain a small quantity of expedient and/or formal tools that resulted from (in-)organic processing activities and/or preparation for hunting. Although these artifacts occur in varied frequencies, tool diversity and density within either the EMF or biface assemblage is low and there are consistent themes regarding material types utilized and artifact condition upon discard. The low diversity of expedient and formal tool types and artifact attributes thereby reflect consistent subsistence pursuits (Binford 1979:268, 1983:330; Keeley 1982).

Definitive evidence for hunting occurs among the biface assemblage. Of 69 bifaces, 22 are diagnostic projectile points and 25 are fragments interpreted as projectile point remnants. These biface types occurred in all lodges but Lodge 28 (see Figures 5.27 and 5.29) indicating that hunting was common among HRV inhabitants. Additionally, 15 bifaces are non-diagnostic fragments that occurred in seven lodges. These bifaces either broke during manufacture or are the exhausted elements of hafted tools (e.g., projectile points), which are more likely to be used to the point of breakage than "hand-held [processing] tools" (Keeley 1982:803). Additionally, the prevalent pattern for broken bifaces represent a consistent pattern of onsite discard and likely retooling activities (*sensu* Keeley 1982), which is most characteristic of "hunting equipment" (cf., Buck et al. 2002:109; Keeley 1982:803).

The remaining seven bifaces and the EMF assemblage suggest animal and/or (in-) organic processing activities. Among the bifaces, seven drills or gravers were likely used to perforate organic materials or soft stone in three lodges (see Figure 5.29; Andrefsky 2005; Binford 1979:263; Crabtree 1972; Keeley 1982). The EMF assemblage potentially bolsters the argument for processing activities (see Figure 5.21). All but one EMF contains one or more edges used for scraping (n=67) and one contains evidence for use as a graver, suggesting that processing occurred in every lodge, whether for working bone, hide, wood, or soft stone (Crabtree 1972; Keeley 1982). Furthermore, two EMFs are concave/notched flakes, one of which contains an adjacent margin used for scraping. Inhabitants of Lodges 19 and 21 likely used these EMFs for shaping wooden shafts used as arrows or darts for hunting (Crabtree 1973; cf., Keeley 1982:802). However, notches could also be "the location of …scraping, shaving or graving activity" (Keeley 1982:802).

Tool classes vary per lodge but generally occur in very low frequencies (see discussion, below). Lodges 10, 13, 19, 21 and 28 predominately contain EMFs while Lodges 16, 26, 49 and SS predominately contain bifaces. Lodge 22 is evenly split between either category (see Figure 5.20). Fourteen to 22 percent of the bifaces in

Lodges 19, 26, and SS are processing tools, leaving Lodge 26 with a proportion of hunting-specific tools reaching 67 percent despite having the highest quantity of bifaces relative to EMFs among the lodges (Figure 6.1; also see Figures 5.20 and 5.29). Bifaces associated with hunting otherwise range from 67 to 100 percent within each lodge's biface assemblage. The only exception is Lodge 19, with only 29 percent of bifaces suggesting hunting activities. The remaining proportion of biface types per lodge include an 11 to 57 percent composition of non-diagnostic biface fragments in seven lodges, and a 14 to 22 percent frequency of processing tools per lodge (Figure 6.1). In other words, hunting tools comprise 10 to 63 percent of each lodge's flaked stone tool assemblage and processing tools comprise 8 to 90 percent. Apart from Lodge 28, inhabitants of every lodge practiced hunting and, potentially, animal processing to varying degrees. Research from other studies at HRV demonstrated that Lodge S reflected an anomalous hunting focus, with 48 projectile points, whereas Lodge CC contained only two complete points (Adams 2010:55). The Lodge CC flaked stone assemblage is comparable to the lodges in this study (but see below) and was dominated by artifacts evincing processing activities. Nonetheless, the relatively low density of tools indicated that (in-)organic processing and/or preparation for hunting were not common activities at HRV (see Tables 5.1, 5.2, and 6.1; cf., Waguespack et al. 2009).

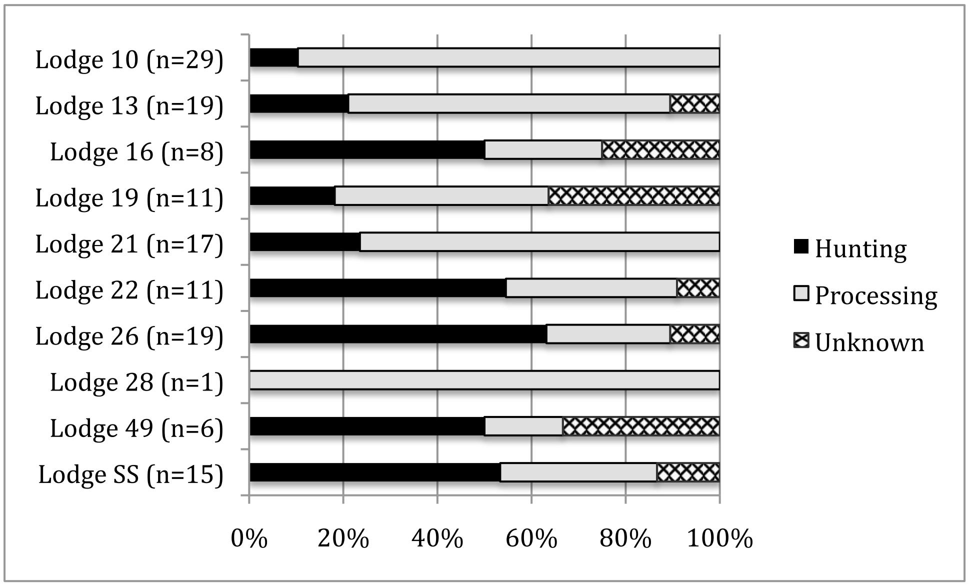

Figure 6.1. Subsistence behaviors inferred from the biface and edge-modified flake assemblages.

Regardless of the intended task, HRV inhabitants primarily used local chert for subsistence activities. Among the EMFs derived from units incorporated into the debitage analysis (n=61), 80 percent were made from local chert. The remaining 20 percent included possible nonlocal Bridger Basin chert (10 percent), nonlocal obsidian (7 percent), and local quartzite (3 percent). Among the biface assemblage, 94 percent were made of local chert. The remaining 6 percent included three bifaces, one quartzite drill, one obsidian projectile point tang fragment, and one fragment of a quartz biface. There is no clear relationship between tool type and raw material type other than locally available chert. Therefore, inhabitants did not reserve nonlocal raw materials for certain tasks and typically exploited local raw materials for all subsistence activities following arrival to the site.

Mobility

Given high elevation models for hunter-gatherer mobility patterns (Bender and Wright 1988; Benedict 1991; Black 1991), HRV inhabitants were hypothesized to either be residentially mobile or engaged in a mixed residential-logistical pattern (*sensu* Binford 1980). A predominate use of local resources, relatively low artifact density and diversity, and an evidently minimal hunting focus support the hypothesis of a predominantly residentially mobile strategy.

A maximum "effective foraging radius" for subsistence resources is generally viewed as 6 km (Kelly 2007:136) in terrain less precipitous than that surrounding HRV, although foraging radii can extend up towards 10 km (Gould 1969; Lee 1979; Morgan 2008:248, 251). Beyond this range, the energy expended in subsistence resource procurement and transport begins to outweigh the energy gained. Therefore, hunter-gatherers may strategically procure lithic and other non-subsistence resources en route to resources and expend minimal additional energy in their procurement (i.e., embedded procurement; *sensu* Binford 1979; Gould and Saggers 1985). Furthermore, although a 6 to 10 km foraging radius is common, walking a roundtrip distance of up to 40 km in a day is possible (Surovell 2003:133). Resources located within a maximum distance of 20 km from camp are therefore considered local (Surovell 2003:133).

A logistical pattern should be reflected by evidence for the procurement of "critical resource[s]" located close to camp (i.e., <20 km) as well as for "equally critical resources" procured "far from" camp (Binford 1980:10). However, if HRV inhabitants regularly pursued critical subsistence resources logistically, such as via hunting or fishing forays, either through direct and/or embedded procurement (*sensu* Binford 1979; Gould and Saggers 1985), then this pattern is not reflected in the lithic (or faunal) assemblage(s). Instead, the resources evidently pursued by inhabitants occur "within [the] foraging range of [their] residential base" (e.g., Binford 1980:8, 15).

Indeed, the HRV artifact assemblage primarily reflects a residential procurement of resources located within a day's walk of HRV (Smith 2011:463; cf., Surovell 2003:133). The closest chert sources to HRV occur 1.5 and 8 km from this site, respectively, across uneven terrain (Koenig 2010:77). Based on visual inspection, 98 percent of the flaked stone assemblage is made from these materials (see Figures 5.1, 5.23, and 5.32; also see below). Also noteworthy is that 88 percent of the groundstone assemblage (n=51) is made from quartzite available onsite (Morgan et al. 2013:46-47) with the remaining 12 percent made from basalt, which occurs ≥12 km from HRV (Adams 2010:59). Lastly, as discussed below, the meager faunal assemblage (mostly artiodactyl and marmot) also reflects the pursuit of subsistence resources that are accessible nearby (Adams 2010; Reed 1976; Thorne 1979).

Artifacts made of nonlocal raw materials include 144 obsidian flakes and one obsidian biface, which source to nine geochemical types (Morgan et al. 2013), and 33 possible Bridger Basin chert flakes. The low quantity of these artifacts arguably reflects the reduction and discard of perhaps a dozen tools, or one or two tools per source. Virtually all obsidian and possible Bridger Basin chert debitage reflects late-stage bifacial reduction and/or retouch. Hunter-gatherers apparently produced tools made from these materials "prior to [arriving]" to HRV (see Smith 2011:463; also see below). Once at HRV, they evidently rejuvenated late-stage bifaces for future use off site, only discarding one tool fragment made of nonlocal material (see Figure 5.28), and transitioned to using locally available raw materials for all other onsite activities that required toolstone.

