

THESIS

**HIGH ALTITUDE STONE AND WOOD STRUCTURES
OF NORTHWESTERN WYOMING: EXAMPLES FROM THE UPPER
GREYBULL RIVER AREA IN THE CENTRAL ABSAROKA MOUNTAINS**

Submitted by

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WE HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER OUR SUPERVISION
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ABSTRACT

HIGH ALTITUDE STONE AND WOOD STRUCTURES OF NORTHWESTERN WYOMING: EXAMPLES FROM THE UPPER GREYBULL RIVER AREA IN THE CENTRAL ABSAROKA MOUNTAINS

This thesis presents the results of archaeological investigations of seven sites with structures identified near the headwaters of the Greybull River in the Absaroka Mountains of northwestern Wyoming. These structures have in common a construction style that consists entirely of dry-laid and/or aligned locally available stone and, in some cases, wooden elements. Investigations, analyses and interpretations of high altitude stone structure sites are often framed by categorical assumptions about site and structure functions. Assumed functions often include game drives, ceremonial localities, location markers, architectural remnants, and windbreaks. These ascribed functions condition the types of data that are gathered, and thus the results of the analyses and interpretations are often self-fulfilling. No single, best, or functionally provable argument, beyond a possible association with hunting, will be provided for the newly presented sites and structures, as too little is known about the builders' cultural and/or temporal affiliations. Rather, conclusions with respect to site and/or structure function will be oriented around pattern recognition and comparative discussion.

An important goal of this thesis is to explore analytical approaches that can be employed regardless of site and/or structure functions, and to this end, three analytical approaches are considered. First, a regional comparison of sites with similar features is presented. Second, data gathered from a structure replication experiment are compared with data collected during field investigations to derive estimates of labor investment for the archaeological specimens. Third, landscape data are used to explore potential topographic signatures that might accompany sites high altitude sites with stone and wood structures. Although the functions of these structures remain unknown, the results of the research suggest that there are some baseline regional patterns in structure placement that should be further investigated. Prehistoric groups were expending energy in high elevation settings for activities that may not have been strictly

hunting related. Finally, landscape data do show potential for exposing patterns of site placement with respect to high altitude stone and wood structures.

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CHAPTER 1

INTRODUCTION

During the 2004 and 2005 field seasons, investigators conducting surveys as part of the Greybull River Sustainable Landscape Ecology (GRSLE) project identified seven previously unrecorded high altitude stone structure sites, with high altitude defined as ~2500-4000 masl (meters above sea level). These sites are located in four tributary drainages of the upper Greybull River in northwestern Wyoming (Figure 1). Taken together, the feature types at these sites include sets of cairns, stone walls, linear alignments, a small rectangular platform, and walled enclosures. These structures have in common a construction style that consists entirely of dry-laid and/or aligned locally available stone and, in some cases, wooden elements. While an association between the prehistoric peoples who used the Upper Greybull ecosystem and the structures is likely for most of these structures, no unequivocal linkages exist and in some cases historic and/or modern origins are possible.

Investigations, analyses and interpretations of high altitude stone structures are often framed by categorical assumptions about site and structure functions. Assumed functions include game drives, ceremonial localities, location markers, architectural remnants, and windbreaks. These inferred functions can condition the types of data that are gathered, and thus the results of the analyses and interpretations are often self-fulfilling. This is not to say that the interpretations of previous investigations are necessarily incorrect. In fact I suspect that they are not. However, these categorical assumptions have potentially put the interpretive cart in front of the methodological horse. Instead, I argue that functional interpretations of stone structures and the associated sites could be strengthened through the construction of more formalized methodological approaches to document the range of variability within and among high altitude stone structures sites. This thesis explores three analytical approaches that have, as an end point, elucidation of stone structure attributes. No single, best, or functionally provable argument, beyond a possible association with hunting, will be provided for the newly presented sites and structures, as too little is known about the builders' cultural and/or temporal affiliations. Rather, conclusions with respect to site and/or structure function will be oriented around pattern recognition and comparative discussion (Figure 2).

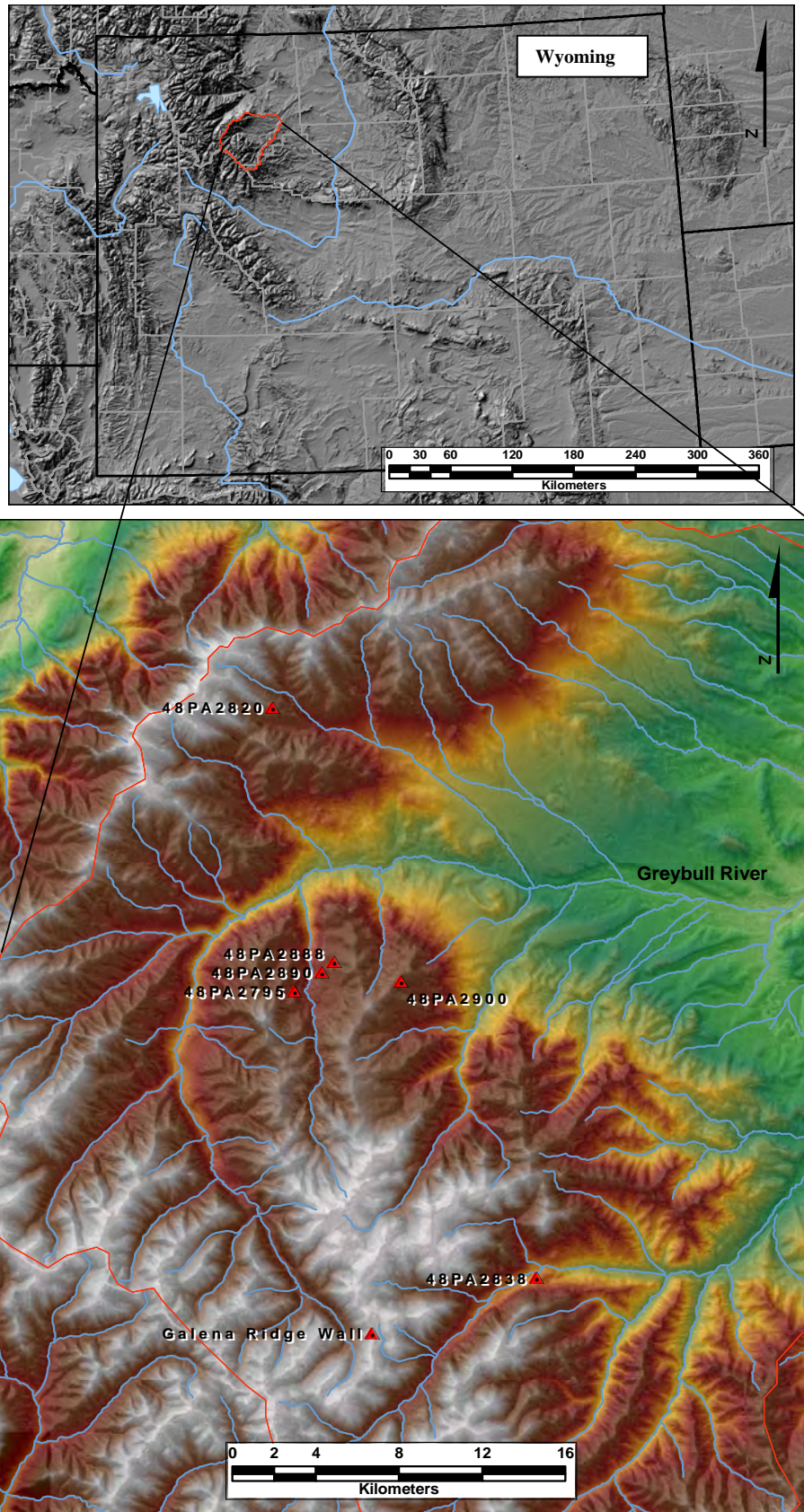


Figure 1. Plan view map of the Greybull River Sustainable Landscape Ecology project area located in northwestern Wyoming showing the locations of high altitude stone structure sites.

High Altitude Stone Structure Sites: Placing the Cart Behind the Horse

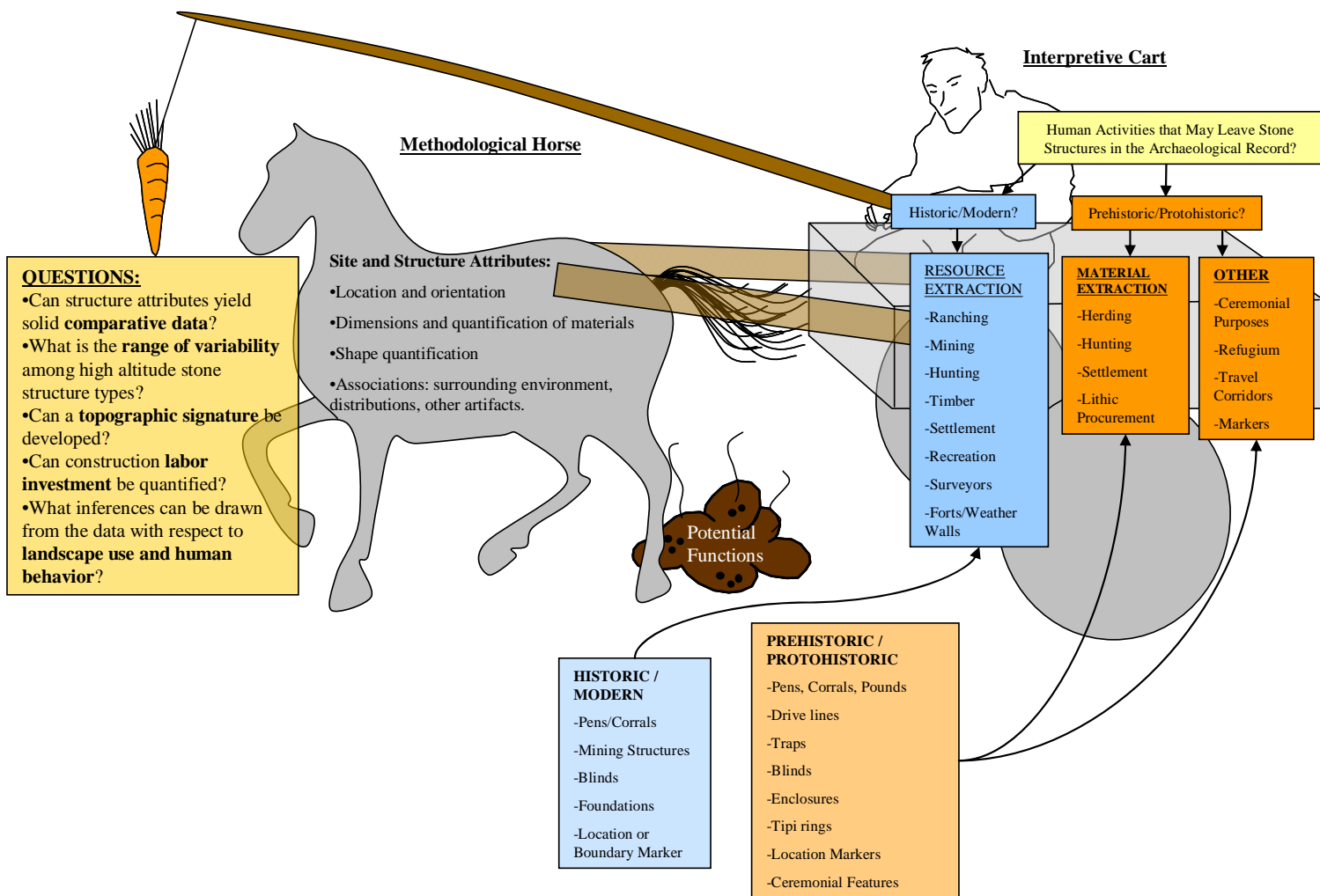


Figure 2. Conceptual model of the proposed relationship for methods and interpretations of high altitude stone structures.

The goal of this thesis is to provide a basic description and analysis of the prehistoric stone structure sites identified within the GRSLE project area. The data gathered from these sites are then used to address the following research questions:

- What are the similarities and differences among stone structures sites within the region in terms of structure types, location, elevational zones, structure orientations, quantities and types of construction materials, and associated artifact densities? Can attribute based investigations of stone structure sites yield solid comparative data?
- Can a topographic signature for high altitude stone structure sites be identified and used to predict the locations of other similar sites?
- Can labor investment be quantified using rock count and size grade data collected during field investigations? If so what does labor investment tell us about the sites?
- What do the distributions and types of stone structure sites in the GRSLE project area tell us about high-altitude landscape use patterns and human behavior in what are sometimes considered marginal environments?

I argue that, regardless of function, stone structures sites contain unique and often untapped data that should be more fully integrated into investigations and interpretations of prehistoric hunter-gatherer landscape use and subsistence.

Prior to the GRSLE project field investigations only seven prehistoric sites had been recorded within the project area. At the end of the 2007 field season nearly 260+ multicomponent prehistoric/protohistoric and at least 24 historic sites, which included tens of thousands of artifacts, had been identified in Upper Greybull project area. These numbers illustrate, in dramatic fashion, the potential for extremely high site densities in an area sometimes considered marginal for human occupation and/or extraction of subsistence resources. With respect to high altitude stone structures in or near the GRSLE area, only one site had been recorded prior to the 2004 field season. Thus far, the current investigation has yielded nine stone structure sites (two additional structure sites recorded in 2007 are not included in this thesis). The seven sites discovered before 2007 form the investigative core for the following discussion of high altitude stones structures. Based on the limited amount of time devoted to survey, particularly in the more inaccessible portions of the GRSLE project area, it seems probable that other stone structure sites are waiting to be discovered.

Project Area and Site Locations

The GRSLE project area is located within the Shoshone National Forest in the central-eastern section of the Absaroka Mountains, a sub-range of the loosely defined Middle Rocky Mountain Physiographic Province (Fenneman 1931:92; Thornbury 1965:362). The GRSLE area (alternately identified as the Upper Greybull ecosystem) encompasses the mountainous headwaters of the Greybull River, its tributary drainages, and surrounding valleys (Figure 1). The project area also encompasses Francs Peak which, at 4012 masl, is the highest point in the Absarokas. Much of the Absaroka Mountain range is located within the national forests that buffer Yellowstone National Park, and due to the proximity of the park, which is located 145 km northwest, this area is sometimes referred to as the “backcountry” of the GYE. This area is situated on the edge of a transitional zone in which higher-elevation alpine uplands yield to the dry desert shrublands of the Bighorn Basin to the east. The GRSLE stone structure sites are located throughout the project area, and individual site locations are described below from north to south.

The Pickett Creek Structures (48PA2820), located in the extreme northern reaches of the project area, overlook the Pickett Creek valley 16 km northwest of the confluence with the Greybull River. These structures are situated on open ridges and saddles from approximately 3075-3200 masl (meters above sea level), and consist of stone walls, blinds, and an anomalous platform. Three sites are located above the Jack Creek valley near the approximate center of the GRSLE project area 6 km south of its confluence with the Greybull River. The first and perhaps best preserved of the GRSLE structure sites is a small two-room enclosure (48PA2795) on a steep east-facing slope that overlooks the valley at 2857 masl. The two remaining sites are situated in the Jack Creek flats area to the east of the creek near the Jack Creek Cow Camp. The first of these sites, 48PA2888, consists of a single course of dry-laid stones that cross a gentle slope at 2888 masl. The second structure site (48PA2890) within the Jack Creek flats area is the most ephemeral. This site consists of three stone alignments that straddle a low hill overlooking the steep-walled Jack Creek valley at 2812 masl.

The Kay Creek wall (48PA2900) is located 3083 masl on the eastern flanks of high ridge that overlooks the Francs Fork River valley. This site is situated 1.3 km northeast of the headwaters of Kay Creek, a tributary of the Francs Fork. This site consists of a short well-preserved wall.

A single anomalous wall was recorded high on Galena Ridge overlooking the Greybull River valley. This feature is located a few meters from the precipice edge at an elevation of 3568 masl. From the edge of Galena Ridge the floor of the Greybull River valley is nearly 500 m below and 1.3 km west of the structure. Although this single stone wall is modern, it is included here because it contains relevant comparative data.

The Double D Ranch structure (48PA2838) is located at 2539 masl near the southeast boundary of the project area on a north-facing slope overlooking the Wood River valley. The site is 500 m south of the confluence of the Wood River and Jojo Creek. From the site the Double D Ranch is visible on the floodplain to the north of the river. This site consists of a circular enclosure created by the removal of stone from a scree slope. Additional improvements to the site include wooden elements that bolster the walls.

Environment

In an effort to gain a better understanding of the possible behaviors that are represented by the GRSLE structures it is vital to employ an investigative approach that relies on context. The Upper Greybull Ecosystem encompasses a variety of components, including abiotic elements of the structural/geologic landscape and climate, biotic components (flora and fauna), and an integrated culture component. Together, these constituents reveal the mechanisms for cultural variability and change (Waters 1996:4).

The following discussion begins with a brief overview of the geologic and physiographic forces of the past that may have played an influential role in the placement and form of the structures. This will be followed by a description of the current climatic variables as well as some regional paleoclimatic trends that may have mediated structure placement and chronology. A brief discussion of the principal floral communities and the controlling elevational gradients will be presented for the purpose of describing the landscape variables that influence distribution of extant faunal communities. Finally, the local faunal communities will be discussed with a particular emphasis on species that may have had significant economic value in prehistory.

Geology and Physiography

Both site placement and site attributes are influenced by the geologic conditions that surround the GRSLE stone structure sites. The underlying geology has contributed to the shape and character of the areas, making some areas functionally superior to others. The substrate exposure and decompositional patterning of bedrock materials is another factor potentially contributing to site placement. The following is a general overview of the geologic formation of the area. Specific geologic descriptions for each site are included in the results in Chapter 4.

The Absaroka Mountains occur along the eastern edge of the central section of the North American Cordillera. Unlike many of the surrounding mountain ranges, these mountains are the result of volcanic eruptions stemming from lithospheric extension rather than subduction and uplift. These mountains began forming in the Mesozoic and early Cenozoic during a long period of crustal compression or shortening. The compressive forces deformed the crust causing it to be overthickened, unstable, and thermally weakened (Liu 1996:448, 450). During the middle Eocene (~53-43 Ma), decompression of the crustal layer underlying the Absaroka area caused magmatism via frictional shearing between the lithospheric mantle and crust (Hiza 1999:159, 163). The prior formation of weak points during the Mesozoic and the coincident extensional thinning of the crust resulted in the extrusion of magma from several volcanic centers throughout the Absaroka volcanic province (Hiza 1999; Liu 1996:455-456).

The structure of the Absarokas was built up by repeated eruptions beginning in the middle Eocene; creating what Breckenridge (1974:6) terms a volcanic pile. Two regional formations are recognized in the GRSLE area, the middle Eocene Pitchfork and Oligocene Wiggins formations (Reitze 2004:12). The Absarokas includes both lava flows and interbedded volcanoclastic sediments (Hiza 1999:53) that overlie a prior landscape that possessed ~300-450 m of relief (Thornbury 1965:375). In many cases, the extruded lava flows and volcanoclastic sediments dip away from the volcanic centers (Hiza 1999:53). Stratovolcanoes formed and deposited igneous materials (Reitze 2004:14). Subsequent processes acting on the Absarokas include secondary deposition and cementation of igneous materials (Burnett 2005:3). Ultimately these processes resulted in the formation of a nearly 2000-m-deep plateau made up almost entirely of weakly aggregated and interbedded volcanic materials. These mountains are a regionally

dominant feature and are nearly 600-1200 m higher than the adjacent Yellowstone plateau (Thornbury 1965:375).

The incipient Absaroka plateau was nearly flat-lying to gently folded, and did not exhibit characteristics of the underlying folded mountains (Love 1939; Mueller 2007). Although some remnant upland surfaces of the plateau remain, the vast majority of this ancient plain is now gone owing to erosional forces that have cut and dissected the plateau over the preceding 58 million years into a series of deep valleys (Reitze 2004:18; Thornbury 1965:362). A combination of fluvial action, periodic glaciations and mass wasting events, primarily in the form of landslides, has altered the Absarokas into a rugged area with diverse landscape types and numerous elevation zones.

The modern surface geology is heavily influenced by the generally unstable volcanic sediments that formed the plateau. The remaining upper surfaces are generally more stable, while the weathered soil bodies that continue to collect in the lower valleys and foothills are prone to mass wasting. I proposed three new physiographic-elevation zones for the GRSLE project area. The Absaroka Plateaus and Peaks ranges (**APP**) are the surfaces at the highest elevations ranging between 3000 and 4000 masl. These surfaces are comprised of exposed bedrock and residual soils. The accompanying remnants of the Absaroka volcanic plateau are characterized as vast, relatively stable rolling plains. The High Meadows and Valleys (**HMV**) ranges are intermediate surfaces located between 2500 and 3000 masl. This range is dominated by steep slopes with colluvial soils, glacial deposits, reworked landslide deposits, decomposed bedrock and terraced valley floors with mixtures of fluvial, colluvial, and landslide deposits. The Foothills and Lowlands ranges (**FL**) are the lowest surfaces, located between 1800 and 2500 masl. These areas are defined by erosion, redeposition, and landscape features formed by mass wasting in the form of slump block and earthflow landslides, many of which have been fluvially reworked (Ollie 2007:29). The consequential bluff-like valley walls exhibit exposed bedrock faces (Burnett 2005:5). These low ranges also include open rolling plains, wide valley floors, and narrow tributary valleys that grade imperceptibly to the HMV ranges.

The upper Greybull River valley is hook-shaped. The headwaters are located in the southwestern portion of the GRLE project area on the northern slopes of Mount Crosby. As the river valley descends it

trends north-northwest for 20 km, then bends to the east-southeast for 18 km to the lowland/foothill area. The river then flows nearly due east for 20 km to the confluence with the Wood River.

From the confluence of the Greybull and Wood Rivers (1835 masl) within the FL range, elevations increase approximately 2175 m over the span of 35 km ending at Francs Peak (4012 masl) in the APP range. The changes in elevation and the associated surface geology have resulted in numerous micro-environments that have specific characteristics and advantages for the biotic species that inhabit the area. However, the climate must be considered prior to forming a picture of the Upper Greybull ecosystem.

Climate

Climate, as a principal driver of both abiotic and biotic systems could play an important role in influencing the placement of stone structure sites. In general Wyoming follows a pattern of short sunny summers and long winters due to its northerly latitude and relatively high elevation (Knight 1994:23). The Absarokas in particular epitomize this pattern.

Two dominant climatic regimes are generally acknowledged for the western United States. A summer-dry/winter-wet pattern, in which eastern Pacific high pressure during the summer suppresses precipitation, causes drought-like conditions. Winter-wet conditions are the result of cooler temperatures which allow the northerly jet stream to drop and bring moisture as rain (on the coast) or snow further into the interior. The other regime, summer-wet/winter-dry, is characterized by summer distributions of monsoonal moisture from the gulfs of California and Mexico across northern Central America, the North American Southwest and north to the Great Plains. Winter conditions are relatively dry due to the effects of the cordilleran rainshadow (Whitlock and Bartlein 1993:233). However, topography, specifically orography, plays an even more important role at local scales. The GRSLE project area experiences a modified pattern dominated by greater precipitation during spring and fall and greater dryness in the summer and winter months. Evapotranspiration rates are heavily influenced by micro-environmental factors such as aspect.

Summer conditions arrive late, usually no earlier than mid-June. Late spring/early summer snow falls are typical. The APP zone may exhibit areas of persistent year-round snow-pack, especially on north-facing and/or shaded slopes. There are frequent thunderstorms during the summer with hail common above

2500 m. Significant snowfall can be experienced at any point during the summer and is nearly guaranteed by late August or early October.

Winters are harsh. Snow is deep and often permanent throughout the season. Some areas at higher elevations are swept free of snow by high winds. In general climatic conditions within the GRSLE project area are variable and to a large extent reflect on topographic relief and elevation. Temperature, precipitation and wind are interrelated and tend toward the extremes at higher elevations.

The GRSLE area temperature and precipitation data shown in Tables 1 and Figure 3 are derived from both the Wyoming Climate Atlas (Curtis and Grimes 2004) and from the National Resource Conservation Service (NRCS 2007). Temperature and precipitation data from the NRCS rely on Parameter-elevation Regressions on Independent Slopes Modeling (PRISM). The PRISM data are based on hybrid statistical-geographic estimates consisting of point measurements of climate data and digital elevation models (Curtis 2007). These data have been manipulated in ArcGIS and correspond to individual ranges along a 34.8-km transect that extends from the confluence of the Greybull and Wood Rivers to the summit of Francs Peak.

Knight (1994:30) suggests an adiabatic lapse rate of approximately 6°C to 9.8°C per 1000 m of elevation gained, but cautions that time of year can greatly influence actual temperature ranges along a gradient (Table 1). Obviously, aspect, slope and vegetation play important roles in determining temperatures within microclimates. Mean annual temperatures for the project area range from 3.1°C at lower elevations in the lowlands and foothills to -5.3°C at higher elevations (Curtis and Grimes 2004). Temperatures as low as -34°C have been noted in January and highs in July can reach 30°C (Reitze 2004).

Most of the annual precipitation falls in the late spring and early summer months as a mixture of snow and/or rain depending on elevation and seasonal temperature fluctuations (Figure 3). The FL range receives the least precipitation during the year (33-53 cm). The HMT range receives between 48 and 69 cm of precipitation annually, while the APP range receives between 58 and 77 cm.

In some cases there are probably relationships between the placement of prehistoric stone structures and wind speed, and direction. In general a west-southwest wind direction prevails for much of the GRSLE project area. Valley shape, aspect, and over-story vegetation influence local wind conditions.

Table 1
Temperature Data by Physiographic Range Type for the GRSLE Project Area

Maximum Temperature								
	F°	C°		F°	C°		F°	C°
Range	LF			HMV			APP	
1800 masl	81	27	2500 masl	71	21	3000 masl	63	17
↕	79	26	↕	69	20.5	↕	61	16
	77	25		67	19.5		59	15
	75	23	3000 masl	65	18		57	13
2500 masl	73	22				4000 masl	55	12.5
Minimum Temperature								
Range	LF			HMV			APP	
1,800 masl	7	-13.9	2,500 masl	9	-12.8	3,000	5	-15
2,500 masl	9	-12.8	3,000 masl	7	-13.9	↕	3	-16
							1	-17
							-1	-18
						4,000	-3	-19.5
Average Annual Temperature								
Range	LF			HMV			APP	
1,800 masl	41	5	2,500 masl	35	1.5	3,000 masl	29	-1.7
↕	39	4	↕	33	0.6	↕	27	-2.8
2,500 masl	37	2.75	3,000 masl	31	-0.6		25	-3.9
						4,000 masl	23	-5

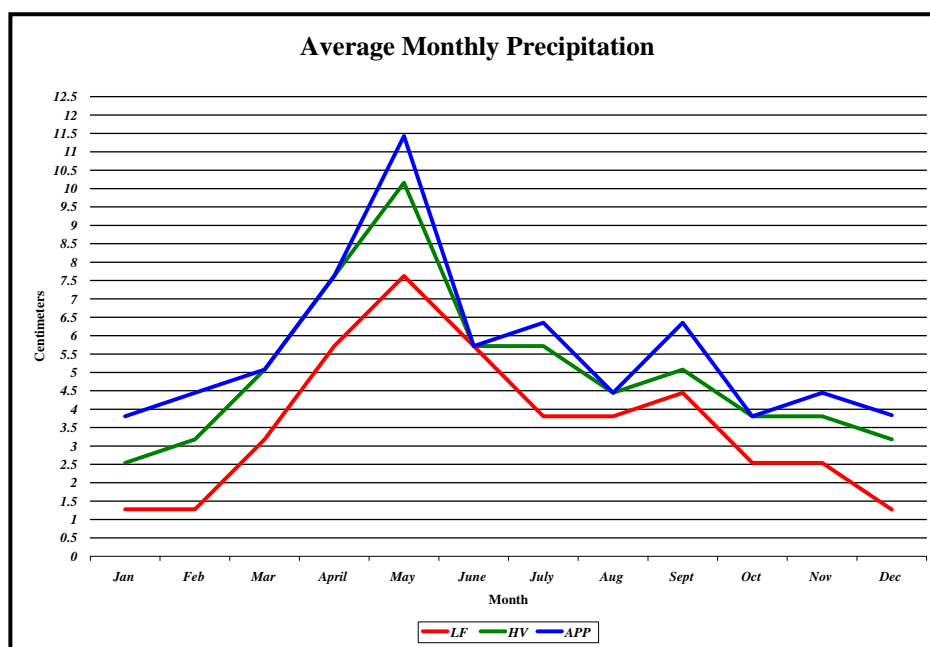


Figure 3. Average monthly precipitation in the GRSLE project area derived from PRISM data.

Specific landscape features often determine the actual direction and speed of ground-level winds. Benedict (2000:21) noted that lee eddies starting at the upper western margins of the Continental Divide at Devils Thumb Pass in the Roosevelt National Forest can cause air to circulate like water in a “plunging breaker.” These conditions are not dissimilar to those of the upper cirques and valleys in the GRSLE area. The open aspects along the east/west-trending ridges are characterized by the prevailing westerly wind patterns. Season and time of day both influence wind speed and direction. For example, during the winter months there are periods during which wind speeds can reach 50-65 km/h with gusts reaching 80-95 km/h (Curtis and Grimes 2004).

Paleoclimatic Trends

Prehistoric use of the GRSLE area must be discussed within a framework of recent paleoclimatic trends. These trends are hierarchical and interdependent both spatially and temporally. Regional trends through time oscillate depending on large-scale circulation controls influenced by seasonal solar radiation fluctuations that are ultimately a function of global axial tilt (Whitlock and Bartlein 1993:231, 234). These relatively slow and stable seasonal circulation patterns are then superimposed on the complex topography of a region. The complexity of the topography controls the amplitude of the seasonal fluctuation of precipitation and temperature. Thus, within a particular region there is a topographically mediated mosaic of climatic patterns which influence micro-environmental characteristics and biotic potential.

Large-scale patterns of precipitation and temperature throughout the last 13,000 years influenced both abiotic and biotic conditions within the GRSLE project area and drove landscape-use patterns at millennial scales (Beaudoin and Oetelaar 2003; Whitlock and Bartlein 1993). However, the heterogeneous topography within the area probably played a dominant role in seasonal-use potential for mammal populations (Coughenour and Singer 1996; Hughes 2000; Reider et al. 1988). Paleoclimatic data for the GRSLE project area are primarily inferred by proxy from the GYE, the Bighorn Basin, and other surrounding areas, and include pollen records and pedological data.

Through the end of Pleistocene the central Absarokas were acted on by Illinoian and Wisconsin glaciers, more specifically the Bull Lake (149,000-45,000 thousand years ago (kya)) of the former period and the Pinedale (25,000–11,000 kya) of the latter period (Breckenridge 1974; Chadwick et al. 1997:1443;

Reitze 2004). These two events are probably most responsible for reworking the incipient Absaroka plateau. Visual proof of this reworking is evident in the Upper Greybull ecosystem and consists of the numerous high hanging valleys and deeply incised drainages.

During the terminal phases of the Pinedale glaciation temperatures were probably 10-13 C° colder than at present (Knight 1994:16). The once extensive ice cap covering the Yellowstone plateau had disappeared during the Pinedale and many even alpine glaciers were receding (Eckerle 1997). Climatic conditions during this interglacial period were both complicated and variable. Isotope data from the high plains suggest a wetter environment during the Younger Dryas from 12,900-11,600 radio carbon years before present (rcybp) and a return to cooler temperatures (Lovvorn et al. 2001:2488). This time period also corresponds with the Temple Lake glaciation in the central Absaroka Mountains (Reitze 2004:67). Alternately, pollen data from the GYE suggest that temperatures were relatively warm based on the rapid reforestation of sub-alpine areas (Whitlock and Bartlein 1993), with treelines ascending perhaps as much as 1200 m from late glacial periods (Baker 1983). While the northern Great Plains were experiencing cool and wet conditions, the GYE and Absarokas were apparently not receiving precipitation inputs from either glacial anticyclones or Gulf monsoons (Lovvorn et al. 2001:2488). Thus, the early Holocene was a transitional period that witnessed the expansion of pine forests and presumably somewhat wetter conditions until the onset of the much warmer and drier conditions of the Altithermal period.

It has been suggested that Altithermal xeric conditions (ca. 8,200-5,000 rcybp) on the high plains resulted in decreased use of the plains and a corresponding increased use of mountain environments by prehistoric human populations (Antevs 1955; Benedict 1979; Frison 1975; Meltzer 1999). Accumulations of illuvial calcium carbonates in soils of this time period in the Wyoming Basin, along with general mobilization of sand dunes and increased evidence of hillslope instability, suggest an overall reduction of surface biomass in the form of vegetation (Eckerle 1997). Benedict (1979) describes two potential periods of intense drought on the high plains from 7000 to 6500 rcybp and 6000 to 5500 rcybp that resulted in the use of the mountains of the Front Range of north-central Colorado as a subsistence refugium. Similar scenarios could have occurred among Wyoming Basin populations with the establishment of refugium areas in the Wind River and Absaroka Ranges. Evidence from the soils of the Dead Indian Pass area suggests dry conditions probably prevailed in some locations for some or all of the Altithermal period in

the central Absaroka Mountains (Reider et al. 1988:194-195). Additional corresponding evidence from woodrat middens suggests arid conditions in the Bighorn Basin immediately to the east of the project area (Burnett 2005:9).

A transition to more mesic conditions and neoglaciation occurred in the GYE sometime after 5,500 rcybp and lasted until around 2,700 rcybp (Burnett 2005). A brief return to xeric conditions in the Bighorn Basin after 2,700 rcybp is juxtaposed against Temple Lake alpine glaciation in the Wind River Range (Burnett 2006; Reitze 2004). The Temple Lake neoglaciation probably extends back further in time and may have co-occurred with both Younger Dryas and Altithermal episodes in the Upper Greybull Ecosystem (Reitze 2004). A second phase of alpine neoglaciation, the Gannett Peak Stade, occurred much later and corresponds with the Little Ice Age (ca. 270-160 rcybp). Current glacial conditions persist in the area in the form of ice-core rock glaciers (William Reitze, personal communication 2007)

Flora

Upper Greybull River ecosystem landscapes are characterized by patchy mosaics of vegetation. The distribution of patches and aggregations is determined by many factors including climate, competition, nutrient and moisture conditions, disturbance histories, soils, geologic substrate and topography (Johnson et al. 2004:872; Knight 1994:183). Vegetation zones grade from the LF grasslands and shrublands, to the HMV zone of meadows, parks, and woodland forests, to the APP zone which is comprised of alpine tundra species (Knight 1994:159).

The uppermost zone, the APP, is composed of low-standing forbs, lichens, shrubs, and a few diminutive trees. A study conducted on the slopes of nearby Carter Mountain found the most basic and abundant plant types to be forbs, grasses, and sedges. Four genera make up 54% of the standing vegetation and include perennial herbs *Trifolium* (18%), *Geum rossii* (15%), *Phlox* (12%), and *Poa* (9%) (Thilenius and Smith 1985:3). However, significant species variability is to be expected across the project area. Lichens occur on most rock outcrops. Common lichens include *Lecidea atrobrunnea*, *Rhizocarpon geographicum*, and *Sporastatia testudinea* (Eversman 1995). Most of the biomass is located below ground (Knight 1994:205). Shrubs are represented by big sage (*Artemisia tridentata*). At treeline, tree species are diminutive and include Engelmann spruce, subalpine fir, Douglas-fir, limber pine, and whitebark pine.