Given that the nonlocal assemblage reflects late-stage reduction and comprises less than 2 percent of the total flaked stone assemblage, these raw materials likely represent a "mobile [forager's] toolkit" used while on transit to and from HRV (*sensu* Kuhn 1994). Residentially mobile foragers depend on toolkits that are comprised of small, reusable, multi-functional tools for survival, and thereby use reliable raw materials (see Kuhn 1994). Obsidian is considered high-quality and "highly desirable" compared to such materials as chert and basalt (Thomas 2012:255, 265; Elston 1990:153). Therefore, it is not surprising that HRV inhabitants reserved obsidian for their mobile toolkit, ultimately producing a founder assemblage (or a "founding curate set," *sensu* Schiffer 1987:90) comprised of this material prior to transitioning over to a prevalent use of local materials. The use/reduction of the possible Bridger Basin chert in a similar manner suggests that HRV inhabitants also viewed this material as a reliable component of their mobile toolkit.

The dearth of evidence for a logistical pursuit of resources at HRV and low diversity of tools (above) evinces short residential occupations (i.e., "high residential mobility;" Binford 1980:9). This pattern results in minimal artifact accumulation compared to sites occupied for longer durations, where a greater diversity of activities occurs (see below; also see Binford 1980:18; Schiffer 1987:54-55). For instance, among lower-elevation sites in western Wyoming with a marked logistical focus on subsistence resources, including Mummy Cave, the Helen Lookingbill site, and the Bugas-Holding site, there are 12 or more tool categories among flaked stone assemblages alone, compared to only seven at HRV (also see below; Table 6.1; Husted and Edgar 2002; Kornfeld et al. 2001; Rapson 1990). Additionally, superficially similar high altitude habitation sites in the Intermountain West, including the White Mountain Villages and Alta Toquima Village, also contain much denser assemblages and a greater diversity of artifact types (Bettinger 1991; Thomas 1982). Unlike HRV, all of the sites mentioned above also contain dense faunal assemblages (see below) as well as tools and/or ornaments made from organic materials. Considering that the densest cultural deposits at HRV occur within the habitation features (see below), these sites' assemblages suggest longer occupations and a more intensive pattern of resource exploitation that incorporated a prevalent logistical and residential pursuit of resources (cf., Kelly 1988:731; Rapson 1990).

It is important to note, however, that the argument for the residential pursuit of lithic resources is tenuous given that the abundant local raw materials near HRV should have been utilized regardless of the mobility or subsistence strategy so long as occupations were more than a few days in length (see below; cf., Bamforth 1991; Cowan 1999; Parry and Kelly 1987). Furthermore, the minimal diversity of tools types could instead reflect how most were multifunctional and/or transported off of HRV for additional use following occupation of this site. Such behaviors are independent of residential or logistical mobility and instead are more typical of a general pattern of high mobility (see Kelly 1988:719; Bamforth 1986). Therefore, any argument for residential mobility requires a complementary discussion of the evidence for occupation span, group size, and the associated subsistence assemblage, when available. These topics are discussed below.

Table 6.1. Relative Occupational Intensity Between HRV and Comparable High Elevation Prehistoric Habitation Sites.

Site	Site Type	Elevation (meters above sea level)	Number of Flake Stone Tool Types	Flake density	Cubic meters excavated	Comments
High Rise Village (average for the 10 lodges in this study)	Short term residential base	3,225 – 3,320 m	7	2,956.9/m^3	7.1515 m^3	Despite a comparable diversity of flaked stone tools between other sites (i.e., The White Mountain villages, Alta Toquima Village, and Mickey's Place), HRV is the only site to lack a tool assemblage comprised of organic materials and/or beads/ornaments (with the exception of one bone awl [Koenig 2010:3]). Additionally, Koenig's (2010:79-81) data for Lodge S yield overlapping artifact categories to those identified in this study.
Mummy Cave, Wyoming (Husted and Edgar 2002)	Primarily used as a logistical base camp for winter procurement of bighorn sheep	1,920 m	12	Described as "thousands of items" reflecting an "amazing …richness of the artifact assemblage" (Husted and Edgar 2002:v); no specification for what percentage is debitage.	~3,058 m^3	"Approximately 4,000 cubic yards of earth removed" (Husted and Edgar 2002:32).
Helen Lookingbill, Wyoming (see Kornfeld et al. 2001:311)	Intensified, "broad based" and "short-term hunting camp" (Kornfeld et al. 2001:320, 322)	2,620 m	13	160,000/m^3 (*maximum density per cubic meter)	11 m^3	Density was not quantified per total cubic volume excavated given the limited data in Korfeld et al. 2001. Maximum density per cubic meter was quantified given the following: "In the main block excavation the artifact densities range from a few artifacts per square meter to over 8000 per sq m in a 5 cm level" (Kornfeld et al. 2001:310).

Site	Site Type	Elevation (meters above sea level)	Number of Flake Stone Tool Types	Flake density	Cubic meters excavated	Comments
Bugas Holding, Wyoming (Kornfel et al. 2010:317, 319; Rapson 1990:107, 118, 121, 314-317)	Single-occupation Shoshone winter village with a prevalent hunting focus	(at least) 2,050 m	14	14,547/m^3	4.2125 m^3	Density quantified by extracting data from Rapson (1990), who explains that an area of 84.25 m^2 contains a cultural deposit averaging 3 to 5 cm in depth. The bulk of water-screened flakes (n=55,470; see Larson 1996) came from this horizon, as did 5,827 piece-plotted flakes (Rapson 1990:118, 121). This grand total of 61,279 flakes was divided by 84.25 m^2 x 0.05 m^2, a conservative measure of depth, to calculate the approximate flake density per cubic meters excavated.
Fish Lake Valley, Utah: Moon Ridge/42SV2229 (Janetski 2010:70, 97, 118; Joel Janetski, personal communication, 2015)	Intensified hunting/fishing camp	~2,700 m	9 (total for site)	Excavation Area 1: 1,563/m^3 Excavation Area 2: 1,031/m^3	EA1: 6.22 m^3 EA2: 4.24 m^3	Density per cubic meter was calculated by Dr. Joel Janetski (personal communication, 2015).
Fish Lake Valley, Utah: Mickey's Place/ 42SV2304 (Janetski 2010:28, 118; Joel Janetski, personal communication, 2015)	Intensified hunting/fishing camp	~2,700 m	8	263/m^3	11.18 m^3	Density per cubic meter was calculated by Dr. Joel Janetski (personal communication, 2015).

Site	Site Type	Elevation (meters above sea level)	Number of Flake Stone Tool Types	Flake density	Cubic meters excavated	Comments
White Mountain Villages, California (n=13; Bettinger 1991:667)	Residential village	3,150 – 3,854 m	7	Within Structure 2 of Crooked Forks, for example, the assemblage contains 1077 projectile points and “thousands” of otherwise uncounted flakes that collectively weigh 5.8 kilograms (Robert Bettinger, personal communication, 2015).	10.8 m^2 habitation feature	"...intensity of prehistoric occupation [not measured]" for the White Mountain Villages (Bettinger 1991:664). This is the case for Alta Toquima Village as well, although Thomas (1982:37, 42) notes "extremely rich artifact" deposits in House IA and IB.
Alta Toquima Village, Nevada (houses IA and IB only; Thomas 1982)	Residential village	3,352 m	8	Described as "thousands of flakes" within both house IA and house IB (Thomas 1982:37, 45).	~10 m^2/house?	

Intensity of Site Occupation

Short versus Long Occupations

Short versus long durations are typically discussed "on an ordinal rather than interval scale" (Chatters 1987:345) given that there is no universally-applicable metric that correlates the archaeological record with length of site occupation. Short occupations can constitute "a matter of hours at the most," such as those produced by task-specific foragers (i.e., "locations," *sensu* Binford 1980:9) or sites occupied for a couple of days (Binford 1980:17). Sites occupied for more than a couple of days (e.g., Kelly 2013:88-89) are deemed longer-term occupations (cf., Parry and Kelly 1987).

Within the debitage assemblage, the relatively even frequencies of expedient and formal technology debris indicate relatively short occupations by mobile hunter-gatherers. Apart from Lodge 28, bifacial debitage ranges from 37 to 63 percent per lodge, with the same range for expedient technology (see Figure 5.2). The Lodge 28 assemblage totals 31 flakes, 20 of which are diagnostic of bifacial or expedient core reduction (see Figure 5.6). Seventy-five percent of these flakes are bifacial reduction debris while the remaining 25 percent are expedient flakes. The lodges with greater prevalence of bifacial technology (see Figure 5.2) evince relatively short occupations while lodges with a greater prevalence for expedient technology evince relatively longer occupations (see Parry and Kelly 1987:299-301). However, the fact that debitage reflecting bifacial technology comprises ≥37 percent of the samples within any given lodge suggests that inhabitants of these lodges never remained at HRV long enough to transition to a prevalent expedient technology typical of less mobile hunter-gatherers (Bamforth 1991; Cowan 1999; Kelly 1988; Parry and Kelly 1987). If HRV was occupied for longer periods of time, then a more expedient pattern should be evident given that: (1) expedient core reduction requires less preparation time (Parry and Kelly 1987:289; cf., Prasciunas 2007); and (2) a variety of raw materials, including quartzite, basalt, and high-quality chert occur near to HRV (Koenig 2010:77; Morgan et al. 2012a). The proximity of raw materials thereby facilitates a more "wasteful" (i.e., expedient) use of raw materials (Parry and Kelly 1987:301, 285).