Krummholz, a form of growth where dense lower branches of spruce or fir trees are protected by winter snow, is less prevalent in this area than many other similar parts of the Central Rockies (Knight 1994:201-202).

The high valleys (HNV) vegetation zone includes similar forbs and sedge species as the APP, but these areas are often more densely populated. Idaho fescue (*Festuca idahoensis* Elmer) and tufted hairgrass (*Deschampsia caespitosa*) are common. Lichens are present both on surface exposures of rock and on the soils at the surface. Once again, big sagebrush is common. Isolated groves of pine-fir forest include Engelmann spruce, Rocky Mountain fir, limber pine, whitebark pine. Tree islands are more common and dense on north facing slopes, and along water courses where late lying snow delivers more effective moisture. Many of these stands are, at present, heavily stressed by persistent drought conditions and consequently have become infested with pine beetle, which contributes to fire risk.

The lowlands and foothills zone is generally more mesic and consists of shrublands, grasslands, and woodlands. Sagebrush grasslands dominated by big sagebrush. Mixed grass prairies occur on the small plains between the dissected foothills. Dense forests with mixtures of pine-fir and juniper stands are located along water courses and on north- and east-facing slopes. Riparian zones are dense, with mixed shrubs and cottonwood trees.

Fauna

The GRSLE project area supports a wide variety of animal life. Artiodactyl species include pronghorn antelope (*Antilocapra americana*), bighorn sheep (*Ovis canadensis*), elk (*Cervus elaphus nelsoni*), mule deer (*Odocoileus hemionus*), and a few moose (*Alces alces*). Bison were present in this area prehistoric and protohistoric periods, even at high elevations (ca. 3330 masl) as evidenced by faunal remains located in the upper reaches of Jack and Piney Creeks (Burnett 2005; Lawrence Todd, personal communication 2007). Recent evidence from the Uinta Mountains of Utah suggests that bison could have ranged much higher (Cannon 2007). Both domestic cows and sheep were present historically, and cattle ranching is still an important economic use of GRSLE project area.

Large predators are making a comeback in this portion of the Central Absarokas. Grizzly bears (*Ursus arctos horribilis*), black bears (*Ursus americanus*), and a pack of gray wolves (*Canis lupus*) are all

present in small numbers. Medium-size predators occupying the project area include coyote (*Canis latrans*), red fox (*Vulpes vulpes*), bobcat (*Lynx rufus*).

Other medium and small-size mammals include the snowshoe hare (*Lepus americanus*), mountain cottontail (*Sylvilagus nuttallii*), yellow-bellied marmot (*Marmota flaviventris*), golden-mantled ground squirrel (*Spermophilus lateralis*), whitetail prairie dog (*Cynomys leucurus*), pika (*Ochotona princeps*), northern pocket gophers (*Thomomys talpoides*), voles (*Microtus* spp.), and mice (*Perognathus* spp.) (Burnett 2005; Burt and Grossenheider 1976; Zeveloff and Collett 1988).

This study deals with the recently identified high altitude stone structure sites in the GRSLE project area. The functions of these structures are not well understood, and the body of research conducted on similar sites is largely framed in terms of assumed functions (e.g., hunting, ceremonial localities, location markers, architectural remains). The goals of this thesis are to provide description and analysis of the sites, and to present possible ways to use structure attribute data to examine patterning among structure types and distributions. A description of the environmental characteristics of the GRSLE project area was provided to describe the landscapes types that surround the sites. The following chapters are intended to provide necessary background information with regard to the bodies of related research and analytical methods that allowed the sites to be contextualized, described, and analyzed.

Chapter Summaries

Chapter 2 addresses some aspects of human use and alteration of the environment with heavy reliance on analysis of systems traditionally ascribed to hunting technologies. Unlike the present research area in the Absaroka Mountains, the high country of the southern Rocky Mountain along the Continental Divide has been intensively investigated for many years. Consequently, many of the comparative data and associated functional interpretations of non-domestic high altitude stone structures are derived from investigations within Southern Rocky Mountains of Colorado. First, aspects of generalized hunting strategies are discussed and placed within the context of human landscape modification for the purpose of procuring game. These systems include jumps, climbs, pens, corrals, and nets as well as perishable traps. Second, the stone structures that occur in the Southern Rocky Mountains, specifically those along the

Continental Divide, will be discussed. Third, the attributes of structures that have been identified within the area encompassing the GRSLE project area, specifically the Greater Yellowstone ecosystem (GYE), and the Absaroka Mountains, will be discussed. Third, potential non-hunting related functions will be presented.

Chapter 3 presents a brief discussion of the middle range theoretical goals. This is followed by description of the field methods used to locate and record the sites. Finally, the data categories and the methods used to acquire them are discussed in detail.

Chapter 4 summarizes the results of the field investigations and presents the data collected for the structures at each site. The summaries begin with site-specific environmental descriptions. Next, the attributes for individual structures and associated artifacts from each site are presented. When possible, temporal associations are included. Finally, a discussion of potential associations for the seven GRSLE sites is provided along with functional suppositions for the structures themselves.

Chapter 5 synthesizes the results of the project beginning with a review of site form data from sites with stone structures in the region. Next, the replicative structure construction is discussed and the data collected for the GRSLE structures are compared against the experimental labor investment data. The data from the proposed topographic signature are compared for the GRSLE structures and discussed in terms of developing regional correlations. A GIS is used to investigate patterns within and among the GRSLE stone structure sites. A brief discussion of the prehistoric chronology of the GRSLE area, based on ongoing investigations, allows for preliminary placement of these stone structure sites within the local archaeological record. Conclusions consist of a discussion of the results and the potential for future research of high altitude stone and wood structures and data that would be needed to link the sites to cultural phenomena.

CHAPTER 2

LITERATURE REVIEW

Landscape as a Tool: Hunting and Landscape Use

The GRSLE structures represent a direct and perhaps quantifiable expenditure of energy. In some cases, such as the Pickett Creek Site, energy expenditure appears to have been significant. Presumably, labor was invested in building the GRSLE structures for a purpose. However, these functions remain elusive. In some cases a variety of potential functions should be considered for the sites because they may have been constructed over long periods of time by different groups of people, and/or they may have been used for more than one type activity.

Comparative research and subsequent pattern recognition rely on identifying similar feature and site types within the archaeological literature. To date, the majority of high altitude non-domestic stone structure research has focused on functions associated with hunting. Thus, the literature reviewed here is weighted towards hunting techniques that result in modifications of the landscape. Comparative data are drawn from game drive sites along the Continental Divide of the Colorado Front Range, and sites within northwestern Wyoming. Non-hunting related functions are also discussed.

Generalized Hunting Strategies: Encountering and Intercepting Game

Binford's (1978b) study of the Nunamiut hunter-gatherers in Alaska focused on collecting ethnographic information about hunting strategies that could be used to analyze patterns in the archaeological record. The following formulation of encounter and intercept hunting strategies is drawn from this research.

Encounter Hunting: Encounter hunting strategies are largely opportunistic. Hunters do not go into the field with a formally constructed plan or targeted species of prey and the locations of the game are unknown. Thus, hunters hoping to encounter game must cover a wide geographic area. Hunters' predictions of game locations are vague and may be based on observations from a previous year (Binford

1978b:169). Binford's (1978b) Nunamiut research indicates that a successful encounter hunting expedition has a two-fold purpose that includes procurement of expedient meat and acquisition of up-to-date information about the timing and movement of prey species (Binford 1978b:196). This type of hunting is flexible. Hunting techniques are adapted on the fly based on the types of prey that are encountered. The size and make-up of a hunting party are customized for the hunting situation (McCabe 2002:132). Encounter hunting is expected to leave a relatively small archaeological footprint, because smaller numbers of game are taken from a spatially expansive area (Benedict 1990:59).

Intercept Hunting: Binford's (1978b) research suggests that intercept hunting is more likely to be a preplanned event that relies on up-to-date information and longer-term, culturally encoded pattern recognition. The observed patterns are then used to target specific areas on the landscape. The hunter employs knowledge based both on personal observations and stockpiled cultural capital. Cultural capital includes a historic knowledge of the landscape and associated prey behaviors (Frison 2004). This knowledge allows the hunter to make predictions about the general location of animals based on conditionally, temporally, and/or topographically constrained sets of variables (Binford 1978a:330). Intercept hunting is enhanced by the hunter's ability to choose a position on the landscape that maximizes both the monitoring and killing potential for a given area where game is expected to aggregate (Benedict 1990:59; Binford 1978a:330).

A key element of Nunamiut intercept hunting strategy is the hunting stand or station. Stations sites are selected because they have particular attributes that allow hunters to locate and monitor prey (Binford 1978a:330; 1980:12). Monitoring activities may co-occur with encounter hunting (Binford 1978b:171). Prehistorically, stations would have served only as observation points. With the introduction of guns the stations may become the locations from which kill attempts are made. Binford (1978b:170) suggests that the best Nunamiut station locations combine two conditional elements: 1) access to prominent overlooks, and 2) places where a break in the topography, such as a ridge top, a steep grade, or a river crossing cause hunters to make a change of pace (i.e., places where a hunters may tend to stop temporarily). Ultimately, the stations are used to preplan an intercept hunting event. Stations sites are expected to leave an archaeological footprint as the result of tool maintenance and subsistence activities. Station locations

used by historic and modern hunters are immediately recognizable by the accumulations of spent cartridges and other associated trash.

Driving Large Game Animals

Traps, jumps, corrals and other such systems involving game drives served as a pragmatic response to the difficulties of game procurement. These systems allowed prehistoric hunters to limit the overall risk of an unsuccessful hunt by reducing uncertainty with respect to proximity, speed, and latitude of prey animals, and thus insure a better return on labor investment (Driver 1990; Frison 2004; Miller 1976:27-30; Spiess 1979). Constructing systems to take advantage of both natural topographic features (arroyos, narrow canyons, ridge top passes, natural pinch points) and the behavior of game animals (e.g., the propensity of Big Horn sheep to run up hill when threatened) allowed past hunters to create a higher expectation of subsistence security. These techniques are often assumed to have been coupled with communal hunting (Benedict and Olson 1978:5, 1996:1-6; Driver 1990; Frison 1970:5-6, 1987). Ethnographic evidence that supports the use of group hunting is widespread. A variety of game driving techniques is associated with communal hunting (Benedict 1996:3; Driver 1990:15-17; Grinnell 1972; Spiess 1979).

Drives Lines: Drive lines are arranged to funnel prey animals along a predictable trajectory. The drive lines might converge at some point, or simply redirect game along a preplanned course. Drive line courses can incorporate features of the natural landscape, such as ridges, swales, stone outcrops, scree slopes, steep hillsides, cliffs, marshy areas, and bodies of water. Various elements can be used to modify the natural landscape. These elements can include stone, wood, brush, cordage, nets, piles of soil, vegetation, or even snow (Benedict 1996; Brink and Rollans 1990; Frison 2004; Grinnell 1972; Kehoe 1973; Loendorf and Stone 2006; Spiess 1979). These added elements function either to aid in directing the prey, or to limit the movement of the animals prior to the kill.

Until recently, the technique of hunting large prey such as reindeer and caribou using game drives was widespread in northern latitudes of North America, Europe, and Asia (Gordon 1991). Some of the best descriptions of game drive hunting techniques are provided by researchers working with Arctic hunters of the recent past (Gordon 1991, Spiess 1979). These hunters constructed stone, wood or brush boundaries

along the drive lines that are referred to as alternately as sewels (Spiess 1979:123), deadmen (Brink and Rollan 1990:155), or *inukshuit* (Spiess 1979:105; Benedict 1996:3). Elements are sometimes added to the tops of the sewels, such as moss, tassels, flapping cloth, or vegetation. (Benedict 1996:3; Blehr 1991:313; Spiess 1979). The additional elements create motion that help the hunters see the drive lines, and mimic the movements of humans, thus directing the animals (Benedict 1996:3). Some of the Arctic hunters participate in the event by driving animals along the drive lines. Other hunters, aided by the sewels, attempt to contain prey within the drive lanes. Ultimately, the hunters await their prey at or near pre-selected ambush points (Benedict 1996; Spiess 1979). Thus the drive acts as a means of decreasing risk and increasing yield on invested energy (Driver 1990:21).

Jumps: On the Plains, jumps are typically associated with procurement of bison (*e.g.*, Brinks and Rollans 1990; Frison 1970; 1991, 2004; Morris 1990; Reher and Frison 1980). However, jumps were also used to kill other species including elk, deer, and pronghorn (Frison 2004; McCabe 2002:132). A jump presumably involves coordination of numerous individuals to control the drive lines. The operators worked the prey into position and then used the natural herding and flight behaviors of the animals to cause them to run off of a precipice. The fall resulted in significant injury or death. Jump locations are identified by the presence of drive lines, a cliff or steep hill, and accumulations of bone at the base of a cliff (Frison 2004:79). Some jumps were non-lethal and terminated in holding pens or natural sinks, such the Vore site (Frison 2004:83; Reher and Frison 1980). Many of the most effective jumping points exhibit intensive long-term reuse. For example, the Logan Buffalo Jump in Montana was apparently used for thousands of years of based on the association of deeply stratified bison bone deposits with diagnostic projectile points (Frison 2004:80). Jumps number in the hundreds throughout Wyoming, Montana, and Alberta and have been identified in Texas, Colorado, the Dakotas, Idaho, Manitoba and Saskatchewan (Frison 2004:80).

Traps: Hunting techniques where animals are partially or completely immobilized in small confined areas are considered traps. The hunters might use natural features of the landscape to contain prey animals (Frison 1973, 2004; Spiess 1979). Investigations into these sites must determine what landscape features were present in the past, and how they contributed to the accumulation of archaeological remains (see

Frison 2004:70). Examples of natural traps include arroyos, canyons, dune blowouts, deep snow banks and river crossings, lakes and shorelines, and bogs, or any location from which game either had difficulty escaping or became incapacitated (Blehr 1991:315; Frison 1987:185, 2004; Nabakov and Loendorf 2004:169; McCabe 2002:130; Morris 1990:201; Spiess 1979:104). Natural traps can be difficult to identify archaeologically unless a large amount of bone is left behind. The Kaplan-Hoover and Hawken arroyo kill sites are two good examples of natural traps with dense bone beds (Todd et al. 2001, Frison et al. 1976).

Constructed traps also occur in archaeological settings. Prehistoric Scandinavian hunters trapped reindeer in timber-lined pits (Gordon 1991:292). Constructed traps are discussed by Frison et al. (1990). These structures were used to contain bighorn sheep, and were built using wood and stone elements. The sheep traps are discussed in detail below.

Hunters using both natural and constructed traps probably employed driving techniques to force game into the traps. Prey may have been driven to the traps using constructed drive lines. Alternately, when the conditions were right hunters using arroyo traps might have utilized stream channel depressions as natural funnels (Frison 2004:69). Once trapped the animals could be killed with projectile weapons, thrusting spears or clubs (Frison 2004).

Corrals: Corrals, also known as pounds, were probably constructed in conjunction with drive lines similar to those employed at jumps and traps. Drive lines helped the hunters direct prey into an artificially constrained area. Corrals are often difficult to identify archaeologically if they have any great time depth because they were typically made with perishable materials (Frison 2004). However, a few prehistoric corrals have been identified by the presence of postholes (Frison 2004:90, 135). Some clues about the corral use are provided in ethnographic accounts from the Arctic (Blehr 1991:313-315; Gordon 1991:293; Spiess 1979:112). These structures are described as consisting of a complex of wing-shaped drive walls, a chute, and a circular pound made of interlaced wood or stacked brush materials Frison 1973:8, 1978:255; Kehoe 1973:172-178). Corrals allowed hunters to kill animals in a variety of ways, similar to those discussed in relation to natural traps. The corral was also probably used to run game in a circle until they tired, making them easy to dispatch (Benedict 1996:1). Corrals could be expected to incorporate elements of the surrounding landscape to reduce investment of labor without compromising effectiveness. Kehoe

(1973:3) suggests that one might expect to find corrals in areas where plentiful supplies of wood or brush are present, and jumps when a cliff was available.

Other Techniques:

Pinch Points and Ambush: The use of ambush areas and pinch points is often inferred rather than archaeologically proven. Many of the Continental Divide game drive sites are assumed to have used blinds as ambush locations for acquiring game (see Benedict 1985, 1996, 2000; Benedict and Olson 1978). Pinch point and drive systems are often located near a large grazing area, adjacent to a long, gently sloping ridge that gradually narrows before terminating at a natural barrier (Benedict 1996:18-20; Morris 1990).

One good example of an ambush tactic is drawn from Shoshonean groups that were known to hunt in and around the GRSLE project area. Loendorf and Stone (2006:140-142) describe a tactic used by the Mountain Shoshone, also known as the Sheep Eater Indians:

...In early spring, capitalizing on their knowledge and working as a team, a group of hunters would locate talus piles of basalt or other dark-colored rock from which the snow had melted but where, at the bottom of the slope, there were patches of fresh new grass that represented prime forage to hungry bighorns. On such a rocky slope, about two or three hundred feet above the fresh grass, hunters would construct hiding places by stacking boulders in a circle to make pits or blinds. After putting branches and dead wood over the top of such a pit, which was typically four to five feet in diameter and three feet deep, several of the hunters would conceal themselves and await the arrival of their prey.

Meanwhile, the remaining hunters and their dogs would locate a group of sheep farther down the slope and begin to approach them from below. They would walk slowly into the open, in a quartering direction, until the sheep noticed them. Once the sheep were alert to the possible danger and were becoming skittish, the hunters would howl like wolves and urge their dogs to charge. Afraid of the dogs and confused by the howling, the frightened sheep would move rapidly upward onto the rocky talus where the hidden hunters waited, revealing themselves only when the sheep were within range of their bows and arrows.