Cortex occurs on <1 percent of bifacial debitage (see Figure 5.9); indicating that these likely represent late stage bifacial production and/or rejuvenation debris (cf., Figure 5.6). The near lack of early stage bifaces onsite further suggests that inhabitants prepared nearly all bifaces off site prior to arriving to HRV, where they then further reduced these tools (see Figure 5.31). This pattern is typical of short-term mobility, with people primarily using bifaces as multifunctional tools with long use lives (Bamforth 1986:40; Black 1991; Cowan 1999; Elston et al. 2014; Kelly 1988; Shott 1986:20).

Expedient flakes demonstrate that cortex was not completely removed from all cores prior to transport to HRV. This pattern can be expected on expedient flakes when raw materials are locally available. Indeed, most cortex-bearing flakes, including the 10 EMFs that retain cortex, were expediently produced from locally available chert materials (see Figures 5.8 – 5.10). Of 166 cortex-bearing flakes, 163 are made from local chert, which constitutes 7 percent of the total chert assemblage (Figure 6.2). The remaining three expedient cortex-bearing flakes are two quartzite flakes and one obsidian flake, or 1 percent of either assemblage.

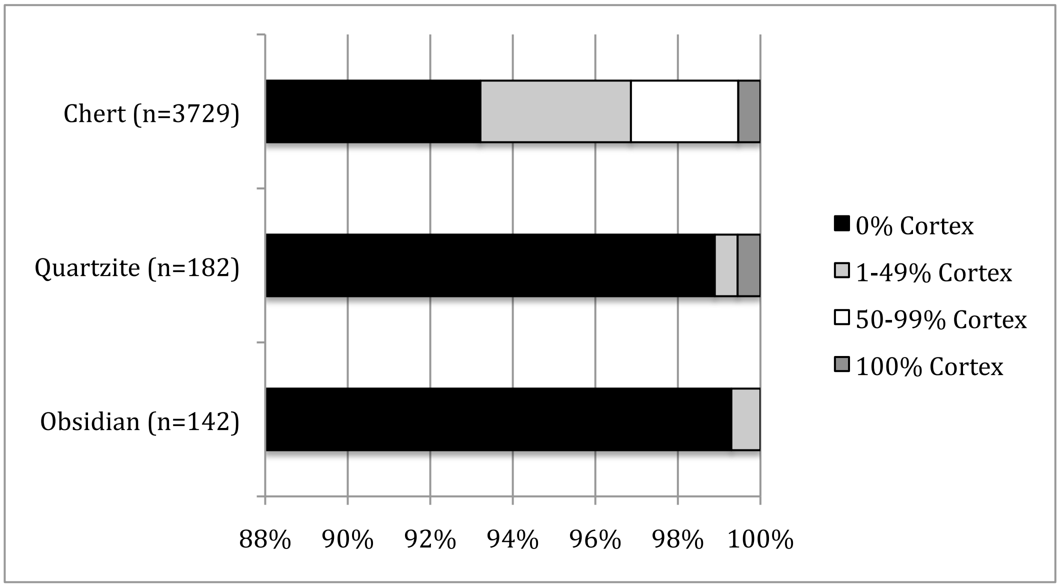

Figure 6.2. Raw materials retaining cortex within the debitage assemblage.

High source diversity (e.g., 2.251; Scheiber and Finley 2011:380; also see Beals et al. 2000) and high source evenness (e.g. "a value of 1;" Scheiber and Finley 2011:378) are not reflected in the flaked stone assemblage, which instead has a very low source diversity of 0.436 and a remarkably low source evenness of 0.165 (Table 6.2; cf., Table 6.3). This low measure for source evenness and diversity among the total assemblage (Table 6.2) suggests shorter occupations (cf., Binford 1980:18) but in the context of locally available, high-quality raw materials transitioning to using these materials for both expedient and bifacial tools should happen regardless of occupational span (Andrefsky 1994:27). Ninety-eight percent of debitage is made from locally available chert (see Figure 5.1), as are every projectile point, 94 percent of all bifaces, and 80 percent of EMFs (see Figures 5.23 and 5.32). Given that no nonlocal toolstone was exclusively reserved for a given task (above), inhabitants apparently deemed locally available raw materials as being high-quality and having "adequate sharpness and durability" for every activity requiring stone tools (Parry and Kelly 1987:300). Readily available raw materials negate the need for toolstone conservation and instead facilitate an "unstandardized" (i.e., expedient) production and replacement of tools (Parry and Kelly 1987:301, 285). Therefore, even highly mobile hunter-gatherers with access to high-quality raw materials should incorporate expedient technology into an otherwise bifacial toolkit (Andrefsky 1994; Kelly 1988; Parry and Kelly 1987:300).

Table 6.2. High Rise Village Source Diversity and Evenness Calculated Among the Obsidian Sources, the Non-Obsidian Sources, and the Collective Assemblage.

	HRV Obsidian	HRV Non-Obsidian	Collective HRV Sources
Sample Size	137	4057	4198
Total Sources	9	5	14
Diversity	1.518	1.609	0.436
Evenness	0.69	0.171	0.165

Table 6.3. Obsidian Source Diversity and Evenness Among the High Rise Village Dataset Compared to Scheiber and Finley's (2011) Regional Datasets.

	HRV	Northwest Wyoming[c]	Southwest Wyoming[c]
Sample Size	137	175	128
Total Sources[a]	9	10	9
Diversity[b]	1.518	1.369	1.778
Evenness[b]	0.690	0.623	0.809

a) Obsidian artifacts with unknown source provenience quantified as a single source.
b) Diversity and evenness quantified using the Shannon diversity index (Beals et al. 2000).
c) Only the datasets temporally associated with Late Prehistoric occupations were borrowed from Scheiber and Finley's (2011) dataset and included in this comparison.

Subsurface testing identified that the bulk of the site's deposits occur within lodges (Morgan et al. 2013:37), which also reflects short occupations. Ethnoarchaeological data indicate that dense deposits located outside of habitation features reflect "larger households [and] longer periods of residence," whereas "household areas occupied by small groups for very short periods of time …may consist of no more than a few [discarded] items" (O'Connell 1987:81-82; also see Schiffer 1972). Short occupations at HRV thereby produced too small a quantity of debris to promote a necessity for cleaning out lodge pads and discarding refuse outside of the habitation features (see below; also see Kelly 1992:56).

The HRV flaked stone assemblage was compared to other high elevation sites in Wyoming and the Intermountain West to discern the relative occupational intensity, or length of occupation and group size, of HRV inhabitants. These comparisons further indicate that occupations were low intensity (i.e., short-term, infrequently reoccupied, and/or comprised of small group(s) of inhabitants [also see below]) (Binford 1980:18; also see Kornfeld et al. 2001; Rapson 1990; Thomas 1982). For instance, HRV has a relatively low artifact density per cubic meter of excavated site matrix (Table 6.1); habitation features only contain an average density of 2,956.9 flakes/m^3. This is notably less than the 14,547 or more flakes/m^3 at habitation sites described as a base camp (Kornfeld et al. 2001) or winter village (Rapson 1990) in Wyoming, and likely much less than the "thousands of flakes" described from habitation structures in high elevation residential villages in the Intermountain West (Bettinger 1991; Thomas 1982; c.f., Koenig 2010).

HRV also has a slightly lower diversity of stone tool types compared to these high elevation sites (Table 6.1) and other than one bone awl (Koenig 2010:3) in Lodge CC (Adams 2010:55), lacks organic tools (e.g., Husted and Edgar 2002) among the scant faunal assemblage (see below; also see Losey 2013:101). For instance, the HRV stone tool assemblage contains seven distinct tool types. Among the flaked stone alone, the sites described above also have a minimum of seven artifact classes (Table 6.1) in addition to a variety of tools and/or ornaments made from organic materials and sandstone. The flaked stone categories include a variety of cores, scrapers, edge-modified flakes, and bifaces between each site, including burins, gravers, drills, denticulates, spokeshaves, projectile points, and knives. The additional tool categories include: (1) bone pressure flakers, awls and beads, wooden arrow shafts, basketry made from plant fiber, and soapstone pendants at Mummy Cave (Husted and Edgar 2002); (2) "basket-weaving needles, an elk antler flesher, bone awls, an elk canine pendant, and tublar bone beads" at the Bugas-Holding site (Kornfeld et al. 2001:323, 325); (3) a variety of beads and antler flakers at Mickey's Place (Janetski 2010:122); (4) "functional worked bone" in more than half of the White Mountain villages (Bettinger 1991:688); and (5) "cut ornamental mica, two bone beads, …three incised pipe fragments [and] two sandstone abraders" at Alta Toquima Village (Thomas 1982:39, 45). Per the Clark Effect, which explains how a more diverse artifact assemblage is expected to be associated with sustained occupations (Schiffer 1987:54-55), low artifact diversity indicates short site occupations. Evidence for greater tool diversity should accumulate at sites occupied for long durations, or frequently reoccupied (also see Chatters 1987). This would either reflect broad-based subsistence activities of hunter-gatherers focused on both hunting and foraging (Bender and Wright 1988; Scharf 2009:17) or simply the greater extent of activities that occur over increasing periods of site occupation (Bender and Wright 1988:629; Kelly 1992:56).

Per the Clark Effect, relatively short occupations might also explain the paucity of cores in the HRV assemblage (n=2), expedient or otherwise. This low quantity is especially surprising in the context of expedient and/or decortication flakes comprising 29 percent of the debitage assemblage (see Figures 5.6 and 5.19; also see Jones et al. 2003:11-12; Elston 1992). In other words, given the prevalence of core reduction flakes, it is surprising that more exhausted or attempted cores were not discarded onsite. Given that raw materials are locally available, this lack of cores is clearly not due to the need to be conservative with limited raw materials (see Koenig 2010:77; cf., Rapson 1990:317). It is also unlikely that cores were discarded elsewhere onsite, as subsurface testing throughout HRV indicated the bulk of cultural material is associated with the residential lodge pads (Morgan et al. 2013:36). Therefore, cores were either transported off site, perhaps for further reduction elsewhere (e.g., Bamforth 2002:81-82) or, per the Clark Effect, short occupations resulted in low artifact diversity. If the former scenario is correct, then HRV was “occupied for periods of time that were shorter than the use lives of the cores that were worked there” (e.g., Bamforth 2002:81-82).

It is worth noting that a consistent pattern of low-intensity use throughout HRV occupation reflects consistent onsite behaviors, which theoretically drive short-term habitations. The HRV pattern primarily dates between 2300 and 850 cal BP (Losey 2013; Morgan et al. 2013). After consideration of the “old wood problem” (Schiffer 1986), calibrated radiocarbon dates indicate that the 10 HRV lodges included in this study were likely inhabited between 2300 and 970 cal BP (Morgan et al. 2013:54; also see Table 2.1). Furthermore, the flaked stone assemblages are comparable between habitation features (see Figures 5.1, 5.2, 5.6, 5.27, and 5.31; cf., Figures 5.20 and 5.29). A consistent pattern of long-term land use at HRV indicates hunter-gatherers were likely familiar with their environment and inhabited HRV for short durations to strategically exploit the "full range of [seasonally] available resources" that they were familiar with throughout the region (Benedict 1992:12).

Collectively, the trends observed among the tool assemblage are characteristic of mobile hunter-gatherers inhabiting a short-term residential base with easy access to high-quality raw materials (above; Bamforth 1991; Parry and Kelly 1987). Every lodge also contains a low artifact density compared to other habitation sites in the region and the Intermountain West, further indicating relatively short-term occupations – perhaps extending no more than one or two weeks per occupation.

Group Size

The consistency in flaked stone typology between lodges (see Figure 5.6), and the co-occurrence of groundstone and flaked stone in nearly every lodge pad (Morgan et al. 2013:46-47) arguably reflects the behaviors of small group(s) (cf., Koenig 2010:4) comprised of family unit(s) (Adams 2010:55; Binford 1980:7; Kelly 1992:46, 2007:131, 133). Groundstone is primarily associated with female processing activities (Elston et al. 2014; Kelly 1992, 1995; Smith and McNees 2011:309; Steward 1938; cf., Waguespack 2005), while projectile points, though uncommon at HRV, are associated with male hunting activities (Kelly 1992; Steward 1938; cf., Kelly 1992:48, 1995:267). This unequivocal co-occurrence of flaked and groundstone, in addition to consistent distributions in flaked stone material and artifact types (e.g., Figure 5.6), indicates that family groups did not partition activities between lodge pads.

On the other hand, Adams (2010:55) discusses distinct assemblages from Lodges S and CC (above): Lodge S "contained mostly weapons," with eight times more projectile points than any other known lodge (see Figure 5.27), and Lodge CC "contained mostly domestic items," such as "bone awl[s] (see Koenig 2010:3), digging implements, pottery, and several shades of red and yellow ocher" not seen in any other lodge. These contrasting assemblages potentially reflect activities differentiated by lodge and by gender (see Adams 2010:55). However, radiocarbon dates (albeit each from questionable contexts) indicate that occupation of these lodges did not overlap and that they were occupied a century or more later than any of the 10 lodges in this study (see Table 2.1; also see Morgan et al. 2013:54). Furthermore, these lodges were arguably inhabited mostly after 800 cal BP when "occupation at [HRV] decreased considerably" (see Losey 2013:121-122). Rather than "gendered space" typical of larger group "village" type settings, this may instead reflect that the use of HRV grew more variable later in prehistory. Nevertheless, these data suggest that HRV lacked a so-called "gendered division of space" at least among the lodges inhabited before 970 cal BP (Morgan et al. 2013:54; cf., Adams 2010:55; Koenig 2010:4). Such a pattern is typical of smaller groups comprised of about 5-10 individuals (Binford 1980:7).

High Rise Village is Not a Village

The Lithic Assemblage

Given the high number of residential features at the site, at first glance HRV appears to be a village, but results from this inter-lodge flaked stone analysis and the groundstone inventory refute this assertion (see Adams 2010). From the ethnographic record, villages or 'minimal residential bands' are often defined by groups of several family units (e.g., at least "twenty-five persons"; see Kelly 2013:10) who inhabit a location on a seasonal or year-round basis (Binford 1990). Archaeological sites with evidence for multiple habitation structures, spatial division of labor, and high occupational intensity are also commonly referred to as villages (e.g., Bettinger 1991; Thomas 1982). Sites deemed high elevation villages in the Intermountain West, including Nevada's Alta Toquima Village (Thomas 1982, 2012) and California's White Mountain villages (Bettinger 1991), as well as low elevation villages in Wyoming, including the Bugas-Holding site (Rapson 1990), contain hundreds of thousands of artifacts (Table 6.1). Many artifacts are associated with co-occurring gendered activities, which indicate the presence of family groups (above; e.g., Steward 1938:44; also see Kelly 2013). Investigators of these sites also associate the abundance of potsherds and groundstone with women's foraging activities (Janetski 2010:118; Kelly 1997). Likewise, the high density of projectile points indicates men's hunting activities (Bettinger 1991; Kelly 1992; Thomas 1982). Though HRV contains these artifact types, they occur in the same depositional contexts and in much lower density per cubic meter (Table 6.1). The HRV assemblage also exhibits lower tool diversity relative to that of the superficially comparable habitation sites (above; Table 6.1; also see Figures 5.22, 5.26, and 5.28; cf., Binford 1979:268; Keeley 1982; Kornfeld et al. 2001).

Although the HRV dataset lacks the temporal resolution to determine whether or not the flaked stone assemblage is indeed a palimpsest, the consistent trend for low artifact density and diversity (see Chatters 1987; Schiffer 1987) and small group sizes (Binford 1980:7) further suggests infrequent, short-term occupations. As with the sites mentioned above, residential sites that are either frequently reoccupied or occupied for a long duration should at a minimum produce dense artifact assemblages (Bender and Wright 1988:629; Chatters 1987; Kelly 1992:56; Schiffer 1987), in addition to storage features (Hitchcock 1987; Kelly 1992) and artifacts that “went with the place” (i.e., “site furniture,” *sensu* Binford 1979:263, or “provisioning of places,” *sensu* Kuhn 1995:22; also see Smith and McNees 1999; 2011). The data at HRV, however (see Morgan et al. 2013), indicate consistently intermittent and short site occupations and little investment in ‘provisioning of place.’

Based on the above discussion and the evidence for smaller family groups (above; Adams 2010:55; Binford 1978; 1980:7), HRV indeed lacked village-level social organization. Hunter-gatherers perhaps organized ‘economic decision-making’ mainly at the ‘household level’ (cf., Thomas 2014a), and “collapse[-d] …the [sexual] division of labor” of tasks typically reserved for specific demographics within ‘bands’ or villages (Binford 1980:7; Kelly 2013; Steward 1938; Thomas 2014a).

The Faunal Assemblage

HRV’s faunal and floral assemblages are discussed as complementary to the flaked stone dataset to bolster conclusions derived from the lithic analysis. Similar to the flaked stone assemblage, the faunal assemblage is sparse and less diverse than lower elevation villages and hunting camps in northwestern Wyoming (cf., Kornfeld et al. 2001; Kornfeld et al. 2010:314-317; Husted and Edgar 2002; Rapson 1990). Among 16 excavated lodges, 9 held a total the 936 animal bones averaging 234/m^3 (Morgan et al. 2013:40). These remains are "extremely fragmentary" (Morgan et al. 2013:40) and bones with diagnostic attributes could only be categorized as marmot and artiodactyl, both of which are available at or near to HRV (Adams 2010; Reed 1976; Thorne 1979) and the latter of which are assumed to be bighorn sheep (*Ovis canadensis*) and/or mule deer (*Odocoileus hemionus*) (Morgan et al. 2013:57). This meager dataset is unexpected given that: (1) HRV is located adjacent to a migration corridor used by one of North America's largest herds of bighorn sheep (Thorne 1979), and (2) that the focus on bighorn sheep subsistence steadily increased from the mid-Holocene on through the Late Prehistoric Period throughout northwestern Wyoming (Husted and Edgar 2002; Kornfeld et al. 2001:322; Rapson 1990).

The faunal assemblage from village contexts in Alta Toquima Village and the White Mountain villages also contain relatively high densities of faunal remains (Grayson and Canaday n.d.). The average number of faunal remains per excavated habitation feature (n=17) at Alta Toquima Village is 406 (although the density per cubic meter excavated was not provided; Grayson and Canaday n.d.). Bones recovered from subsurface deposits total 14,747 at Alta Toquima Village. The average quantity per the 21 excavated habitation features from nine White Mountain villages was not provided (Broughton and Grayson 1993; Grayson 1991), but an average of 33,651 bones were recovered from subsurface deposits from each site (the density per square meter was also not provided; Grayson 1991:488, Table 4; also see Bettinger 1991:661). Lastly, HRV nearly lacks midden deposits (above; also see Morgan et al. 2013) that indicate longer-term and/or village occupations (Schiffer 1972). Lodge 26 is the only exception, with a "shallow" accumulation of fauna, charcoal, and flaked stone within a 40 cm-deep cultural deposit (Christopher Morgan, personal communication, 2015). On the other hand, Alta Toquima Village and the White Mountain villages contain "dense" and "fairly deep" midden deposits (Grayson 1991:484; Thomas 1982:27). The faunal assemblage from Alta Toquima Village more than doubles in size if remains from midden deposits and other contexts outside of habitation features are included. These data are not provided for the White Mountain villages although Bettinger (1991:662) explains that only 27 percent of the excavation lots were placed within habitation features. This implies that more than half of the White Mountain faunal remains originate from cultural deposits located outside of habitation features as well.