This ambush tactic could have been accomplished with only a few hunters. Also, minimal modification of the landscape was needed. The use of a talus slope would reduce the overall mobility of the prey.

Snares: Historic ethnographic accounts of Arctic hunters illustrate an extremely common trapping technique based on the use of rawhide or willow snares (Spiess 1979). The Tikkerarmuit Eskimos were witnessed setting willow snares that were roughly the height of the deer (caribou). These snares were set in double rows in the shape of a corral (Spiess 1979:106-107). Eye witnesses reported that it was possible for more than one caribou to be caught in a single snare. Expediently constructed snow walls limited the movement of the caribou so that a small number of hunters could drive the game back and forth through the snares (Spiess 1979:107). Other techniques include attaching logs to the snares (Benedict 1996:1). The logs would drag behind the snared animals, and eventually become entangled in underbrush. Frison et al. (1986:356) indicate that the Pomo used snares (in conjunction with nets) to capture elk and bears. A snare that he believes is associated with small game trapping was recovered from a cave in southwestern Wyoming (Frison 1991:264-265). Ideally, archaeological research may need to develop ways to target other explanations for prehistoric big game hunting techniques, especially those techniques that relied on perishable materials.

Nets: Most nets recovered in archaeological settings are associated with trapping of small animals (Frison et al. 1986:354; Benedict 1996:1). However, the basic function of the net is the same for both large and small prey. A net is stretched across the area where the game will be driven. Once the animals become entangled in the netting the hunters can capture or kill them. The nets may have been affixed to the ground via stakes or may have been hand-held. Great Basin groups, for example, conducted jackrabbit drives with nets suspended on poles (Benedict 1996:1).

There are a few accounts of big game netting from the West and Northwest which date to the historic period. Frison et al. (1986:353-358) report that California groups including the Western Mono and two Youkut groups practiced hunting with nets. The Klikitat and Unatilla from the Columbia Plateau region may have also used nets.

Only one complete net has been reported in Central and Southern Rocky Mountains region. This net was recovered by people hiking on Sheep Mountain east of Cody (Frison et al. 1986). It is a late Paleoindian artifact with a 2-sigma age of 9528-10369 rcybp. Frison and colleagues (1986:355) suggests

that it is associated with hunting of game species such as pronghorn, deer, or bighorn sheep. Also, numerous small fragments of cordage that were woven into netting were recovered from Mummy Cave (Husted and Edgar 2002:68).

Frison et al. (1986) speculate that big game hunting nets would need to be large, and made of relatively heavy materials like the juniper cordage of the Sheep Mountain net. Big game nets may have functioned either to contain prey animals or to make them lose their footing and become disoriented (Frison et al. 1986). Ethnographic accounts reported by Frison et al. (1986) suggest that the nets were used to form corral areas. These corrals were set up during the evenings on known deer trails. The hunters would then return in the morning and kill the captured animals (Frison et al. 1986:356). It is possible that the Sheep Mountain net was used in a similar manner, and perhaps in conjunction with game drives.

Continental Divide Drive Lines of the Colorado Front Range (Figure 4)

The spatially extensive networks of stone structures found along the Continental Divide of the Colorado Front Range are truly unique. Approximately 50 systems of stone structures have been identified. Numerous investigations of these structures have been conducted over the last 30 years (Benedict 1975, 1981, 1985, 1990, 1996, 2000, 2005; Benedict and Olsen 1978; Cassells 1995, 2000; Hutchinson 1990; Morris 1990). Many of the sites have been discussed in books, theses, journal articles, and/or in the published reports of the Center for Mountain Archaeology (Appendix A). Current functional interpretations of these systems suggest that they were used for communal hunting of large game (Benedict 1996:1-6).

The systems range from single stone walls or alignments to complex networks of stone features. The features that make up these game drive systems include low stone walls, alignments of single stones, cairns alignments, circular enclosures, arc-shaped enclosures, and depressions. In general, these systems are oriented to form u-shaped, v-shaped, and funnel-shaped alignments (Morris 1990:200). The walls,

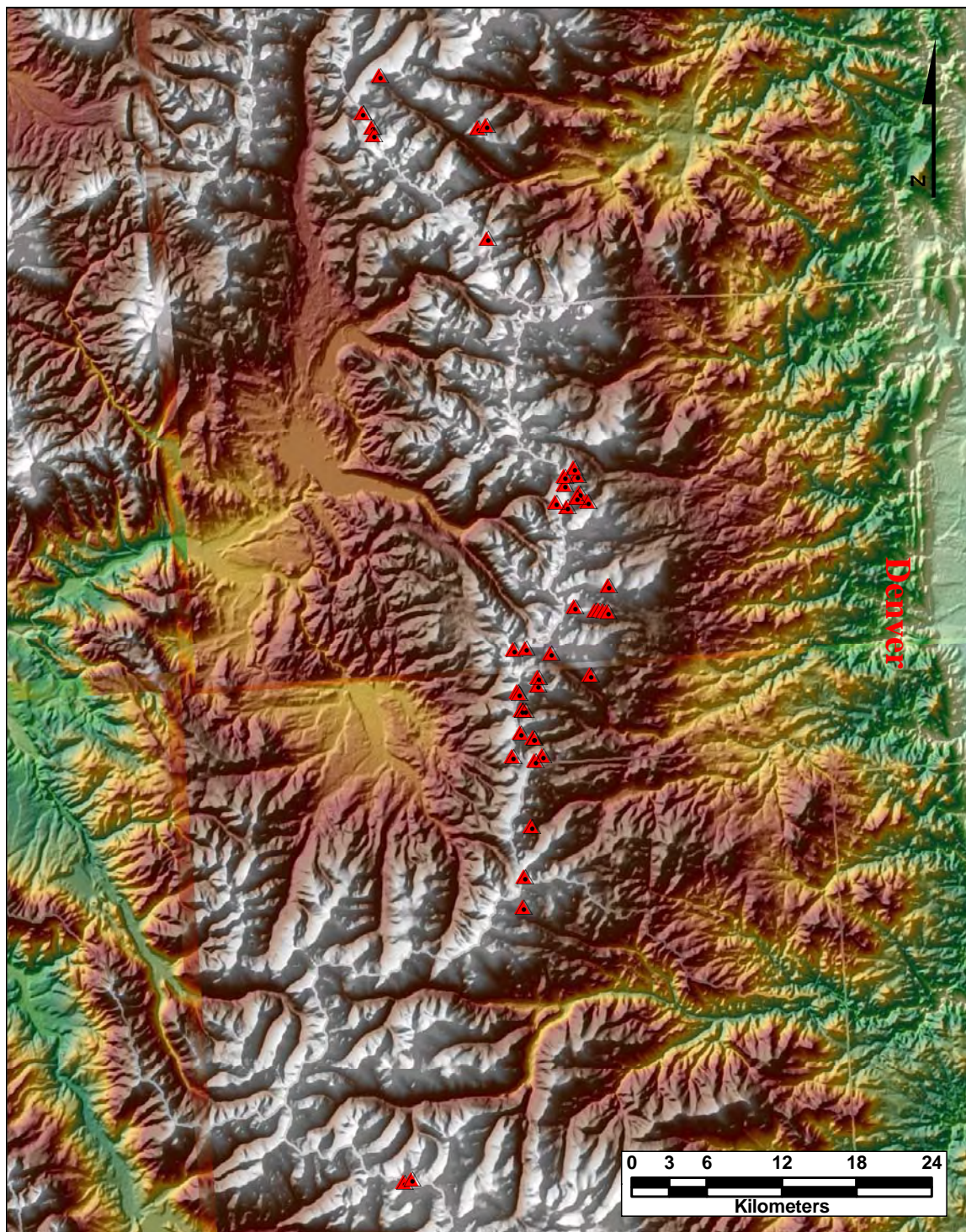


Figure 4. Map showing the distribution of known high altitude stone structure sites clustered along portions of the Continental Divide of the Colorado Front Range near Denver. Site locations are indicated with red triangles.

alignments, and cairns are too low and discontinuous to be considered physical barriers. Instead, the structures are believed to have been persuasive in “drifting” game animals towards a concentration area (Benedict 1985:85; Hutchinson 1990:62; Morris 1990:200). Benedict (1985:85) suggests that this driving technique may have been more effective if the prey were aware of danger but not extremely alarmed. Some of the systems cover extremely large areas and are made up of numerous walls (some over a kilometer long), blinds, and cairns (Benedict 1996:3). Smaller systems consist of a single wall or a blind (Hutchinson 1990:59-60). The systems are proposed to have functioned as drive lines for the procurement of elk or bighorn sheep (Benedict 1996). However, bison procurement cannot be ruled out (Morris 1990).

Often, the term “site” is inadequate, as the systems are amorphous. The structures probably represent multiple activities conducted by numerous groups through time. Particular areas were probably used differently through time (Benedict 1996). Many of the structures have characteristics which suggest that they were repaired, rebuilt, and reoriented through time so that they could be reused (Benedict 1996).

These walls and alignments tend to be sinuous in form. In some cases this sinuous shape may have been determined by the character of the surrounding topography, and the directional needs of the hunters. Hutchinson (1990:43) suggests that the sinuous shapes of the walls at the Water Dog Divide site (5CF373) resulted from the builders’ desire to incorporate prominent bedrock outcrops. Thus the transported stones are aligned between extant outcrops. Walls are typically made of aligned and/or dry-laid stones. Often these walls are only stacked a few stones high (30-50 cm), although slabs of stone placed were sometimes placed on their edges create walls up to 90 cm tall (Benedict 1996:9). Some of the well preserved walls are over a meter high (Benedict 1996:4).

Cairns, composed of stacks or piles of dry-laid stones, are common in high altitude areas. While some are prehistoric, many others have been built by historic and modern humans to mark travel corridors. Some of the prehistoric cairns that are incorporated into game drives may have functioned like the sewels or inukshuit used by Arctic hunters. The only corroborative evidence is in the form of the wooden posts that were incorporated into walls of the Water Dog Divide site (5CF373) (Hutchinson 1990:43).

Semi-circular to circular stone structures are described as hunting blinds (Benedict 1996; Hutchinson 1990). These structures are reported in association with the walls and alignments at nearly all

of the Continental Divide sites. Blinds are located in a variety of locations along the course of the systems, as well as the terminal points where walls finally converge. These structures are constructed by the removal of loose bedrock from an area, which creates a small depression. The loose bedrock is then placed around the outer edge of the depression to create an enclosure deep enough to conceal a hunter. These blinds blend in well with the surrounding landscape because they are constructed of stones from the immediate area (Benedict 1996:4-5; Hutchinson 1990:58). Some of the blinds that have been recorded are quite small, perhaps only big enough for a single hunter, while others are up to 3 m in diameter and could have hidden several hunters (Hutchinson 1990:62).

These systems are generally located at or above the current treeline between 3400 and 3900 masl and these systems tend to be placed on ridges and slopes. In some cases the structures are oriented parallel with the landforms, while others run against the natural contours of the surrounding topography. Benedict (1996:4) suggests that these sites tend occur:

- *...along the Continental Divide, where westward-sloping tundra meadows are truncated by the headwalls of Eastern Slope cirques*
- *On ramps and benches bordered by steep cliffs or unstable scree*
- *On narrow ridges that slope eastward from high-altitude grazing areas*
- *On passes traversed by game animals during their seasonal migrations across the Continental Divide*
- *On floors of cols or saddles used by elk or bighorn to cross interfluves*
- *In valleys where natural obstacles such as lakes, bedrock knobs, and krummholz thickets channeled animal movements*

Additionally, slope and wind direction are considered important for these systems to function efficiently. However, Benedict (1996:4) believes that wind direction was more important than slope.

These sites are sometimes dated through standard associations with diagnostic artifacts such as projectile points. Alternately, Benedict (1996:80-83, 1993) has used two techniques derived from geology to obtain relative stone structure ages. One innovative method involves measuring lichen thali on stones incorporated into a structure. The measurements are compared with known lichen growth rates curves to identify the latest possible construction date. Benedict has also used the baseline decomposition rates of weathering granite to infer potential structure ages.

The most reliable absolute ages are provided by radiocarbon dating. Charcoal has been recovered from blinds and nearby hearths. Radiocarbon dates suggest that drive lines have probably been used from at least the Early Archaic period to the modern era. A 2-sigma age of 6911-7250 BP was returned from a blind on Mount Albion (5BL66) in the Indian Peaks Wilderness (Benedict 1996:6). This blind represents the oldest known game drive feature. However, three Paleoindian projectile points were found on the floor of Devil's Thumb valley near a well known site. These points suggest that older associations are possible (Benedict 1996:6). The youngest date obtained from the Continental Divide sites, 220 ± 60 rcybp, is from the Flattop Mountain game drive (5LR6).

There are no known ethnographic accounts of aboriginal hunters using the game drives systems along the Continental Divide of the Colorado Front Range (Benedict 1985:84). Thus, the functional interpretations of these sites are premised on ethnographic analogy. Two sources of information have been used to explain the functions of these systems. First, investigators have looked to the traditional communal hunting practices employed in the Arctic, as discussed previously. Various groups are known to have placed a heavy reliance on game drives as part their big game subsistence regime (Benedict 1996, 1985; Binford 1978b; Blehr 1991; Gordon 1991; Grønnow et al. 1983; Spiess 1979). Second, ethnographic accounts indicate that numerous Protohistoric and historic Indians, living on Great Plains used game drive hunting techniques (Benedict 1996; Brink and Rollans 1990; Frison et al. 1986; Grinnell 1972; Kehoe 1973; Verbicky-Todd 1984). The descriptions of the game drive systems used by Arctic and Great Plains are strikingly similar. In both areas, hunters constructed funnel-shaped drive walls and alignments to direct prey to predetermined ambush points, jumps, corrals, or traps.

Benedict (1996:3) suggests that these systems represent a specialized adaptation of game drive hunting techniques for high altitude tundra environments. He speculates that, prior to the introduction of the horse, game drive hunting techniques may not have been exceptional (Benedict 1996:3). Rather, these techniques may have been used across much of North America. Benedict believes that although many of these systems could have been constructed at lower altitudes they have not been preserved for two reasons. First, game drive structures at lower altitudes may have disappeared because they were composed of

perishable materials such as wood and brush (Frison 2004:132-133). Second, non-perishable materials used in low altitude game drives may have been destroyed by later agriculture and/or land development. Admittedly, more research needs to be conducted to determine the true archaeological patterning of low elevation drive systems, as their paucity may be a function of archaeological recognition. Benedict (1996:3) argues that game drive structures are preserved in the mountains because they are constructed primarily of readily available stone. Also, the level of disturbance is much lower in the mountains because modern humans are much less likely to occupy high altitude environments.

Stone and Wood Drive Lines in Northwestern Wyoming

There are far fewer sites with linear stone structures in northwestern Wyoming, when compared with the robust sample of stone structure systems along the Continental Divide of the Colorado Front Range. However, according to Frison et al. (1990:210), these sites do exist:

“Between the Paleoindian and Historic periods, there are many site manifestations at higher altitudes for which reliable dates are not yet available. These consist of rock alignments associated with what are probably hunting blinds which cannot yet be dated.”

The high altitude alpine tundra areas that surround the GRSLE project area have not been intensively surveyed. Many more sites with stone and wood structures are expected to be identified in the future. The following discussion summarizes some of the published information about game drives and other high altitude stone structures sites in the GYE, specifically those recorded near the southern Absaroka Mountains.

Sheep Traps and Associated Structures: The majority of well reported game drive sites in the GYE are attributed to trapping big horn sheep (Finley and Finley 2004; Frison 1991, 2004; Frison et al. 1986; Frison et al. 1990; Keyser 1974; Wright and Miller 1976). A number of wooden sheep trapping complexes, perhaps as many as 20+, have been reported in the mountains of Wyoming and Montana (Loendorf and Stone 2006:142). The main elements of the structures were tailored to the local topography to take

advantage of natural landscape features, such as bedrock outcrops or timber stands. The drive lines are constructed of tall interlaced wooden fences. The terminations of the drive lines are described as narrow enclosures constructed with interlaced logs. Frison et al. (1990; Frison 1991:248-250, 2004:147) describe these containment areas as cribs, traps or catch pens. Sometimes the walls of these cribs slope inwards to contain the sheep (Frison et al. 1990, Frison 1991, 2004; Keyser 1974:173). Circular enclosures are often associated with these drive systems. These structures are described as either “shaman huts” or hunting blinds (Frison et al. 1990; Loendorf and Stone 2006). Although these fences and traps are principally made of deadfall wood materials, small amounts of stone and small cairns are sometimes incorporated to fill gaps. These systems are generally presumed to be of Protohistoric or historic age based on the preservation of wooden elements. Even today some of these systems extend over long distances (Frison et al. 1990:211).

There are at least eight similar sheep trapping sites in clustered a small area around the town of Dubois at the southern tip of the Wind River Mountains (Figure 5). Because bighorn sheep tend to flee uphill or to rough rocky slopes when threatened, the drive line systems are oriented so as to allow the game initially to move upslope (Loendorf and Stone 2006; McCann 1956:305; Steward 1938:37). However, as the fences draw together the drives bend back downslope into the catch pen (Frison et al. 1990:218). Sometimes wooden ramps or dirt and rocks are piled up at the entrance of the catch pen. The interior dimensions of the pens range from 4 to 7 m in length and 2.5 to 4 m in width. Some sites, such as Amos Welty 2 (Appendix B), occur at natural passes where game trails exit forested areas. Modern sheep bedding grounds are often situated near the complexes (Frison et al. 1990:223; Loendorf and Stone 2006:143).