In short, the HRV faunal assemblage is relatively low density compared to other residential sites (Bettinger 1991; Thomas 1982; also see Rapson 1990; Rapson and Todd 1999). This low density likely reflects some combination of a minimal hunting focus and "poor bone preservation [in the] acidic montane soils" (Morgan et al. 2013:58). Nonetheless, neither this dataset nor the stone tool assemblage suggest intensive hunting and animal processing.

The Floral Assemblage

Floral remains have not been identified in archaeological context at HRV despite an extensive macrobotanical analysis led by Losey (2013; also see Morgan et al. 2013:49). Losey (2013) floated (see Stuart 1968) 21 sediment samples comprising 84 excavated liters from five lodges: 16, 22, 26, 49, and W. No seeds or evidence of prehistoric subsistence were identified in the light fraction (Losey 2013:101). Furthermore, groundstone is associated with nearly every lodge (cf., Koenig 2010:4), which typically indicates plant-processing activities (Pitblado 2003). However, residue analysis on groundstone tested negative for 11 plant and 17 animal antisera (see Losey 2013:101-102). The function of HRV's groundstone thereby remained unknown (until recently; see below). Losey (2013:101) suggests that these negative results may be due to poor preservation or sampling bias, and considers the possibility that HRV inhabitants did not target plant resources. Together with the lack of a substantial faunal assemblage, these results left to question what resources HRV inhabitants pursued throughout the centuries of site occupation.

Despite the dearth of direct evidence for specific subsistence strategies, Stirn's (2014) model for high elevation land use in the Wind River Range indicates that high altitude residential locations are associated with the densest whitebark pine (*Pinus albicaulis*) stands. Although additional research on the topic is needed, Stirn's (2014) results indicate that predictable resources including whitebark pine nuts, seeds, berries, geophytes, and small mammals (Adams 2010; Losey 2013:55; Reed 1976) likely played a role in shaping the settlement and subsistence strategies of HRV inhabitants as well as inhabitants of the additional 18 high elevation habitation sites recently identified in the region in near-identical environmental contexts (Stirn 2014).

Hunting and Foraging at High Rise Village

Stirn's (2014) results complement the interpretations of the flaked stone assemblage conducted in this study: the inhabitants of HRV were comprised of small groups of mobile hunter-gatherers who 'mapped on' to specific resource patch(-es) as they became seasonally available (Benedict 1992; Binford 1980:10; Black 1991; Frison 1992, 1997). With HRV occurring in one of the largest stands of homogenous whitebark pine forests in the Wind River Range (Morgan et al. 2012a; Stirn 2014), its inhabitants may have been seasonally, albeit intermittently, focused on exploiting floral resources associated a particularly dense whitebark stand within a more extensive resource patch/ecozone. Despite negative results from previous residue analyses, the occurrence of groundstone in association with nearly every lodge pad supports this assertion (Morgan et al. 2013:47; cf., Pitblado 2003; Smith and McNees 2011:309); as do the preliminary results from UNR Master's candidate Amanda Rankin's residue re-analysis (Amanda Rankin, personal communication, 2015). Furthermore, the HRV assemblage reflects a minimal focus on animal resource procurement. If HRV was indeed a village, a greater density and diversity of material evidence resulting from hunting and/or foraging activities would be expected (cf., Bettinger 1991; Rapson 1990; Scharf 2009; Thomas 1982).

Habitation Features

On an additional note, the construction of 52 habitation features coupled with a pattern of repetitive land use could be interpreted as an intensive/village occupation (cf., Thomas 2012:264). However, occupation in and of itself is not necessarily indicative of long, intensive, or frequent (re-)occupations. For instance, an experiment conducted by

Dr. Christopher Morgan at the 2012 Utah State University archaeology field school found that using fire-treated digging sticks to replicate the construction of a HRV lodge pad required minimal investment in construction time (Christopher Morgan, personal communication, 2012). In the summer of 2008, Richard Adams also led an effort to construct a model habitation feature near HRV while the site was "covered with deep snow" (Wingerson 2009:17). The process of gathering and assembling 130 wooden poles took eight hours of labor (Wingerson 2009:17). Furthermore, Binford (1990:122) found that hunter-gatherers almost always produce some variety of shelter for themselves; the structures most difficult to identify and/or least likely to preserve in the archaeological record were typically "expediently produced" in particularly short-term, "special-purpose" sites (e.g., single-day logistical forays) rather than residential bases (Binford 1990:122; Binford 1980:12, 19; also see Morgan et al. 2012b; Surovell and Waguespack 2007). Therefore, the evidence for HRV being part of a repetitive, seasonal, land-use pattern, during the highest peak of population density in the prehistory of western Wyoming (below; Metcalf 1987; also see Janetski 2010:117) should not automatically imply that large groups intensively used this site even for short periods of time, or that small groups used this site for long periods of time, relatively speaking (see Chatters 1987:345). Instead, while Binford's (1990) data indicate a pattern of shelter construction reflecting a residential base, results from the HRV flaked stone analysis indicate that habitation was infrequent, short-term, and comprised of small groups. What makes this relatively less intensive pattern of land use remarkable in this high elevation context is both the duration of this evident pattern and the sheer number of habitation features (Morgan et al. 2012a). The apparent lack of diachronic lodge pad re-use may be in part a result of the ease of making a new foundation; each succeeding family unit inhabited their preferred location within the HRV whitebark pine patch.

Contextualizing High Rise Village in Wyoming

Calibrated radiocarbon dates indicate that HRV was primarily inhabited between 2300 and 850 cal BP (Losey 2013; cf., Morgan et al. 2013), and as early as 2800 cal BP (Morgan et al. 2013), after consideration of the old wood problem (Schiffer 1986). These dates overlap with western Wyoming's Late Prehistoric Period (1800 to 250 cal BP) as well as two major climatic trends. In the following section, these regional trends are used to contextualize the behavioral patterns at HRV.

High Rise Village, Climate, and the Uinta Phase

The Uinta Phase (1800 to 900 cal BP) of the Late Prehistoric Period overlaps with peak occupation at HRV (Losey 2013; Morgan et al. 2013); these timeframes are thereby discussed in reference to one another. However, the Uinta Phase chronology was designed to describe the culture history of the adjacent Wyoming Basin, and therefore does not specifically apply to the Wind River Range.

As seen in the Wyoming Basin's Early Archaic Opal Phase (6000 to 3700 cal BP; also see Mensing et al. 2012 and Chapter 2), wetter conditions (Kelly et al. 2013:443; Morgan et al. 2014a; Shuman 2012; cf., Mensing et al. 2012:746) during the Uinta Phase may have led to increased population density (Kelly et al. 2013:446; Metcalf 1987:236) likely resulting from an increase in predictable resource patches (see Losey 2013:126; also see Larson 1997; Mensing et al. 2012; Smith and McNees 1999, 2011; cf., Surovell et al. 2009). This increase in predictable resources resulted in a characteristic "persistent [use of] places" during both phases (*sensu* Schlanger 1992:97; Smith and McNees 2011:307; also see Larson 1997).

In the northern Wind River Range, wetter conditions also prevailed at high elevations throughout the Uinta Phase (Morgan et al. 2014a; also see Chapter 2 overview) and before that for a brief period around 2600 cal BP (Kelly et al. 2013). Similar to the pattern of increased resource patch quantity and predictability that occurred in low elevation contexts (Larson 1997; cf., Smith and McNees 2011), these wetter conditions correspond with an increase in the treeline elevation and possibly the predictability of resource yield (Losey 2013:123) of the whitebark pine patch that encompasses HRV (Morgan et al. 2014a; Stirn 2014).

Considering these corresponding high and low elevation datasets, the interpreted seasonal transhumance-based adaptation pattern at HRV corresponds with the contemporary "...stable, structured long-term land use pattern" that characterized lower elevation contexts during the Uinta Phase (Larson 1997; cf., Smith and McNees 1999, 2011:307). A persistent focus on this dense whitebark pine stand resembles a less intensive "persistent use of places" (*sensu* Smith and McNees 2011:307), which is indicated by a consistent but sporadic pattern of HRV settlement and subsistence behaviors spanning the period of occupation (above). Furthermore, Stirn's (2014) aforementioned model indicates that high elevation habitation features correlate with relatively dense, moderately predictable (Tomback et al. 2001) whitebark pine stands throughout the Wind River Range.

The coincidence of peak HRV habitation occurring in predictable resource patches within the same period as the lower elevation Uinta Phase residential pattern indicates that hunter-gatherer settlement and subsistence patterns were likely regionalized and routinely incorporated both high and low elevation sites – though less routinely and more sporadically in high elevations (as the data indicate at HRV). This pattern conforms with Black's (1991:21) and Benedict's (1992:12) conclusions of high elevation use within a "seasonal transhumance[-based]" adaptation. These points are echoed by the obsidian dataset (see below).

High Rise Village and Regional Lithic Conveyance

HRV sourcing data suggest a pattern in obsidian conveyance consistent with low elevation Late Prehistoric sites throughout northwestern Wyoming (Scheiber and Finley 2011:374). X-ray fluorescence spectrometry results from 137 of the available obsidian artifacts (n=144 flakes; n=1 biface) indicate that HRV inhabitants incorporated material from a diversity of geochemical types into their toolkit, typically from locations in northwestern Wyoming and northeastern Idaho (see Figure 5.4). Northwestern Wyoming sources include Huckleberry Tuff, Lava Creek Tuff, and Obsidian Cliff from the Greater Yellowstone Area, and the Teton Pass and Crescent H sources from near Jackson. Idaho sources include Bear Gulch and Packsaddle Creek from northeastern Idaho and the Malad source from southeastern Idaho. These results are consistent with those from Scheiber and Finley's (2011:386-387) study of obsidian conveyance among Late Prehistoric hunter-gatherers who inhabited contemporaneous lower elevation sites in northwestern Wyoming. The regional variation in obsidian source evenness and diversity among the

HRV assemblage also comes closest to these figures among Scheiber and Finley's (2011: 378, 287) dataset for northwestern Wyoming obsidian (Table 6.3). This coincidence suggests that HRV inhabitants primarily settled, subsisted, and traveled throughout northwestern Wyoming and northeastern Idaho, but most often within the Greater Yellowstone Ecosystem (see Morgan et al. 2015). In any case, obsidian was either directly procured or exchanged for in transit to HRV, after which HRV inhabitants transitioned to using locally available raw materials.

It is worth noting that the difference between exchange and direct procurement is difficult to discern in the archaeological record (see Hughes 2011; Kelly 1992:55; Smith 1999). While the pattern of late-stage bifacial reduction and maintenance at HRV is expected with increased distance from the source, regardless of procurement strategy (Beck et al. 2002; Brantingham 2006; Carr and Bradbury 2001; Shott 1994; also see above), the small proportion of this material onsite may reflect limited access and/or exchange (Smith 1999:287). However, in the context of the overwhelming evidence for a regionally transhumant pattern, direct procurement by "fairly mobile foragers …during their normal seasonal round" is most likely (Morgan et al. 2015; Smith 1999:286-287; also see Kornfeld et al. 2010; Metcalf 1987; Smith and McNees 2005).

There are two exceptions to the main obsidian conveyance pattern (see Figure 5.4). First is the occurrence of a chert type similar to Koenig's (2010:78) description of southwestern Wyoming's Bridger Basin chert (also see Figure 5.3; Kornfeld et al. 2010:590). Second is obsidian originating from southeast Idaho's Malad source. Although the association with Bridger Basin chert is questionable given limitations in chert sourcing (Andrefsky 2009:78-79), and though chert may have been procured in a different context altogether, this material only occurs in Lodge 10 (n=33). This lodge also happens to be only one of two lodges containing obsidian from the Malad source, the most distant source from HRV (249 km). Obsidian from the Crescent H source near Jackson Hole is the other obsidian type with the same provenience as the possible Bridger Basin chert and originates from the closest utilized source to HRV at 104 km (Morgan et al. 2012a:49).

According to Scheiber and Finley's (2011:385-386) dataset, southwestern Wyoming hunter-gatherers routinely incorporated Malad obsidian in their toolkits, as well as had an overlapping obsidian procurement zone with northwestern Wyoming hunter-gatherers in the Jackson Hole area (Scheiber and Finley 2011:386). Assuming the (tentatively-identified) Bridger Basin chert designation is correct, it is possible that inhabitants of Lodge 10 either traded with, or in fact were, hunter-gatherers based out of southwestern Wyoming (cf., Harvey 2012). Nevertheless, these exceptions are based on a very small dataset, with the Malad and possible Bridger Basin chert debitage assemblages likely originating from a single tool (per material type) given the small sample size and isolated provenience within Lodge 10. The obsidian dataset otherwise indicates that HRV inhabitants primarily interacted with northwestern Wyoming inhabitants during their summer seasonal occupation of HRV, if they were not primarily northwestern Wyoming inhabitants themselves (also see Morgan et al. 2015).

Conclusion

A flaked stone sample from 10 lodge pads was analyzed and interpreted to explain patterns in subsistence, settlement, and occupational intensity. Low tool and raw material source diversity, low artifact density, and a mixed expedient-bifacial assemblage ultimately supports the hypothesis that small groups of residentially mobile, seasonally-transhumant family units occupied HRV, thereby conforming with Black's (1991:21) and Benedict's (1992:12) conclusions of integral high elevation use within a "seasonal transhumance[-based]" adaptation. These data also suggest that occupation was on a sporadic, opportunistic basis, a pattern specifically accounted for by Black (1991). Co-occurrence of groundstone and artifacts associated with animal hunting further suggest family occupation (Kelly 1992, 1995; Morgan et al. 2013; Smith and McNees 2011:309; Steward 1938; but see Waguespack 2005), with the lack of flaked and groundstone spatial differentiation at this site indicating small group sizes (i.e., lack of gendered space; *sensu* Adams 2010:55).

The results of the flaked stone analysis do not support the hypothesis that HRV inhabitants practiced a mainly logistical strategy and pursued a broader array of floral and faunal resources at a greater distance from the base camp (Bender and Wright 1988). This is indicated by the dearth in storage features (Hitchcock 1987; Kelly 1992), the absence of a predominantly expedient pattern among the tool and debitage assemblages (e.g., Andrefsky 1994; Bamforth 1991; Benedict 1992:12), and by a relatively low prevalence of artifacts associated with hunting activities, tool diversity, and artifact density, compared to base camps in the region and the Intermountain West (Table 6.1, also see Binford 1980:18; 1983:330).

HRV inhabitants thus engaged in a settlement and subsistence pattern that does not conform to those of 'village' and/or band-level sites (Kelly 2013) in high elevation contexts throughout the Intermountain West (Bettinger 1991; Thomas 1982) or to lower elevation contexts in western Wyoming (Kornfeld et al. 2001; Rapson 1990). Instead, results from this study, together with the floral and faunal datasets, conform to a less diverse and shorter-term pattern of subsistence, settlement, and occupational intensity within a period spanning at least 2300 to 970 cal BP (Losey 2013; cf., Morgan et al. 2013; also see Table 2.1). This pattern relates to the low elevation transhumance pattern that simultaneously occurred during the Wyoming Basin's Uinta Phase (Larson 1997; cf., Smith 2003; Smith and McNees 1999, 2011); residentially mobile inhabitants of HRV 'targeted' or 'mapped on to' (*sensu* Binford 1980) the expansive whitebark pine ecozone as a regional resource patch and a "persistent place" (*sensu* Schlanger 1992:97), as Stirn's (2014) evidence for a focus on settling dense whitebark pine stands suggests. However, unlike these low elevation Uinta Phase sites, HRV itself was not visited annually or even perhaps regularly. Instead, HRV may have been one of many potential stops within a region covering at least 337 km^2 (Stirn 2014:526), where resources associated with the densest whitebark pine stands/resource patches were exploited (Stirn 2014:530). While HRV was re-occupied intermittently, comparable sites in the region were potentially inhabited/exploited during the interim (see below). Given the lack of whitebark pine nuts from flotation analyses (Losey 2013:101) and a low emphasis for hunting indicated by the flaked stone analysis, targeted resource(s) likely consisted of floral resources associated with the whitebark patch.

In addition to the Uinta Phase pattern, the main period of HRV occupation also correlates with "a broad pattern of resource intensification across the Great Basin" (Janetski 2010:117; also see Elston 1986; Kelly 2001; Morgan et al. 2012b), Northwestern Plains, and Rocky Mountains (Kornfeld et al. 2010:130) that began by

1500 cal BP. Although continuous mountain use is noted since ca. 4000 cal BP in western Wyoming (Bender and Wright 1988:634; also see Benedict 1992; Black 1991:21), a "persistent use of [particular resource patches]" (see Smith and McNees 2011:307) likely resulted from a regional trend for intensified resource procurement during this period (see Zeanah and Leigh 2002:41; Thomas 2014a). As lowland population densities increased along with biotic and resource productivity in western Wyoming by 1900 cal BP (Kelly et al. 2013; also see Larson 1997), hunter-gatherers already familiar "with the full range of ecosystems and resources" would expectedly incorporate a greater range of exploitable resource patches within their regular seasonal round, including those in remote high elevation contexts (Benedict 1992:12; e.g., Bender and Wright 1988:634; Husted and Edgar 2002; Scheiber and Finley 2011; cf., Thomas 2014a). In terms of behavioral ecology, as higher ranked resources such as big game decrease in (relative) quantity due to 'over-predation' and/or increased hunter-gatherer group size, groups may be forced to expand their diet breadth to regularly include 'lower-ranked [floral and faunal] species' until more desirable high return resources rebound (i.e., per a "stable limit cycle"; Belovsky 1988; Winterhalder et al. 1988; also see Fitzhugh 2003:112). Indeed, regional familiarity and regional intensification is reflected at HRV by a long-standing period of habitation that peaked by 1500 cal BP (Losey 2013; Morgan et al. 2013). This is also indicated by short-term residential occupations characterized by a focus on predictable lower-return resources associated with the local whitebark pine ecozone (Losey 2013; also see Benedict 1992:12). Furthermore, as whitebark pine resource patches around HRV became more expansive and predictable with wetter environmental conditions (Kelly et al. 2013; Losey 2013:126; Morgan et al.

2014a:215), small groups of hunter-gatherers may have found seasonal occupation of sites such as HRV even more appealing (Adams 2010); giving competing "independent foraging households" an "economic and adaptive incentive" to intensively procure resources for their use alone (Thomas 2014a:in press; also see Steward 1938:230-231). Similarly, the decline in mesic conditions and lowland hunter-gatherer population density throughout Wyoming that began by 1170 cal BP (Kelly et al. 2013:443; also see Kornfeld et al. 2010:69), in addition to a corresponding steady increase in big game population density in the Wyoming Basin (Byers et al. 2005), likely led to the 'dramatic decrease' of use at HRV by 800 cal BP (Losey 2013:8). After this period HRV "was likely avoided in favor of more predictable and productive lowland environments," which were also less remote and thereby required less energy to access (Losey 2013:123). Therefore, use of HRV shifted from the consistent pattern identified in this study to its ultimate abandonment following an increasingly infrequent and more variable pattern in site use after ca. 800 cal BP (see Lodges S and CC discussion, above).

Additional research in western Wyoming suggests that a high elevation transhumance-based settlement-subsistence strategy is not unique to HRV, at least within the context of the Wind River Range (Stirn 2014). Investigations in other high elevation contexts of the adjacent Teton and Absaroka Ranges continue to produce comparable results (Eakin 2005; Scheiber et al. 2009; also see Dayton 2014). However, little research has been conducted to correlate these sites with potential resource patches or identify additional high elevation habitation sites in a manner consistent with Stirn's (2014) predictive model. Furthermore, excavation and analysis of the radiocarbon and flaked stone assemblages at these sites are also currently lacking or in-progress, preventing a potentially comparable dataset to that of this study. If such efforts were conducted, those results should substantiate my suspicions that this Late Prehistoric pattern extends throughout northwestern Wyoming.