Of the sites near Dubois, the Black Mountain, Wiggins Fork, and Indian Point sites all have significant stone structures included along with the wooden features of the drive systems (Frison et al. 1990). Undoubtedly, many drive line systems constructed with wood have been destroyed by forest fires, natural decay, and/or anthropogenic deconstruction. It seems reasonable that in some cases the stone portions of drive line systems are all that is left intact after a fire.

Although they have not been well reported, there at least three stone structure sites in Yellowstone National Park (YNP) (Ann Johnson personal communication 2007). Another unrecorded site in YNP is

reported to include both stone walls and blinds. The Slough Creek Compound (48YE420) is composed of walls, stone rings, cairns and a series of post holes (Hoffman 1953:28-31). As with other such sites, the Slough Creek Compound is tentatively associated with driving game.

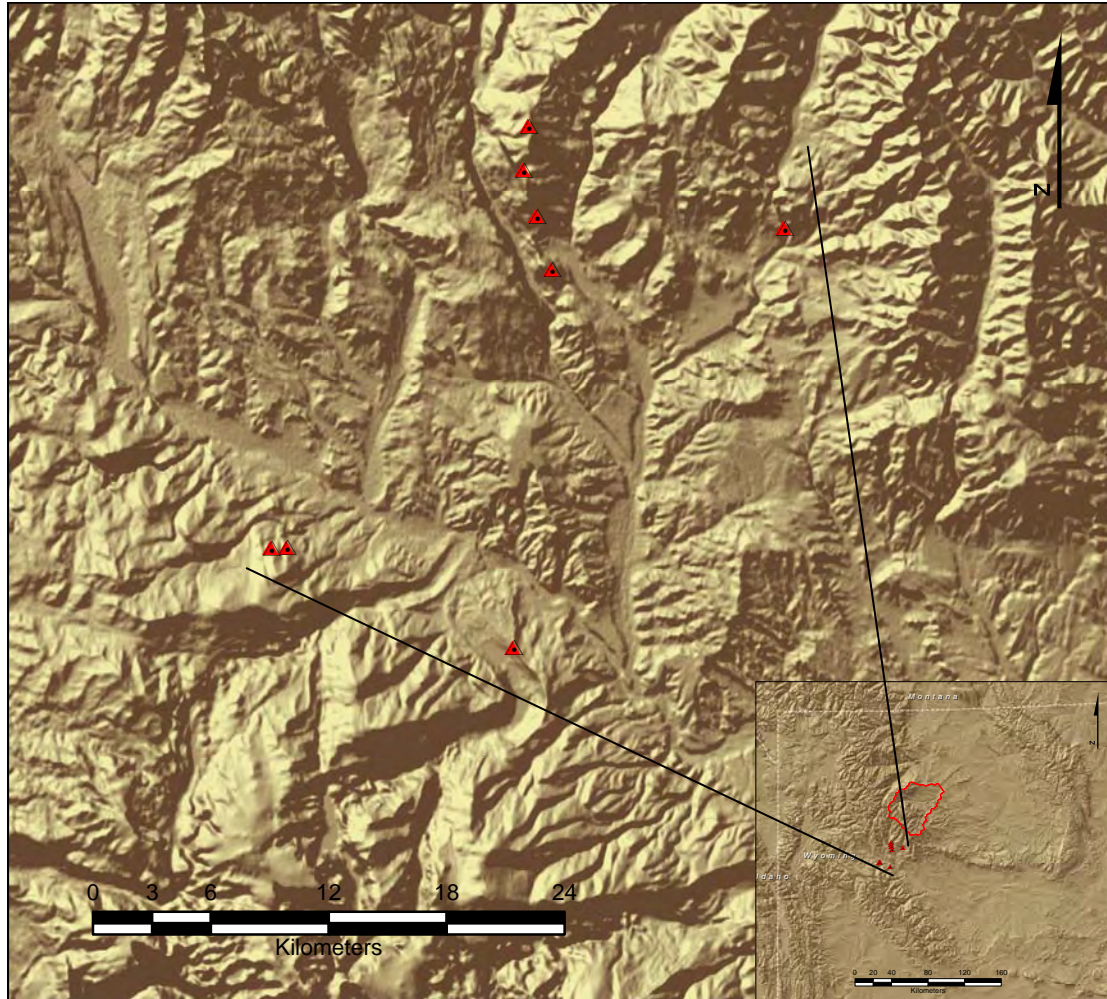


Figure 5. Map shows the distributions of stone and wood drive lines near Dubois, Wyoming.

Boulder Ridge: The Boulder Ridge Sheep Trapping sites (48PA781 and 48PA2646) are located approximately 20 km west of the GRSLE project area. These two systems are good examples of the composite wood and stone game drives. These sites are located at or just above the current treeline within the AP physiographic zone between 3000 and 3050 masl. Frison (1991:248-250) initially described site 48PA781 (presently known as Boulder Ridge South) as a series of discontinuous alignments of stones, cairns, and timber fences that extended over 1.6 km. Several hunting blinds, consisting of “horseshoe-

shaped stone piles,” were observed along the drive lines (Frison 1991:250). Frison (1991:249-250) suggests that the converging alignments funneled game uphill to a bluff.

During the 2003 field season Boulder Ridge was thoroughly reinvestigated by archaeological field school staff and students from Northwest College of Powell Wyoming. These investigations identified a complex of sites on the ridge. The Boulder Basin II fire that occurred during 2003 revealed intense occupations of the Boulder Ridge area during the Protohistoric and historic periods. The following discussion summarizes the information recorded during investigations of the Boulder Ridge Sheep Trapping sites.

Boulder Ridge South Sheep Trapping Site (48PA781): This proposed sheep trapping system is over 1 km in length. The northernmost portion of the system consists of a cribbed timber structure constructed around the base of large boulder (Finley and Finley 2004:16). From this structure, discontinuous and poorly preserved sections of a wooden drive line run south over talus slopes and across narrow saddles. Finley and Finley (2004) believe that a number of locations along these slopes and saddles could have been used to trap or shoot at prey. Some narrow points between boulders and cliff faces may have been bolstered with cribbed log structures.

At least five blinds were incorporated into this system. The first blind is situated near the center of the discontinuous drive lines and consists of a stone circle that surrounds the base of a boulder. The second blind, located at the south end of the discontinuous drive lines, is constructed of timbers and stone slabs. This poorly preserved structure may have been a circular enclosure.

From the second blind, the drive lines continue south over open and flat grasslands. There are two primary alignments in this section, and both are well preserved and continuous. The first is a 250-m-long alignment of timbers and stone cairns. This alignment runs south before bending to the west near the southern end. The second, shorter alignment begins to the west at a small timbered area. This section converges with the longer section at a point approximately 50 m south of the second blind.

A third alignment, located to the south of the “main” drive lines, is oriented east-west. This feature is composed of a single line of partially buried stones. A third blind, composed of circle of stones and timbers, is located at the western end of this structure. The two remaining blinds are located on an

exposed point at the northeastern portion of the site. These two well defined blinds consist of circular enclosures made of stacked stone and timbers.

The jumps that Frison (1991) discusses were reinvestigated. However, no evidence supportive of a jumping game was found. In general, Finley and Finley (2004) indicate that the site probably had multiple use configurations. The discontinuous portions may have been adapted “on the fly” for a range of trapping activities. The well preserved southern sections could have funneled game to the west toward a possible jump location, or game might have been driven into the converging drive lines to the north.

Boulder Ridge North Sheep Trapping Site (48PA2646): This complex of cairn lines, blinds, and timber fences is proposed to have functioned as sheep trapping area (Finley and Finley 2004:33). Structures at this site were placed along a saddle to the north, and run upslope to the south to a ridge crest. The system is broken into two sections.

The southern section, which runs across the crest of the north-south ridge, consists of cairn alignments and four U-shaped blinds (Finley and Finley 2004:33-35). One of these blinds, located near southern end of the site, has a 60-cm-tall wall on the west and a perimeter of single stones aligned in a circle to the east. The remaining three u-shaped blinds run north along the ridge at 20-m intervals. In some cases cairns have been erected in between these blinds to form a barrier.

The northern section is composed of timber structures and two possible blinds (Finley and Finley 2004:33-35). Two timber structures are located on the west-facing slope between the ridge and the saddle. The first of these is a timber corral with a diameter of 50 m. A possible blind is constructed into the eastern margin of this corral. The second is a timber fenceline that runs north from the northern edge of the corral toward the saddle and another blind. The final north-south section of fenceline is situated across the saddle to the north of the blind. These timber structures are situated at the edge of a standing forest, and it seems possible that game animals were driven east through the forest into the corral. Together these two sections of fenceline may have funneled the game that escaped the corral toward hunters waiting in the blind.

Summary of the Boulder Ridge Sites: The Boulder Ridge sheep trapping sites were probably left by Late Prehistoric through Protohistoric Shoshonean groups; where Protohistoric groups are differentiated from earlier groups based on the presence of European trade goods in direct association with traditional Native American artifact assemblages. In particular, these sites are probably associated with the Sheep Eater Indians (Eakin 2007; Finley and Finley 2004). Early accounts of these aboriginal groups from the Yellowstone area resulted in the “myth” of the Sheep Eaters. This myth suggests that the Sheep Eaters were small, dirty, and timid savages who barely survived by living in marginal areas (Hughes 2000; Loendorf and Stone 2006; Nabakov and Loendorf 2004). This image is flatly contradicted both by historical ethnographic evidence and by the richness exhibited in the artifact assemblages of many Sheep Eater sites (Eakin 2007; Nabakov and Loendorf 2004; Lawrence Todd personal communication 2007). While the Sheep Eaters may not have had large numbers of guns, knives and horses, the evidence from ethnographic reports suggests that at least some of them were well outfitted with more traditional technologies and had excesses of both hides and meat (Nabakov and Loendorf 2004:141). Intensive archaeological investigations of the Absaroka region are beginning to reveal a much more robust presence of Shoshone Sheep Eater Indians than was previously known.

Because many of the elements of the Dubois and GYE drive systems are constructed of wood, it can be reasonably inferred that their use and maintenance occurred in the recent Protohistoric or historic time periods. Dendrochronology dates for the Black Mountain, Bull Elk, and Amos Welty 2 sites all yielded relatively recent ages from A.D. ca. 1775-1850 (Frison et al. 1990). Diagnostic arrow points at site 48PA781 suggest a Late Prehistoric age with potential Protohistoric associations based on the preservation of the wooden building materials. However, these sites could have been used and maintained over many centuries, and even longer histories for individual game drive systems cannot be ruled out.

The fires that swept through the timber adjacent to sites 48PA781 and 48PA2646 consumed much of the 20-cm-thick layer of loose pine needles and leaves that covered the forest floor. Resurvey of this burned area resulted in the identification of thousands of artifacts including bone, lithic materials including Shoshone knives, projectile points, and ceramics in association with metal trade points and glass beads (Eakin 2007). These Protohistoric artifacts confirm that the site was used relatively recently by post-contact Shoshonean groups.

Functional Ambiguity and Stone Structures

The true functions of other kinds of stone lines and cairns are more conjectural, but they very likely were not associated with game procurement.

(Frison et al. 1990:210)

It seems probable that some of the non-domestic stone and wood structures located in high altitude environments were used for purposes other than driving and hunting large game animals. These sites often lack definitive temporal and/or cultural associations that would help investigators to answer relevant questions. Field recording methods of ambiguous structures should be premised on collecting as many data as possible in order to allow researchers to fully evaluate the phenomena.

Other Prehistoric Functions

A wide range of functions not directly related to big game procurement has been suggested for high altitude stone structures. Some functions seem unlikely while others merit further consideration. The following section summarizes some the potential functions that have been suggested for high altitude structures including ceremonial functions, eagle trapping, navigation or uses as boundary markers, and semi-residential use and/or caching. These sites may in some instances have modern associations, while in other cases they may not be the result of cultural processes at all.

Ceremonial Functions:

Shaman's Huts: These structures, discussed by Frison and others (Frison 1971, 1991:244-255; Frison et al. 1990:222-238; Loendorf and Stone 2006:143), are described as small wooden and/or stone enclosures. Within the GYE these structures are primarily associated with sheep trapping sites. Frison et al. (1990:238) suggest that the some of the enclosures are not part of the drive systems either because they are located outside of the hypothesized sheep trap drive lines, or because they do not appear to enhance the functionality of the drive system. They suggest that “a strong argument can be made for shamanistic involvement in communal sheep trapping. This is indicated by what are believed to be religious structures

incorporated into drive lines which appear to have no direct functional relationship to sheep procurement.” The presence of sheep skulls incorporated into living trees near the drives is offered as proof of ritualistic behaviors in association with sheep traps (Frison et al. 1990:238).

Ceremonial activities are sometimes presumed to have involved a person who would direct the hunting event. Most reports of these functions are based on ethnographic analogy and speculation. Although specific ethnographic and/or ethnoarchaeological evidence supporting this practice in the Absarokas are not available, there are ethnohistoric reports of hunting-related ceremonial activities among both Plains Indian and Arctic groups (Frison 1971; Grinnell 1972:278; Steward 1938; Verbickey-Todd 1984). For example, among the Assiniboiné ritual offerings were sometimes placed within the pound area. A designated master, or supervisor, of the hunt sometimes took a position within the pound, and remained there while animals were being driven inside (Verbickey-Todd 1984:44). Alternately, an Assiniboiné shaman's tent was sometimes erected near the opening of the pound ceremonies that occurred during the hunt (Frison 1971:87-88). Although no structures are mentioned, Steward (1938:34-36) reports that the Shoshone hunts for antelope and deer were sometimes managed by shaman.

Vision Quest Structures and Fasting Beds: Many aboriginal groups are reported to have constructed U-shaped alignments or low walls in which person would fast in isolation for an unspecified number of days (Benedict 1987; Morris 1990:201; Weimer 2007:35). Ethnographic accounts of vision quest ceremonies and fasting beds are known primarily from Protohistoric and historic era Indian groups (Benedict 1987; Toll 1962). Various groups presumably conducted the vision quest in many different ways. Weimer (2007:36) suggests that a vision quest was conducted either to acquire power, or in the hope of attaining some form of spiritual guidance (Benedict 1922). The locations of these sites are sometimes associated with areas of high visibility such as a mountain crest or high ridge (Hutchinson 1990:63). One U-shaped structure, on Mount Ida near the Continental Divide, is interpreted as a fasting bed based on the shape and orientation of the structure (Benedict 1987:17). However, the structure appears to have been rebuilt in the recent past, and may modern.

Shrine sites are described as having functions similar to vision quest sites. However, these sites exhibit large numbers of artifacts including ceramics, river cobbles, and projectile points that are presumed to be offerings (Benedict 1985; Hutchinson 1990:63).

Medicine Wheels: Another type of structure, typically associated with a ceremonial function, is the medicine wheel. These alignments have been reported in both Wyoming and Montana. They consist of circular stone rings with spokes radiating from a central point (Malouf 1961:381-382). The type site, the Bighorn Mountain Medicine Wheel, is located in the northern Bighorn Mountains. The Wyoming site database contains hundreds of circular structures and many are associated with the term “medicine wheel.” Some of these sites are more recent in origin and may represent Euro-American recreations (Frison 1991:362).

Another structure type that must be mentioned in this group is the Great Arrow (48PA66), located in north-central Wyoming to the northeast of Meeteetse. This large arrow-shaped petroform points to the northeast. Loendorf (1978) has suggested that it is oriented toward either the Bighorn Mountain Medicine Wheel or the rising sun. It seems reasonable in some cases to assume that structures like medicine wheels and arrows are the result of artistic expression but functional characteristics may yet be determined by excavation and further research.

Eagle Traps: The activity of eagle trapping is described by Grinnell (1972:299-307) and others as having purposes related to both ceremony and resource acquisition (Howard 1954). In Grinnell’s account of the Cheyenne practice, eagles were trapped because the feathers were a valuable and tradable resource. The Cheyenne eagle trappers were viewed by their people as exceptional. As stated by Grinnell (1972:299), eagle trapping...“might not be done by everyone, for eagle catchers were regarded as possessing much spiritual power.”

The technique involved digging a small hole or building a small structure of wood and/or stone. This structure was usually only large enough for a single occupant to sit in (Grinnell 1917; 1972:300,302). The top of the structure was usually camouflaged, first with logs and then grass, leaving enough holes to allow the hunter to look out. Bait such as small mammal was placed on the top near a hole. When a raptor

landed and attempted to take the bait, the hunter reached through the hole, grasped the raptor's leg, and pulled it into the enclosure (Howard 1954; Hutchinson 1990:62-63; Morris 1990:201; Grinnell 1972). In Grinnell's (1972:301) description of the Cheyenne technique a thong was looped around the raptor's neck. The other end of this thong was tied to the hunter's foot. The hunter then used leg strength to throttle the bird. Grinnell (1972:304) provides the following descriptions of an eagle trap structure:

"On the highest of three bald hills...two unroofed shelters – eagle pits – of stones and logs, the walls being about four feet high. These hills are about as high as the Tongue River Divide. On two of them are monuments, a few great stones heaped up to a height of four or five feet, and of about the same diameter at the bottom. One of the hills that bears a monument has at the other end of its highest part the eagle pits referred to. These constitute a single structure, or perhaps two adjoining structures, roughly built of the irregular, large, burned rocks which crop out in a ledge on the summit of the hill. Advantage has been taken on this outcrop in building the shelters, and one great rock projecting from the ground to a height of six or seven feet forms the wall of a part of each pit. Other rocks, estimated to weigh several hundred pounds each, appear to be in place. Other stones, large and small, have been used to make a wall for the two structures..."

As described, this structure is similar in size and construction to some of the "shaman huts" described by Frison (1991:253). The placement of the structure on a high point would seem advantageous for attracting large bird of prey (Grinnell 1972:305).

Navigation or Boundary Markers: Benedict summarizes a series of other potential functions that are only loosely associated with ethnographic accounts. Sometimes high altitude structures are associated with aboriginal "forts," or territorial boundaries (Benedict 1996:xiii). However, these associations are uncorroborated speculations. It seems obvious that many of the cairns located at high altitudes are modern navigation aids for hikers. Some have probably been built over cairns with historic and/or prehistoric origins. Cairns and alignments probably served as trail or course markers prehistorically. The use of structures for navigational functions by Indians is supported by ethnographic evidence presented by Toll

(1962:30). For example, stone alignments or cairns that once crossed Estes Park are known to have functioned as navigational aids according to Arapahoe informants (Toll 1962:30).

Semi-Domestic/Cache Features: Two final prehistoric interpretations of high altitude stone/composite structures are mentioned, but are not well supported with the current evidence. It is possible that some small stone enclosures or pits served as small expedient shelters. Some of these structures are large enough to hold multiple individuals (Hutchinson 1990:63-64). However, most campsites with hearths and associated domestic debris tend to occur at lower elevations. Often the proposed residential sites occur along treeline or at the upper forest border where firewood, shelter and water were more readily available (Morris 1990:201-202).

Alternately, Morris (1990:201) proposes that some high altitude stone pits served as meat caches (Hutchinson 1990:63; Morris 1990:201). If too much meat was harvested-perhaps during a game drive hunting event-a possible storage strategy would be to construct a small depression. The meat could then be placed inside and covered with rocks and/or snow. Once frozen the meat or supplies would be safe from both scavengers and decay (Morris 1990:201). Ethnographic accounts of the use of this technique originate in the Arctic and are described by Binford (1983:124).

Modern Associations: Modern land altering activities also result in walls, alignments, cairns and other such structures. Benedict (1996: xiii, 24) has suggests a number of presumably modern functions that should be considered when evaluating high altitude stone and wood features. These functions could include stock fences and or sheep corrals, mine claim boundaries or disturbances related to mining, walls associated with World War I era infantry training exercises, shelters built by modern or historic hikers, and cairns erected as modern trail markers (Benedict 1996:24; Frison 1991:363). Frison (1991:357-361) suggests that some “cairn lines” are probably toss piles created during construction of two-track roads. These toss piles have been observed within the project area (Figure 6). Modern hunters may erect short walls or blinds in high altitude locations to serve as wind breaks, or for other aspects of hunting. For example, the Galena Ridge wall that is discussed in this thesis is a modern wall constructed by a sheep hunter to serve as a windbreak. This modern wall was included as a comparative specimen. As mentioned



Figure 6. Overview of the road leading to Pickett Creek (northwestern Wyoming) showing a modern alignment of stones that were removed during road/ditch construction.

previously, the Mount Ida fasting bed is probably of recent construction based on the fact that stones at the base of the structure rest on modern turf and lichen growth on stone occurs on randomly oriented surfaces of the stones. Benedict (1987:3) speculates that the Mount Ida fasting bed is still used by modern Indians.

Natural Occurrences: It must also be noted that natural processes at high altitudes can result in alignments of stone. Natural freeze thaw cycles can shift stones on a slope into what appear to be unnatural patterns. Periglacial phenomena such as patterned ground can occur as a result of frost heave, and produce areas that are covered with regularly shaped polygons (Benedict 1992: Reitze 2004:72). Nivation hollows, or shallow depressions that form under snow banks, could also be mistaken for constructed depressions, and stone stripes observed in high elevation settings could be easily be mistaken for man-made stone alignments (Reitze 2004:72, personal communication 2007). In some cases, the processes that occur in alpine zones can create block fields that exhibit extremely regular patterns. These block fields were sometimes harvested by prehistoric hunters while building game drives (Benedict 2005: 425). For

example, the stone structure sites in this thesis all incorporate natural elements. Evaluations of the natural background distributions of stone within a site area should be attempted in order to exclude natural features. However, natural features must be included as an important part of the overall site description.

Chapter Summary

In this chapter I addressed aspects of human use and alteration of the environment, particularly those alterations ascribed to hunting technologies. One way to recognize patterns in the archaeological record is to study ethnographic analogs. Binford's (1978b) studies of Nunamiut hunting strategies resulted in two general concepts of prey acquisition that include intercept and encounter hunting. Encounter hunting strategies tend use explicit knowledge about the landscape and prey behavior to reduce uncertainty with respect to the locating and, acquisition of prey. Included with encounter strategies are modifications to the landscape in the form of systems developed to drive prey to predetermined locations; these can include construction of drive lines, jumps, climbs, pens, corrals, and nets and other perishable traps.

The drive line sites along the Continental Divide of the Colorado Front Range have been intensively investigated for many years and provide robust comparative information. Additionally, these investigations have set the benchmark for functional interpretations of non-domestic high altitude stone structures sites. Similar sites and drive systems have been studied within the area encompassing the GRSLE project area, and include the Boulder Ridge sites and the Dubois, WY sheep traps. The sites along the Continental Divide and those in the GYE provide necessary background information for interpreting the results of the field investigations in the GRSLE project area.

Finally, other potential functions for non-domestic high altitude stone structures were presented. While the structure functions may often seem obvious, it is important to consider all of the alternative interpretations before labeling a site. In some cases natural processes should be considered; in others, a range of human behaviors not related to hunting (e.g., those related to ceremony, construction of navigation markers, cache locations, or modern associations) should be considered and eliminated prior making functional interpretations.

CHAPTER 3

THEORETICAL CONSIDERATIONS AND ANALYTICAL METHODS

Theoretical Considerations

Currently, the proposed functions of high altitude stone and wood structures are based on ethnographic analogies and historic associations (Benedict 1996; Frison et al. 1990; Hutchinson 1990; Nabokov and Loendorf 2004; Verbicky-Todd 1984). As such, the current themes of functional interpretations (e.g., hunting or ceremonial uses) are based on creating inferential links using middle range theory. While the interpretations may be correct, the arguments that have been used to develop them have not always been subjected to adequate scrutiny. The categorical assumptions of site and/or structure functions often drive the models that are used to research high altitude non-domestic stone (and wood) structure sites. Thus, when a site with stone alignments and U-shaped walls is located, the information for understanding how it might have functioned as a game drive is usually gathered. Conversely, the information for understanding how the site functioned to guide Martians spaceships to Pomo Indian villages in California is ignored. In other words, our interpretations are self fulfilling, and the result is one-legged middle range stool. A more robust method of archaeological research with respect these types of sites should focus on systematic pattern recognition. At some levels pattern recognition can be accomplished independently of functional interpretations, and comparisons of the individual site attributes can be viewed more objectively.

The compilation of detailed inter-site or regional comparative data sets must begin by cataloging attributes at both the feature and site level. The identification of a topographic signature at one site cannot be effectively assessed for predictive utility without similar systematic data collection at related sites. Viable estimates of labor investment (as discussed in Chapter 5) cannot be obtained without specific and consistent data collection procedures. The goals discussed here are all premised explicitly on extending the linkages between the sites and structures, and the behaviors they represent. While function is acknowledged as an important end point for describing behavior, the identification of patterns related to the

attributes of sites, and the structures recorded therein, is equally important for characterizing aspects of human behavior and cultural variability (Binford 2001:51).

It is acknowledged that the site selection process ultimately controls which attributes are compared and thus biases the comparative results. However, this is always the case and is a function of the questions that are asked. One way to mediate the harsh influence of site selection bias is to cast a wider net when finding sites and areas to compare. Is the variability within a particular area less than or greater than the variability between two areas? Perhaps the narrow definitions that influence what constitutes a site can be reconciled by using smaller analytic units such as the individual features within a “site” as the comparative unit.

Locating Stone and Wood Structure Sites

The sites identified in this project were located using two techniques. The most basic technique was pedestrian sample survey. The second technique for locating structures consisted of conducting interviews with local informants who provided specific site location and background information.

Pedestrian Survey

Areas chosen for investigation as part of this thesis project were delimited by breaks in the topography, rather than divided into standardized geometric area plots (quadrants, triangles, or blocks) (Banning 2002). Transects were terminated at boundaries determined by large-scale landscape characteristics such as macro-scale slope fluctuations, (e.g., cliffs). While it is acknowledged that most designations for survey boundaries are at some level inherently arbitrary, a cliff seems less arbitrary than a section line (Burger 2002:25).

A few areas were subjected to systematic reconnaissance through the use of standard parallel transects 10 m to 30 m wide. The concept of an “adequate” survey transect width is distinctly arbitrary and target-dependent (Reitze 2004:39, Mueller 2007:10). As such, surveys should be conducted at the smallest possible scale for which time allows. Optimal spacing here is considered a matter of practicality, and transect spacing decisions include weighing the size of the selected area and surface visibility components

against the constraints of crew availability, and project budget. It is also worth mentioning that, while maintaining a systematic approach is considered useful for testing the effectiveness of a particular survey strategy, non-systematic survey was also employed successfully in identifying patterns of archaeological surface expressions.

Visual Identification of the Structures

Recognition of stone structures is less a matter of employing an ideal transect width and more a matter of perception and perspective with respect to a particular target. The paradox of recognizing these types of stone structures is that they are both visually obtrusive and, at the same time, potentially difficult to identify. Detectability, as Banning (2002:40) describes, is the potential for failing to discover the target even when it is included in an observation. Thus, the two factors of perception and perspective are of fundamental importance when attempting to locate stone structures. Descriptions of some of the more easily identifiable characteristics of the targets, such as being aware of unnatural alignments or recognizing piles of intentionally stacked stones, could greatly aid crew members with visual recognition of certain types of features. Techniques like stopping from time to time to scan the surrounding area are considered to be advantageous over standard survey methods that tend to focus on a relatively narrow field of view directly in front of the surveyor.

A hybrid systematic/non-systematic approach was used to inventory large areas where no prior surveys had been conducted. Crew members aligned themselves parallel to a ridge crest and spread out to the edges, leaving at least one person on the apex of the ridge crest. Crew members were encouraged to zigzag back and forth to get a closer look at interesting landscape features but were not permitted to cross over the transect of the adjacent surveyor. This technique was flexible in that crew members were not required to stay on a precise transect but instead contoured the landscape to gain the best possible view of the most areas from a variety of perspectives.

Recognizing Prehistoric Structures

It is not always a straightforward task to determine prehistorically vs. historically constructed stone structures. Also, natural periglacial phenomena, such as patterned ground, can produce odd

landscape features that may, at first, appear to have been built or modified by humans (Benedict 1978; Cassells 1995:15-18). Dry laid, stacked or aligned stone structures are considered here to represent a relatively rudimentary construction style. As such, they can be expected to have been produced with little difficulty by a variety of potential builders. In both prehistoric to modern populations there have probably always been behaviors that resulted in piling or stacking of stones. Hence, there is a definite need for some baseline attributes that can be verified in field and allow investigators to make the best possible choices with respect to assessing relative age and/or associations of stone features. Deaver and Peterson (1999:1-2) identify three attributes that characterize cairns.

- 1) Older cairns tend to be slightly buried at least around the bottom of the basal layer of stones. The amount of aeolian deposition, often called "siltation," is highly variable in different settings, but typically the basal layer of stone in prehistoric cairns is 50 percent buried. Rock piles that sit on the top of the ground surface, particularly multi-tiered piles, are more likely modern.*
- 2) The stones in older cairns tend to have more lichen cover, and the lichen grows only on the top of the stones, not on the bottom. Modern rock piles contain stones that accumulated lichen on their tops, but when they were placed in the piles, the lichen covered surfaces may end up face-down.*
- 3) The stones in prehistoric cairns tend to have a narrow range in sizes, typically softball to melon size (12 cm to 30 cm in diameter). Modern rock piles have many small stones and a few very large stones (over 50 cm in diameter).*

Although these criteria are applied specifically to cairns, they are useful for other stone features. Other characteristics that may help investigators make a determination of relative age include lichen orientations and lichen bridging among stacked stones (Benedict 1987:3; Weimer 2007:3). Lichenometry has been used to date stone structures by a few investigators (Benedict 1981, 1985, 1987, 1996 2000; Cassells 2000; Cassells 1995). However, there are currently no lichen growth rate curves for the GRSLE project area.

Informants

While prehistoric, historic, and modern landscape use patterns may vary, there is a thread of temporal and spatial continuity among human groups with regard to what it means to be a "local." Although the project area itself is not home to any year-round inhabitants, many people from the

surrounding area use the GRSLE project area for subsistence needs. Many of these individuals have acquired information useful to archaeologists. The area is currently used by ranchers who move livestock back and forth between the plains and mountains seasonally. One set of structures was identified based on an account provided by the late Calvin Todd, who was ranch manager of the well known Pitchfork Ranch (Lawrence Todd personal communication 2005).

Modern hunters also use the GRSLE area for subsistence and recreation. Although big game animals are generally taken from the area at various times between September and December, hunters often visit throughout the year to gauge the locations of particular game species and observe their behaviors. These local hunters have significant knowledge about the Upper Greybull landscape and many of them have used the area for generations. Knowledge about good hunting areas and local landmarks is passed along from one generation to the next. One local hunter visited the CSU field camp during summer fieldwork in 2004 and provided information about an anomalous set of wall structures.

Finally, local game wardens and forest rangers also have an intimate knowledge of the area and may possess useful information. A game warden was encountered during 2005 fieldwork and questioned about some specific locations in the Project area. This individual provided detailed information about one structure and even guided a CSU crew to its location. Ultimately, three of the seven sites were identified by local individuals prior to CSU's field investigations, and much of the credit related to identifying the GRSLE stone structure sites is owed to these individuals.

Data Collection

Site Recording

Site recording procedures consisted primarily of mapping, measuring and photographing the structures. Locations were recorded with global positioning systems (GPS) devices as discussed below. All artifacts were coded and measured using digital calipers, and the information was saved in an Excel spreadsheet on a personal data assistant (PDA). The structures were measured using standard metric measuring tapes. Measurements recorded for structure attributes during both the 2004 and 2005 field

seasons consisted of length, width, and height. During the 2004 field season metric attributes, consisting of maximum lengths, were recorded for a sample set of stones incorporated into structures. During the 2005 field season the maximum length of every stone was measured to provide continuous data for comparison with the stone structure replicative construction. All photographs were taken with digital cameras and the highest resolution was used whenever possible. Slopes and degrees of orientation were collected with either a Brunton pocket transit, or standard compass, or in some cases are derived from ArcView 9.2 or MapTech Terrain Navigator Pro software packages.

The majority of the computer aided analyses were accomplished using DEMs. Digital elevation models (DEMs) are area maps that contain elevation data. The resolution of the DEMs used for the following analyses represent a 10 m per pixel ratio. DEMs are based on USGS 7.5-minute quadrangle topographic maps; thus, the DEMs are bound to the same accuracy standards as those used to assess the accuracy of USGS 7.5-minute topographic maps. The horizontal accuracy standard requires that 90% of all points tested are accurate to within 0.5 mm on the map at 1:24,000 scale. A 0.5 mm horizontal accuracy on the map translates to 12.2 m. The vertical accuracy standard requires that 90% of all points are accurate within half of the contour interval of the actual elevation (USGS 2007). The contour interval for the GRSLE project area is 40 feet (12.2 m), and thus the elevations derived from DEMs are 90% accurate to within 6.1 m. The computer aided analyses completed for this project have an average estimated accuracy of ± 16 m.

Global Positioning Systems (GPS): Crew members recorded locations of features with Garmin Rino 110 GPS units. These units feature wide area augmentation system (WAAS), which increases horizontal and vertical accuracy to within 7 m approximately 95% of the time (Garmin 2007). Both GPS waypoints and track logs were recorded during the investigations. GPS waypoints were recorded for points along walls, at corners and center points of features, and at selected photograph locations. Tracks logs were used to show the locations of individual survey transects. Spatial information was collected as Universal Transverse Mercator (UTM) coordinate system points, using the World Geodetic System datum of 1984 (WGS 84). Sites and individual structures were then integrated into a GIS platform.

Types of Data *(Not all of these data were always available)*

Landscape Data

- **Elevation** is recorded in meters above mean sea-level at one or more points on major landforms in and around the sites. Elevation data are compiled from a variety of sources that include GPS receivers, topographic maps, digital elevation models, and national elevation datasets.
- **Slope** is measured for an entire site and at most of the features using both in-field measurements and computer-generated information.
- **Aspect** is recorded as either a descriptive classification based on the slope direction, or a compass direction of a hill face and/or quantification via GIS that identifies the steepest downslope direction from each cell to its neighbors.
- **Surface Geology and Substrate** is described both in terms of on-site classifications for the surface geology and the prevalent substrate as indicated by the Geologic Map of Wyoming (Love and Christiansen 1985).
- **Depositional Environment** is a descriptive characterization of the area surrounding the site with respect to the soil formation processes.
- **Wind** direction and prevailing speeds of ground-level winds are measured when possible with a wind speed meter and compass.
- **Temperature** information includes both annual and seasonal averages, as well as minimums and maximums, and is derived from PRISM data described in Chapter 1.
- **Vegetation Communities** on the site and in the surrounding area are described during field recording, with information also derived from Wyoming GAP data.
- **Precipitation** information is also assembled from PRISM data, and may include regional and micro-environmental precipitation patterns.
- **Modern Game** distributions, locations of game trails, and bedding areas are noted whenever possible. Coverage data for this information includes Wyoming GAP Analysis expressed as a model of vertebrate populations.

Structure Data

- **Structure Dimensions** generally include measurements of length, width and height; and individual descriptions are provided for measurements that require additional explanation. Average dimensions are often presented due to field recording time constraints. **Structure Elements Dimensions** include both the integrated elements that have been transported and placed as part of the feature, and in-place elements that are considered to be naturally occurring but are utilized as part of the feature.

Transported Elements are measured for maximum dimension using metric units. In some cases only a sample of the elements were measured and thus the largest transported element and the average sizes are recorded. As no clear cutoff for minimum size could be identified objectively, no attempt was made to collect minimum size data. In the cases of integrated organic materials, such as wood elements, diameter and maximum length were recorded. A general description of the outer surfaces of incorporated elements was made and then compared to surrounding non-transported materials in order to identify surface modifications, including the degree of lichen cover and any notable exterior weathering.