Superficially, HRV appears to be an anomalous high elevation village site. However, this study suggests that it represents a short-term residential base occupied seasonally and intermittently within a period spanning at least 2300 to 970 cal BP (Losey 2013; cf., Morgan et al. 2013). Corresponding trends for a comparable but more intensive and annual use of specific resource patches in lower elevation sites suggest that HRV was a seasonal destination for small family group(s) of residentially mobile hunter-gatherers based in western Wyoming (Larson 1997; Metcalf 1987; Scheiber and Finley 2011). This long-term pattern of land use, in addition to preliminary research on comparable sites in the region, also suggests that HRV was likely one of many high elevation sites that resulted from this pattern. Comparable investigations at these sites and the adjacent mountain ranges are needed to test this assumption.

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APPENDIX 1

Total Flaked Stone Assemblage

Table A-1. Total Flaked Stone Artifacts from 10 Selected Lodges.

Lodge	Volume Excavated (m^3)	Bifaces	EMFs	Flakes	Cores	Total Artifacts
10	0.35	2	26	958		986
13	0.6	6	12	1,003		1,021
16	0.55	6	2	2,781	1	2,790
19	0.25	7	4	866		877
21	0.6	1	8	493	1	503
22	0.45	7	4	2,390		2,401
26	0.65	16	1	1,826		1,843
28	0.2		1	31		32
49	0.8875	5	1	666		672
SS	0.6375	11	2	657		670
Total	5.175	61	61	11,671	2	11,795

APPENDIX 2

Debitage

Table A-2. Excavated Provenience of Obsidian Debitage. Note: Levels Were Excavated in Centimeters Below Surface, Unless Noted as Centimeters Below Datum (cmbd).

Lodge	Level	Quad	N (flakes sampled and analyzed)			
			Unit 1	Unit 2	Unit 3	Total
10	5-10	NE	1			
10	5-10	NW	1			
10	5-10	SE				
10	5-10	SW	5			
10	10-15	NE	2			
10	10-15	SW				
10	10-15	SE	3			
10	10-15	SW				
TOTAL			12			12
13	5-10	NE	1			
13	5-10	NW		1		
13	5-10	SE				
13	10-15	NE				
13	10-15	NW		1		
13	10-15	SE	2			
TOTAL			3	2		5
16	5-10	NE				
16	10-15	NE	1			
TOTAL			1			1
19	0-5	NE	1			
19	0-5	NW				
19	0-5	SE	2			
19	0-5	SW				
19	5-10	NE	2			
19	5-10	NW				
19	5-10	SE	7			
19	5-10	SW	5			
19	10-15	NE				
19	10-15	NW	12			
19	10-15	SE				
19	10-15	SW				
19	15-20	NW	1			
TOTAL			30			30
21	0-5	NE				
21	0-5	NW				
21	0-5	SE	2			
21	0-5	SW				
21	0-5	ALL		1		
21	5-10	NE	7			

21	5-10	NW	1			
21	5-10	SE	7			
21	5-10	SW	2			
21	5-10	ALL		6		
21	10-15	NE	10			
21	10-15	NW	0			
21	10-15	SE	6			
21	10-15	SW	1			
21	10-15	ALL		11		
21	15-20	NE	2			
21	15-20	NW				
21	15-20	SE				
21	15-20	SW				
21	15-20	ALL				
21	15-20	NE				
21	15-20	NW				
21	15-20	SE				
21	15-20	SW				
21	25-30	ALL		1		
TOTAL			38	19		57
22	0-15	NE	4			
22	0-15	NW	8			
22	0-15	SW	7			
22	15-20	NE				
22	15-20	NW	3			
22	15-20	SW				
TOTAL			22			22
26	0-20 (cmbd)	NE	2			
TOTAL			2			2
49	10-20	NE				
49	10-20	SE				
49	10-20	SW				
49	20-25	NE		1		
49	20-25	SE				
49	20-25	SW		1		
49	25-30	NE				
49	25-30	SE				
49	25-30	SW		2		
TOTAL				4		4
SS	5-20 (cmbd)	NE			2	
SS	3-22 (cmbd)	NW				
SS	14-35 (cmbd)	SE			6	
SS	20-40 (cmbd)	NE	1		1	
SS	20-40 (cmbd)	NW				
SS	20-40 (cmbd)	SE				
SS	23-28 (cmbd)	SW			1	
TOTAL			1		10	11

Table A-3. Excavated Provenience of Non-Obsidian Debitage from Selected Quadrants. Note: Levels Were Excavated in Centimeters Below Surface, Unless Noted as Centimeters Below Datum (cmbd).

Lodge	Level (cmbs)	Quad	N (flakes set aside for the Milne [2009] sampling equation)			
			Size Cat. 1 (<6mm)	Size Cat. 2 (6-12 mm)	Size Cat. 3 (>12mm)	Total
10	5-10	NE	11	42	11	64
10	5-10	SE	16	44	23	83
10	5-10	SW	27	90	0	117
10	10-15	NE	22	69	25	116
10	10-15	SE	17	101	46	164
10	10-15	SW	13	45	22	80
10	15-20	NE	9	24	9	42
10	15-20	SE	14	35	26	75
10	15-20	SW	7	45	6	58
10	20-25	NE	1	3	1	5
10	20-25	SE	4	9	1	14
10	20-25	SW	2	2	0	4
10	25-30	NE	0	2	1	3
10	25-30	SE	0	1	0	1
10	25-30	SW	0	0	2	2
TOTAL			143	512	173	828
13	5-10	NE	7	36	17	60
13	5-10	NW	11	79	23	113
13	5-10	SE	2	18	21	41
13	10-15	NE	6	58	12	76
13	10-15	NW	11	69	26	106
13	10-15	SE	8	46	19	73
13	15-20	NE	0	10	5	15
13	15-20	NW	5	9	3	17
13	15-20	SE	7	25	12	44
13	20-25	NW	0	1	0	1
13	20-25	SE	0	4	2	6
TOTAL			57	355	140	552
16	5-10	NE	8	125	36	169
16	5-10	NW	12	90	12	114
16	10-15	NE	43	226	51	320
16	10-15	NW	5	53	6	64
16	15-20	NE	2	5	4	11
TOTAL			70	499	109	678
19	5-10	NE	13	55	28	96
19	5-10	NW	1	50	24	75
19	5-10	SE	7	45	11	63
19	5-10	SW	23	48	16	87
19	10-15	NE	4	13	10	27
19	10-15	NW	36	188	35	259
19	10-15	SE	0	1	1	2
19	10-15	SW	3	8	2	13
19	15-20	NW	1	4	0	5
TOTAL			88	412	127	627
21 (Unit 2)	5-10	ALL	32	84	29	145
21 (Unit 2)	10-15	ALL	20	127	56	203
21 (Unit 2)	15-20	ALL	4	26	17	47
21 (Unit 2)	20-25	ALL	3	32	13	48
21 (Unit 2)	25-30	ALL	1	10	3	14

21 (Unit 2)	30-35	ALL	0	2	0	2
TOTAL			60	281	118	459
22	0-15	NW	108	430	150	688
22	15-20	NW	38	146	52	236
22	20-25	NW	0	1	1	2
22	25-30	ALL	2	4	1	7
22	30-35	ALL	0	1	0	1
TOTAL			148	582	204	934
26	20-25 (cmbd)	SE	5	3	8	16
26	20-25 (cmbd)	SW	2	6	7	15
26	25-30 (cmbd)	SE	3	6	6	15
26	25-30 (cmbd)	SW	2	9	4	15
26	30-35 (cmbd)	ALL	2	20	8	30
TOTAL			14	44	33	91
28	5-10	NE	0	3	0	3
28	5-10	NW	0	1	2	3
28	5-10	SE	0	1	1	2
28	5-10	SW	1	6	1	8
28	10-15	NE	3	6	1	10
28	10-15	NW	2	1	0	3
28	10-15	SE	0	2	0	2
TOTAL			6	20	5	31
49	10-20	NE	12	44	14	70
49	10-20	SE	11	37	21	69
49	10-20	SW	2	33	14	49
49	20-25	NE	8	35	7	50
49	20-25	SE	1	6	2	9
49	20-25	SW	8	53	24	85
49	25-30	NE	0	10	4	14
49	25-30	SE	1	9	8	18
49	25-30	SW	0	6	9	15
49	30-35	SW	7	22	1	30
49	35-40	SW	2	8	1	11
TOTAL			52	263	105	420
SS (Unit 3)	5-20 (cmbd)	NE	4	19	8	31
SS (Unit 3)	3-22 (cmbd)	NW	4	21	7	32
SS (Unit 3)	14-35 (cmbd)	SE	27	163	39	229
SS (Unit 3)	20-40 (cmbd)	NE	29	60	28	117
SS (Unit 3)	20-40 (cmbd)	NW	5	22	15	42
SS (Unit 3)	20-40 (cmbd)	SE	10	17	17	44
TOTAL			79	302	114	495

Table A-4. Excavated Provenience of Sampled and Analyzed Non-Obsidian Debitage. Note: Levels Were Excavated in Centimeters Below Surface, Unless Noted as Centimeters Below Datum (cmbd).

Lodge	**Level**	**Quad**	**N (flakes sampled and analyzed)**			
			Size Cat. 1 (<6mm)	**Size Cat. 2 (6-12 mm)**	**Size Cat. 3 (>12mm)**	**Total**
10	5-10	NE	11	30	11	52
10	5-10	SE	16	30	23	69

10	5-10	SW	27	48	0	75
10	10-15	NE	22	30	25	77
10	10-15	SE	17	38	46	101
10	10-15	SW	13	31	22	66
10	15-20	NE	9	24	9	42
10	15-20	SE	14	30	26	70
10	15-20	SW	7	21	6	34
10	20-25	NE	1	3	1	5
10	20-25	SE	4	9	1	14
10	20-25	SW	2	2	0	4
10	25-30	NE	0	2	1	3
10	25-30	SE	0	1	0	1
10	25-30	SW	0	0	2	2
TOTAL			143	299	173	615
13	5-10	NE	7	29	17	53
13	5-10	NW	11	39	23	73
13	5-10	SE	2	18	21	41
13	10-15	NE	6	40	12	58
13	10-15	NW	11	45	26	82
13	10-15	SE	8	36	19	63
13	15-20	NE	0	10	5	15
13	15-20	NW	5	9	3	17
13	15-20	SE	7	25	12	44
13	20-25	NW	0	1	0	1
13	20-25	SE	0	4	2	6
TOTAL			57	256	140	453
16	5-10	NE	8	68	36	112
16	5-10	NW	12	61	12	85
16	10-15	NE	30	49	48	127
16	10-15	NW	5	34	6	45
16	15-20	NE	2	5	4	11
TOTAL			57	217	106	380
19	5-10	NE	13	48	28	89
19	5-10	NW	1	38	24	63
19	5-10	SE	7	35	11	53
19	5-10	SW	23	44	16	83
19	10-15	NE	4	13	10	27
19	10-15	NW	30	99	34	163
19	10-15	SE	0	1	1	2
19	10-15	SW	3	8	2	13
19	15-20	NW	1	4	0	5
TOTAL			82	290	126	498
21 (Unit 2)	5-10	ALL	30	39	29	98
21 (Unit 2)	10-15	ALL	20	34	55	109
21 (Unit 2)	15-20	ALL	4	26	17	47
21 (Unit 2)	20-25	ALL	3	30	13	46
21 (Unit 2)	25-30	ALL	1	10	3	14
21 (Unit 2)	30-35	ALL	0	2	0	2
TOTAL			58	141	117	316
22	0-15	NW	108	310	146	564
22	15-20	NW	30	101	51	182
22	20-25	NW	0	1	1	2
22	25-30	ALL	2	4	1	7
22	30-35	ALL	0	1	0	1

TOTAL			140	417	199	756
26	20-25 (cmbd)	SE	5	3	8	16
26	20-25 (cmbd)	SW	2	6	7	15
26	25-30 (cmbd)	SE	3	6	6	15
26	25-30 (cmbd)	SW	2	9	4	15
26	30-35 (cmbd)	ALL	2	20	8	30
TOTAL			14	44	33	91
28	5-10	NE	0	3	0	3
28	5-10	NW	0	1	2	3
28	5-10	SE	0	1	1	2
28	5-10	SW	1	6	1	8
28	10-15	NE	3	6	1	10
28	10-15	NW	2	1	0	3
28	10-15	SE	0	2	0	2
TOTAL			6	20	5	31
49	10-20	NE	12	34	14	60
49	10-20	SE	11	29	21	61
49	10-20	SW	2	33	14	49
49	20-25	NE	8	27	7	42
49	20-25	SE	1	6	2	9
49	20-25	SW	8	35	23	66
49	25-30	NE	0	10	4	14
49	25-30	SE	1	9	8	18
49	25-30	SW	0	6	9	15
49	30-35	SW	7	22	1	30
49	35-40	SW	2	8	1	11
TOTAL			52	219	104	375
SS (Unit 3)	5-20 (cmbd)	NE	4	19	8	31
SS (Unit 3)	3-22 (cmbd)	NW	4	21	7	32
SS (Unit 3)	14-35 (cmbd)	SE	27	86	39	152
SS (Unit 3)	20-40 (cmbd)	NE	29	41	28	98
SS (Unit 3)	20-40 (cmbd)	NW	5	22	15	42
SS (Unit 3)	20-40 (cmbd)	SE	10	17	17	44
TOTAL			79	206	114	399

Table A-5. Material Types Among the Analyzed Debitage Assemblage.

Lodge	Chert	Quartzite	Basalt	Quartz	Obsidian	Total
10	573	41		1	12	627
13	360	87	3	3	5	458
16	367	13			1	381
19	486	11	1		30	528
21	452	6	1		57	516
22	750	6			22	778
26	86	5			2	93
28	30	1				31
49	372	3			4	379
SS	386	11		2	11	410
Total	3,862	184	5	6	144	4,201

Table A-6. Maximum Lengths Among the Analyzed Non-Obsidian Debitage Assemblage.

Lodge	1-2.5 mm	2.6-5 mm	5.1-7.5 mm	7.6-10 mm	10.1-12.5 mm	12.6-15 mm	15.1-17.5 mm	>17.5 mm	Total
10	2	204	218	92	58	14	12	15	615
13	1	144	172	66	26	21	11	12	453
16	2	126	129	50	35	16	8	14	380
19	5	199	137	61	35	22	18	21	498
21	1	183	155	68	28	11	6	7	459
22	4	260	281	109	38	34	10	20	756
26		25	34	14	9	7		2	91
28		9	13	6	3				31
49	6	115	143	57	24	15	5	10	375
SS	7	145	143	53	25	7	11	8	399
Total	61	49	1,404	1,417	28	280	147	81	4,057

Table A-7. Debitage Categories Among the Analyzed Non-Obsidian Assemblage.

Lodge	Primary	Late Interior	Flake Fragment	Shatter	Biface Thinning	Pressure	Retouch Chip	Retouch Chip Fragment	Pot Lid	Total
10	10	87	71	15	66	23	190	147	6	615
13	41	72	62	18	51	30	65	111	3	453
16	13	72	61	18	48	51	18	96	3	380
19	21	65	92	35	51	43	41	131	19	498
21	34	77	28	14	38	7	150	93	18	459
22	57	65	73	46	91	11	157	235	21	756
26	9	42	82	29	53	21	31	87	21	91
28	51	49	64	16	71	38	30	75	5	31
49	14	11	14	5	11	8	4	22	2	375
SS	1	4		1	1	1	13	8	2	399
Total	250	540	545	197	479	234	699	998	102	4,057

Table A-8. Maximum Lengths Among the Obsidian Debitage Assemblage.

Lodge	2.5-5 mm	5.1-7.5 mm	7.6-10 mm	10.1-12.5 mm	12.6-15 mm	>15 mm	Total
10	2	9	1				12
13		3	1	1			5
16		1					1
19	6	20	2	2			30
21	5	27	17	7	1		57
22	5	10	6	1			22
26						2	2
49		1			1	2	4
SS	1	3	2	3	2		11
Total	19	74	29	14	4	4	144

Table A-9. Debitage Categories Among the Obsidian Assemblage.

Lodge	Primary	Late Interior	Shatter	Biface Thinning	Pressure	Retouch Chip	Retouch Chip Fragment	Indeter-minate	Total
10			1		5	5	1		11
13				1		1	3		5
16				1					1
19		1		5	3	13	8		29
21		1	2	12	5	22	15		54
22			2	7	1	4	6	2	20
26	1	1							0
49		3					1		1
SS		3		3	3	1	1		8
Total	1	9	5	29	17	46	35	2	129

APPENDIX 3

Edge-Modified Flakes

Table A-10. Edge-Modified Flake Categories.

Lodge	End Scraper	Side Scraper	Side Scraper and End Scraper	Side Scraper and Graver	Notched Flake	Notched Flake and Scraper	Total
10	10	12	4				26
13	4	6	2	1			13
16	1	1					2
19	1	2			1		4
21	5	3	4			1	13
22		3	1				4
26	1						1
28			1				1
49			1				1
SS		2	1				3
Total	22	29	14	1	1	1	68

Table A-11. Edge-Modified Flake Material Types.

Material Type	End Scraper	Side Scraper	Side Scraper and End Scraper	Side Scraper and Graver	Notched Flake	Notched Flake and Scraper	Total
Chert	17	24	13	1		1	56
Obsidian	5	3	1		1		10
Quartzite		2					2
Total	22	29	14	1	1	1	68

Table A-12. Original Flake Categories of Edge-Modified Flakes.

Original Flake Category	End Scraper	Side Scraper	Side Scraper and End Scraper	Side Scraper and Graver	Notched Flake	Notched Flake and Scraper	Total
Biface Thinning	3	2					5
Blade-like			1				1
Flake Fragment	6	7	2			1	16
Primary	1	4	3				8
Retouch Chip	5	3					8
Retouch Chip Fragment	2	2			1		5
Late Interior	5	11	8	1			25
Total	22	29	14	1	1	1	68

Table A-13. Edge-Modified Flake Maximum Lengths.

Lodge	<9 mm	9-12 mm	>12 mm	Total
10	4	3	19	26
13		2	11	13
16			2	2
19		2	2	4
21	2	4	7	13
22			4	4
26			1	1
28			1	1
49			1	1
SS	1		2	3
Total	7	11	50	68

APPENDIX 4

Bifaces

Table A-14. Biface Categories.

Lodge	Drill	Graver	Tip or Tang Fragment	Medial Fragment	Base Fragment	Unknown Fragment	Projectile Point	Total
10					2		1	3
13			3	1		2		6
16						2	4	6
19	1		1			4	1	7
21			2	1			1	4
22			3	1	1	1	1	7
26	4		2	2		2	8	18
28								0
49					1	2	2	5
SS	1	1	2	1	2	2	3	12
Total	6	1	13	6	6	15	21	68

Table A-15. Biface Material Types.

Material Type	Drill	Graver	Tip or Tang Fragment	Medial Fragment	Base Fragment	Unknown Fragment	Projectile Point	Total
Chert	5	1	12	6	6	14	21	65
Obsidian			1					1
Quartz						1		1
Quartzite	1							1
Total	6	1	13	6	6	15	21	68