In-Place Elements considered unmovable are measured for maximum length, width and height when applicable. Smaller in-place elements, such as a single stone integrated into an alignment, are measured for maximum dimension and noted as “in-place.”

- **Element Counts** consist of tallies of transported materials as well as in-place elements.
- **Viewshed** analysis is accomplished using with a GIS. Viewsheds are located at one or more points within or near the structures; a 2-meter vertical adjustment (offset) was used to approximate a standing human’s field of view.
- **Direction and Orientation** is measured using a Brunton hand transit or compass with each measurement described individually. Orientations of walls are generally derived from an imaginary line drawn through the long axis. Blinds or other structures for which a function of directionality is inferred are explained individually.

- **Associations** include narrative descriptions of inferred relationships among structures and/or the physical environment (e.g., do structures incorporate a tree islands or other vegetation?) as well as associated cultural manifestations.

Electronic Data and Sources

Computer aided landscape analysis was accomplished using a GIS (ArcView 9.2). Physiographic data including elevation, slope, aspect, and viewshed (derived from 10 m DEMs) and climate data including temperature and precipitation were compiled from the USDA: NRCS Geospatial Data Gateway (<http://datagateway.nrcs.usda.gov/>). Data specific themes including surface geology soils, permanent water, modern landcover/vegetation, temperature and precipitation were compiled from the Wyoming Geographic Information Science Center (<http://www.sdvc.uwyo.edu>).

Chapter Summary

In this chapter I addressed the inadequacy of relying on assumed functions for high altitude stone structure sites. Identification of patterns in the distribution and composition of stone structure sites is no less important than determining site function. I advocate using analytical techniques that are independent of function to generate and recognize patterns in the distributions and attributes of the structures and sites.

This chapter also presents the technique used during this project to locate and record the GRSLE stone structures sites. Sites were located using both systematic and non-systematic pedestrian survey. At least three sites were located based on descriptions provided by local informants. Once a site was located a suite of data was collected including metric measurements of site and structure dimensions, as well as data for surrounding landscape.

CHAPTER 4

RESULTS OF INVESTIGATION

Archaeological investigations of stone structure sites within the GRSLE project area yielded nine sites, seven of which are reported here. These sites are all sparse in terms of directly associated lithic materials and none show evidence of hearths. Information for each site was collected in an attempt to answer the basic questions posed in the first chapter. Specifically, can attributes-based data collection procedures yield solid comparative information; is there a topographic signature associated with the locations of stone structure sites; can the attributes of the walls be used to quantify labor investment; are the regional scale distributions of stone structure sites indicative of prehistoric use environments that are sometimes considered marginal? Data gathered from each site are described in this chapter and summarized in Table 2.

GRSLE Stone and Wood Structure Sites

48PA2795 – Possible Eagle Trap (Figures 7-12)

Setting: This site is situated at an elevation of 2857 masl, in the HMT range, at the termination point of a steep southeast-trending ridge. The ridge descends from a small pinnacle on the west, dropping 194 m in elevation over the course of 465 m to the site location. The bedrock outcrop on which the site is located defines a break in the slope. Below the site to the south, east and north the slopes become slightly steeper prior to termination at the lower terrace. The ridge to the northwest ranges from 9 to 11° in slope. The slope at structure is 0-2° with 15-17° slopes in the area immediately to the east and southeast. A small precipice, formed of outcropping bedrock, is located immediately to the south and slightly below the site (Figure 10).

The Jack Creek valley dominates the entire viewshed to the east of the site as it flows from the south, near Francis Peak, to its confluence with the Upper Greybull River. The surrounding drainages are unnamed tributaries of Jack Creek, a second order drainage. The nearest source of permanent flowing water

Table 2. GRSLE Structures Attributes

Site Number	Structure ID	Planview Shape	Max. Length or Circumference (m)	Max. Segment Thickness or Width (m)	Max. Segment Height (m)	Stone Count	Avg. Stone Size in cm (cm)	Max. Transportable Stone Size (cm)	Orientation (Degrees)	Orientation Description	Wooden Elements (Y/N)	Wood Count	Avg. Wood Length (cm)	Avg. Wood Diameter (cm)	Artifacts Associated (Y/N)
48PA2795	1	circular	12.40	0.54	1.50	626	32.40	54.00	100-110°	E-W long axis	Y	30	155.30	12.20	Y
48PA2820	1.1	linear-straight	1.44	0.48	0.38	7	34.50	45.00	130°	E-W long axis	N	-	-	-	Y
48PA2820	1.2	linear-straight	14.00	1.23	0.45	240	45.00	80.00	135°	E-W long axis	N	-	-	-	Y
48PA2820	2	linear-straight	7.00	1.60	0.40	150	27.50	45.00	125°	E-W long axis	N	-	-	-	Y
48PA2820	3	rectangular	4.00	3.00	0.90	~972 (est.)	40.00 (est.)	80.00	10°/100°	N-S/E-W	N	-	-	-	Y
48PA2820	4	linear-curved	4.00	1.70	0.90	75	45.00	100.00	10°	N-S long axis	N	-	-	-	Y
48PA2820	5.1	linear-curved	33.50	0.90	0.75	380	40.00	90.00	45°	NE-SW long axis	N	-	-	-	Y
48PA2820	5.2	linear-straight	1.05	0.33	0.27	4	30.00	40.00	40°	NE-SW long axis	N	-	-	-	Y
48PA2820	5.3	linear-straight	2.00	0.50	0.27	7	30.00	50.00	45°	NE-SW long axis	N	-	-	-	Y
48PA2820	6	circular	1.50 (est.)	0.75 (est.)	0.60 (est.)	21 (est.)	35.00 (est.)	50.00 (est.)	15° (est.)	N-S long axis	N	-	-	-	Y

Table 2. GRSLE Structure Attributes (continued)

Site Number	Structure ID	Planview Shape	Max. Length or Circumference (m)	Max. Segment Thickness or Width (m)	Max. Segment Height (m)	Stone Count	Avg. Stone Size (cm)	Max. Transportable Stone Size (cm)	Orientation (Degrees)	Orientation Description	Wooden Elements (Y/N)	Wood Count	Avg. Wood Length (cm)	Avg. Wood Diameter (cm)	Artifacts Associated (Y/N)
48PA2838	1	circular	24.00 (est.)	2.00	1.00	350	4.00 (est.)	70.00	5° (est.)	N-S long axis	Y	6 (est.)	1.75-2.00 (est.)	12.00-15.00	N
48PA2888	1	linear-straight	98.40	0.30	0.18	284	25.00	60.00	48°	N-S long axis	N	-	-	-	Y
48PA2890	1	linear-straight	19.90	0.25	0.25	88	30.32	62.00	55°	NE-SW long axis	N	-	-	-	N
48PA2890	2	linear-straight	45.35	0.25	0.13	128	25.45	76.00	75°	NE-SW long axis	N	-	-	-	N
48PA2890	3	linear-straight	12.81	0.20	0.11	57	18.75	46.00	66°	NE-SW long axis	N	-	-	-	N
48PA2900	1	linear-straight	1.56	0.30	0.66	36	28.20	48.00	60°	NE-SW long axis	N	-	-	-	N
Galena Ridge Wall	1	linear-straight	2.28	0.66	1.00	-	-	-	-	-	N	-	-	-	N

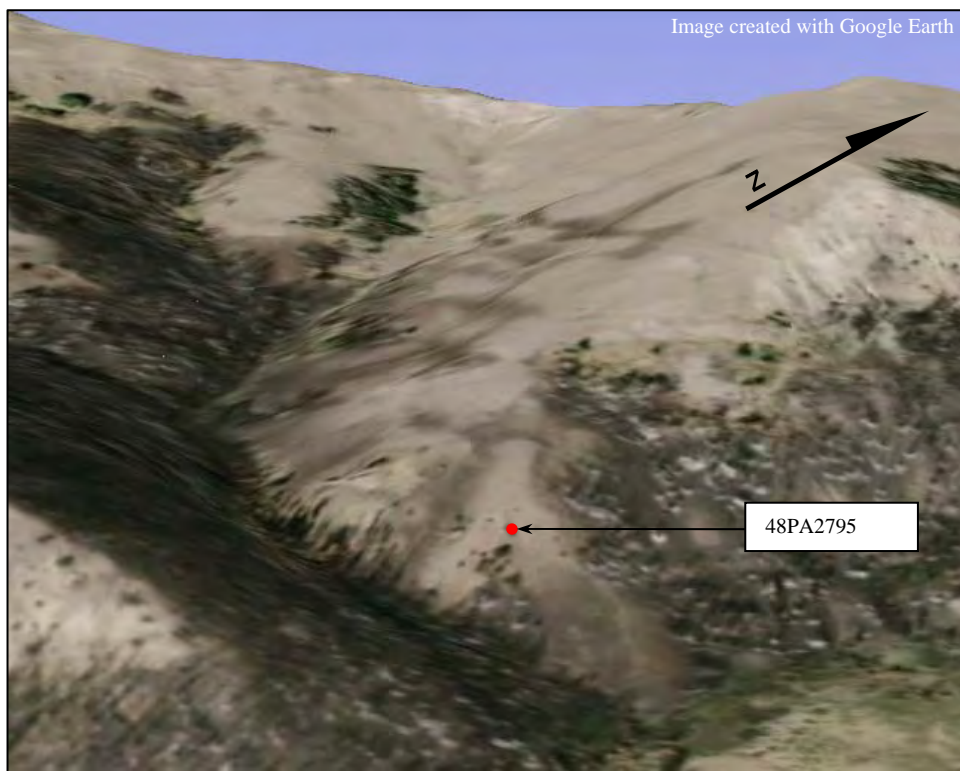


Figure 7. Overview of site 48PA2795, facing northwest. The Jack Creek valley is located in the foreground.



Figure 8. Overview of the stone and wood structure at site 48PA2795, facing east.

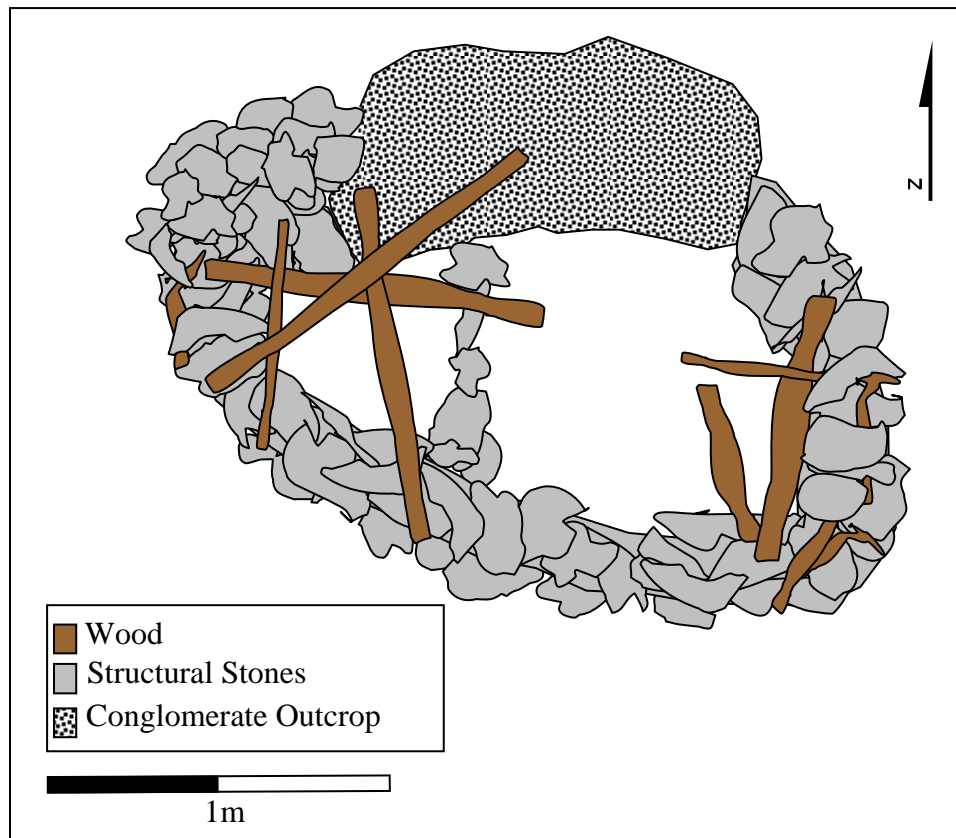


Figure 9. Plan view of the stone and wood structure at site 48PA2795.



Figure 10. Over view of site 48PA2795 showing the small precipice to the south of the structure, facing southeast.

water is located 150 m to the southeast in a deeply incised valley. A small perennial pond 430 m to the northeast is the headwaters for another small tributary stream. Below the site, at the base of the slope to the east, lies a low marsh area filled with grass hummocks. Bull Elk Draw (which is a tributary of the Greybull River) is located 1 km west of the site at the base of a deeply incised valley beyond the western rim of the Jack Creek valley.

Both the surface geology and geologic substrate in the immediate vicinity are composed of conglomerate breccias derived from Wiggins Formation volcanoclastic deposits (Love and Christiansen 1985). However, the site is located at the margins of a Pleistocene/Holocene landslide deposit. Thus, the underlying deposits are expected to consist of both bedrock that is weathering in place and tumbled bedrock. Soil depth is to non-existent and materials on the surface are primarily weathered angular conglomerates within a matrix of coarse sand.

Vegetation immediately surrounding the site consist of perennial herbs, mixed bunch grasses, sedges and woody shrubs. Notable species on site are big sage, and mountain gooseberry. Ground coverage is less than 10%. In general the surface is bare ground composed of exposed and weathering bedrock outcrops. The surrounding vegetation is composed of a mixture of open south-facing short grass meadows and stands of trees located on the wetter north-facing slopes. Timber stands surrounding the site are primarily spruce-fir forest that include, but are not limited to, Engelmann spruce, limber pine, lodgepole pine, subalpine fir, and whitebark pine trees. Much of the surrounding forest has been killed by drought and concomitant pine beetle infestation (Figure 11). In general the mosaic characteristic of plant communities in the area is controlled by the amount of available soil and the aspect which determine the duration and intensity of available moisture.

Site Description: This site consists of a single stone structure and one associated lithic artifact. The structure is roughly circular to oval-shaped stone enclosure. Three sides (west, south and north) are constructed of dry-laid / stacked stones that have been transported to the site, presumably from the area immediately surrounding the feature. From the outer wall edges, the long axis of the structure is 6 m long and is oriented 100-110°. The width is approximately 4.5 m at a point perpendicular to the long axis along the eastern edge of the wall, narrowing to 2.3 m at the western end. The western and southwestern wall



Figure 11. Overview of the stone and wood structure at 48PA2795 showing the effects of beetle infestation on the surrounding timber stands, facing south.

portions are in good condition and stones appear to be in the original positions. This portion of the structure corresponds with a low interior wall. This wall divides the structure along the short access and probably served to define two interior spaces. The interior floor slopes 2° from the western edge to the inner wall.

What remains of the southeastern and eastern portions of the structure is situated on a bare bedrock outcrop that slopes down from the inner wall approximately 10° from west to east. This portion of the structure is in ruins and consists of tumbled wall fall. Although an exact determination of the original form of the eastern portion is not possible, the overall shape appears to have enclosed a slightly larger interior area, and an entryway may have been located on the southeastern portion of the wall.

Approximately 75% of the northern wall is made up of a single bedrock outcrop. This outcrop is composed of the same conglomerate breccias that make up the transported portions of the structure. The location, shape and orientation of the outcrop play key role configuration of the structure as whole. This outcrop is the only geologic feature in the area that extends above ground. Looking upslope from the east, the outcrop forms a small cliff that projects upward from the eastern slope 5.75 m. The portion of the

outcrop that has been utilized for the structure forms a natural wall that is 1 to 1.5 m wide within the structure and 4.1 m in length.

Nine fragments of wood are incorporated into the structure, while the remaining 21 pieces in the immediate vicinity are presumed to have been a part of the superstructure at one time. The wooden elements consist of limber pine and other unknown coniferous tree species. These elements probably served as cross members of a roof and may have been part of the walls along the eastern edge (Figures 12). Thirty pieces of wood were recorded, all which were in similar condition and appear to be of the same age. Several fragments exhibited evidence of having been cut down with either stone, bone or metal implements (Figure 13). The level of disturbance with respect to the “in-place” elements is unknown, and it is possible that fragments currently resting atop the walls have been placed/replaced by recent visitors. No trees are currently located on site. However, wood is readily available to the north and south within 50-75 m of the structure.

A single flaked stone artifact consists of a bifacially worked lag gravel of banded chert (Figure 14). This tool was located on a steep slope below the structure to the east. It is 80.3 mm long, cm wide, and



Figure 12. Stone and wood structure at 48PA2795 showing integrated wood elements, facing west.



Figure 13. Close-up of an integrated timber from the stone and wood structure at site 48PA2795 showing cut mark.



Figure 14. Flaked stone tool from site 48PA2795.

59.6 cm thick. One side exhibits nearly 100% cortex that is the same color and texture of much of the surrounding conglomerate, which suggest that it was procured locally. The early stage of lithic reduction and large amount of cortex indicate that this tool was either an expedient core cobble tool or a tested cobble. No other lithic debris or flaked stone tools are present at the site. This lithic artifact is associated with the structure based on its proximity.

Discussion: The age and function of the site and its relationship to sites in the surrounding area are unknown. No temporally diagnostic artifacts were located within or around the site boundary. A Prehistoric or Protohistoric age is associated with this structure based on three types of circumstantial information. First, a local informant has reported that the structure is relatively old. Third the structure is associated with a lithic tool that is presumed to be either prehistoric or Protohistoric. Third, the general construction style is similar to other known, and prehistorically attributed occurrences in the area.

Calvin Todd's report from the 1960's indicates that the structure had been in its current configuration since at least the 1930's when he became aware of it (Lawrence Todd personal communication 2005). There is a possibility that the structure was constructed historically by sheepherder, hunters, or other travelers through the area. However, this seems unlikely based on the general tendency of historic builders to construct cairns or linear wind breaks rather than small enclosures (Dodge 2007).

At present, very few published descriptions of structures similar to site 48PA2795 are available. Brief descriptions of similar structures from archaeologists in the region are often related anecdotally. However, there are a few scraps of information contained in both historic and archaeological texts that may corroborate an inferred prehistoric/Protohistoric age for this structure. The first is George Bird Grinnell's (1972:299-307) discussion of eagle trapping practices among the Cheyenne Indians prior to the 1920's (see Chapter 2, page 38). The unroofed shelters, described as eagle traps, bear a descriptive resemblance to the enclosure at site 48PA2795. Grinnell suggests that such a structure included two discrete areas and incorporated a natural outcrop on a prominent overlook of the surrounding area (1972: 304) (Figure 15). Descriptions from Cheyenne informants also indicate the use of long poles as roofing materials (Grinnell 1927:306). Three structures with stacked stone walls and wooden elements are pictured in *Prehistoric Hunters of the High Plains* (Frison 1991:255) (Figure 16) and another similar structure is located at

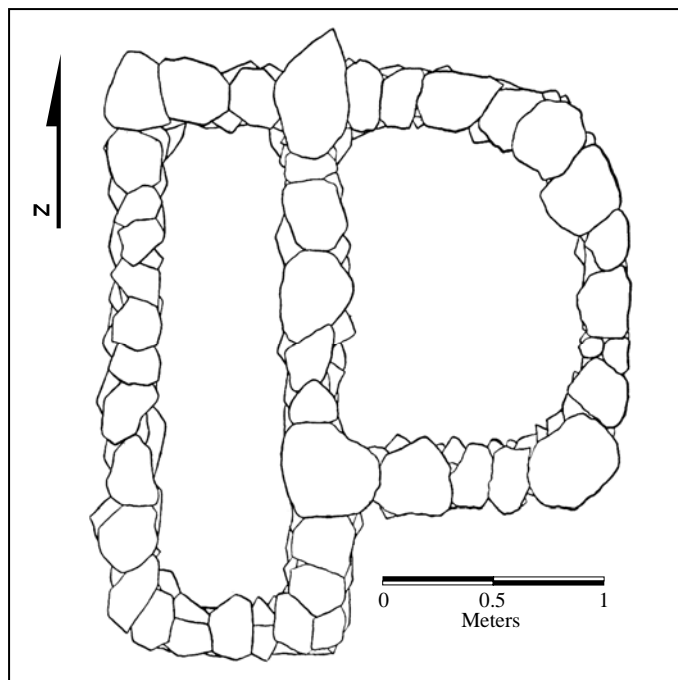


Figure 15. Illustration of a possible eagle trap modified from Grinnell (1972:305).



Figure 16. Two possible shaman huts that are similar to the stone and wood structure at site 48PA2795, modified from Frison (1991:255).



Boulder Ridge (Finley and Finley 2004). Other similar stone structures with wooden roofing elements and stacked stone walls are present in Yellowstone National Park. Most of these examples are associated with hunting activities of prehistoric groups (Nabokov and Loendorf 2004:87-88). However, there are not secure functional interpretations or temporal associations for these structures.

The association of the flaked stone tool is supportive of a prehistoric/Protohistoric age for this structure. The presence of lichen bridging, which is sometimes indicative of construction age, was noted among integrated stacked stones. However, no lichen growth curves or species studies that could shed more light on the range of variability in lichen species are currently available for this portion of the Absaroka Mountains (Breckenridge 1974:40-42).

48PA2820 – Bill Dooley’s Pickett Creek Structures (Figure 17)

Setting: The Pickett Creek site consists of three walls (#s 1,2,5), an anomalous platform/wall (#3), two blinds (#4 and #6) and three lithic artifacts. William L. Dooley of Buffalo, Wyoming described the location of the Pickett Creek game drive in detail prior to visitation by field archaeologists. Dooley, an avid bighorn sheep hunter, encountered structures while hunting in the area. He reported that bighorn sheep are currently hunted on and around the ridges and slopes surrounding the structures. He also noted that a well-established elk trail skirts the base of the ridge (William Dooley personal communication 2004).

This site is situated between 3075 and 3200 masl, in the APP range, on the crest of two ridges overlooking the north fork of Pickett Creek. The ridge on which the site is located begins 3.5 km to the west on a low pinnacle of Carter Mountain. The spine of the ridge is sinuous and is marked by numerous outcrops of conglomerate bedrock which form a series of steps that descend from the cirque headwalls along the eastern flanks of Carter Mountain approximately 500 m to the site. From the site the ridge trends east/southeast for 2.765 km, dropping nearly 500 m to the valley floor where it terminates at the confluence of two forks of Pickett Creek. Slopes on site range from 0-2° along the crest of the upper and lower ridge to 15-20° on the side slopes. Numerous finger ridges extend to the north and south from the ridge, and there is a sheer cliff face approximately 300 m west of the site. The site area encompasses a large central portion of the ridge as well as a part of a lower secondary ridge that projects northeast from the main ridge

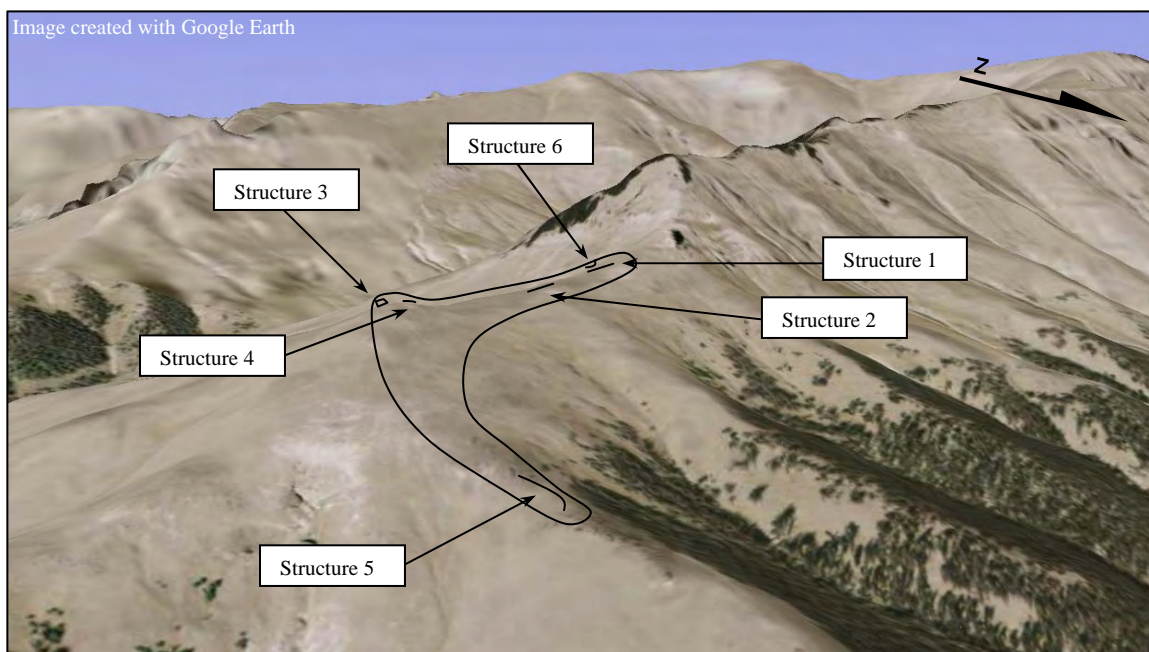


Figure 17. Overview of site 48PA2820, showing the locations of 6 structures, facing southwest.

Features range in elevation from 3075 meters at the lowest point (Structure 5) to 3200 meters at the highest point (Structure 4).

The headwaters of the Pickett Creek watershed encompass the ridge on which the site is located, to both the north and the south. The cirque headwalls to the northwest and southwest have snowfields that feed Pickett Creek and its tributaries. The main channel of Pickett Creek, a first order drainage, flows along the base of the northern face of the ridge. This creek is the nearest permanent source of water to the site and lies approximately 750 m to the northwest of the structures on the upper ridge. At this point the creek is a high-energy braided stream which descends rapidly to the confluence with the Greybull River, 20 km to the southeast of the site.

The surface geology along the ridge is a direct expression of the primary geologic substrate of the surrounding area. This substrate is composed of conglomerate breccias derived from the Wiggins formation volcanoclastic deposits (Love and Christiansen 1985). Pleistocene/Holocene landslide and slump deposits occur below the site area in the lower reaches of the Pickett Creek valley. With the exception a few very small pockets of aeolian deposits the upper ridge is generally devoid of soil. The lower ridge exhibits a thin mantle of coarse sands and gravels weathering from the conglomerate parent material. Pin flag probes indicate soil depths of no more than 5 cm. The slopes on the southern side of the ridge are also

devoid of soils. The northern slopes exhibit deeper soils that range from 20 cm to 1 m in depth.

The site is located in the APP physiographic zone, and is characterized by attributes of both the spruce-fir forest and alpine tundra zones (Knight 1994). The climate of the region surrounding the site is predominantly mesic, with 50 cm of precipitation annually and a mean daily temperature of 35° F (1.67° C) (Breckenridge 1974:10). The south-facing slopes receive much more direct sunlight during the year, especially during the colder months, and so tend to be warmer and dryer. North-facing slopes support late-lying snow fields, and receive most of the annual moisture runoff, as evidenced by the predictable presence of patterned vegetation and timber stands (Knight 1994:155). Trees on the northern slopes of the ridge consist of spruce-fir forest. Tree species include but are not limited to Engelmann spruce and subalpine fir, with a few limber pine and whitebark pine trees interspersed on the lower flanks of the slope. This tree community is almost completely dead as a result of spruce beetle infestation, and forest fire risk is high.

The rocky slopes that separate the structures and the timber stand support alpine tundra probably as a result of a short, cool growing season. Plant species in this area are grasses and perennial herbs, including sedges and woody shrubs. The growing season occurs from June to August and may last 30-75 days (Knight 1994:205). The higher shoulder slopes and ridge tops support a mixture of sparse vegetation coverages (30-50%), bare ground and exposed bedrock. Vegetation persists but is restricted by lack of moisture and high wind conditions. The south-facing slope is far less productive due to drier growing conditions. Talus slopes are more active on the south side of the ridge because sufficient vegetation is not present to stabilize the loose, eroding bedrock.

Site Description: The site consists of six stone structures and three lithic artifacts. The features fall into three categories: straight walls, curved walls, and a rectangular platform. Four structures are located on the flat to gently sloping portions of the long east/west-trending primary ridge. This ridge is approximately 500 m long and defined by resistant bedrock outcrops. Beginning at the large vertical outcrop of conglomerate at the western edge of the site, the ridge descends to the southeast to a low saddle, and then abruptly rises again at the eastern edge, terminating at Structure 4 on a flat outcrop of resistant bedrock. From this point the ridge descends rapidly to the south and east. The descent to the northeast is much more gradual, and from Wall 4 the slope drops 107 m in elevation to the lower ridge saddle where Structure 5 is

located. This ridge continues to descend for 1 km and terminates at the main fork of Pickett Creek approximately 1.3 km from the top of the primary ridge.

Structure 1 is a long, straight structure that begins 100 m from the vertical outcrop of conglomerate. This structure is composed of two discontinuous sections. Structure 1-Section 1 is 1.44 m long and has a bearing of 130° (Figures 18 and 19). This shorter section has a maximum width of 48 cm and a maximum height of 38 cm, and is composed of seven boulders with maximum size ranges of 24-45 cm. Structure 1-Section 2 is much longer and extends 14 m across the weathered conglomerate bedrock. This structure has a maximum width of 1.23 m and a maximum height of 45 cm and is composed of 247 cobbles with average size ranges of 25-30 cm (maximum dimensions of 80 cm). This thick width is the result of accumulated wall fall and the incorporation of natural unmovable boulders. This structure was probably much higher in the past based on the presence of the wall fall stones surrounding the base.

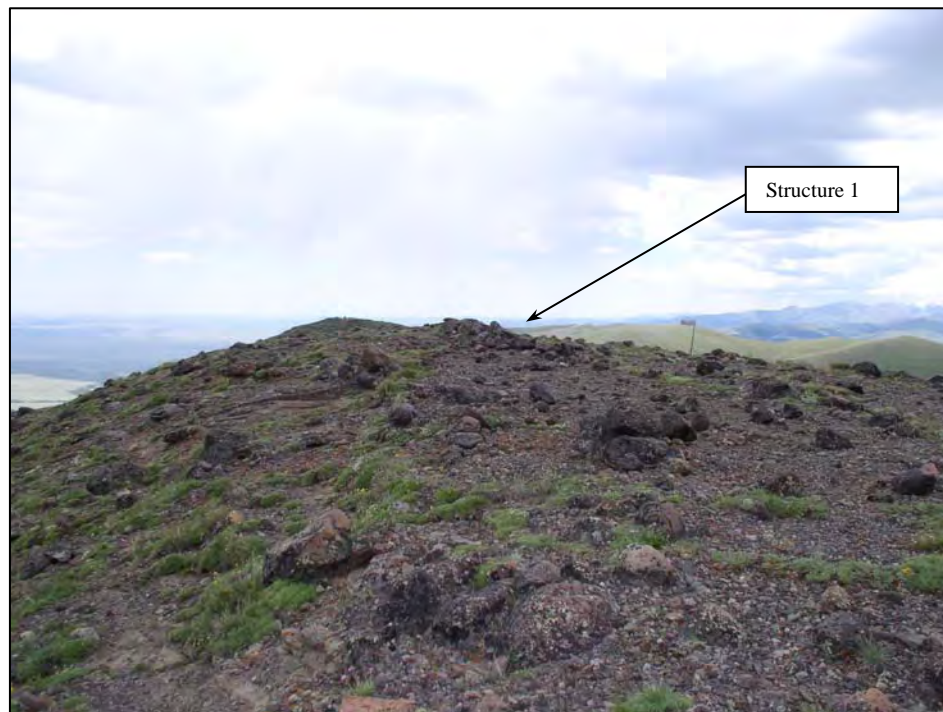


Figure 18. Structure 1 at site 48PA2820, facing southeast.

Structure 2 is aligned roughly with Structure 1 and separated from it by approximately 20 m (Figures 20 and 21). It is 7 m long and has a bearing of 125°. Structure 2 has a maximum width of 1.6 m, presumably the result of wall fall episodes, and an average width of 25 cm. The maximum height for Structure 2 is 40 cm and incorporates 150 cobbles with average size ranges from 25-30 cm. A few larger cobbles (45 cm) were noted.

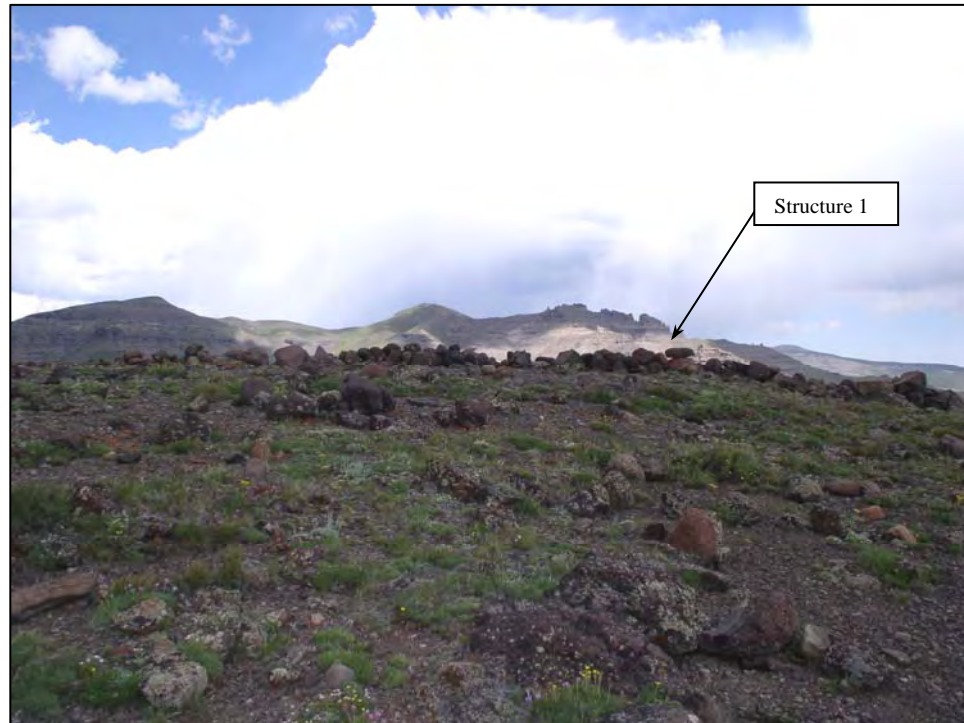


Figure 19. Structure 1 at site 48PA2820, facing north.

Structure 3 lies at the far eastern margin of the primary ridge. This structure exhibits an anomalous shape that is unlike other known structures in the area (Figure 22). The structure apparently represents an attempt to level the shallow slope with three walls forming a platform (Figure 23). This platform structure was constructed on the south side of the sloping ridge and faces south. In plan this structure is square with maximum dimensions of 4 m (north-south) x 4 (east-west). The southern retaining wall of the structure rises approximately 75 cm from the slope below. The platform gradually tapers into the slope at the northern edge. The interior of the platform appears to have been backfilled with larger stones at the bottom and grades to smaller pebbles and unconsolidated sediments

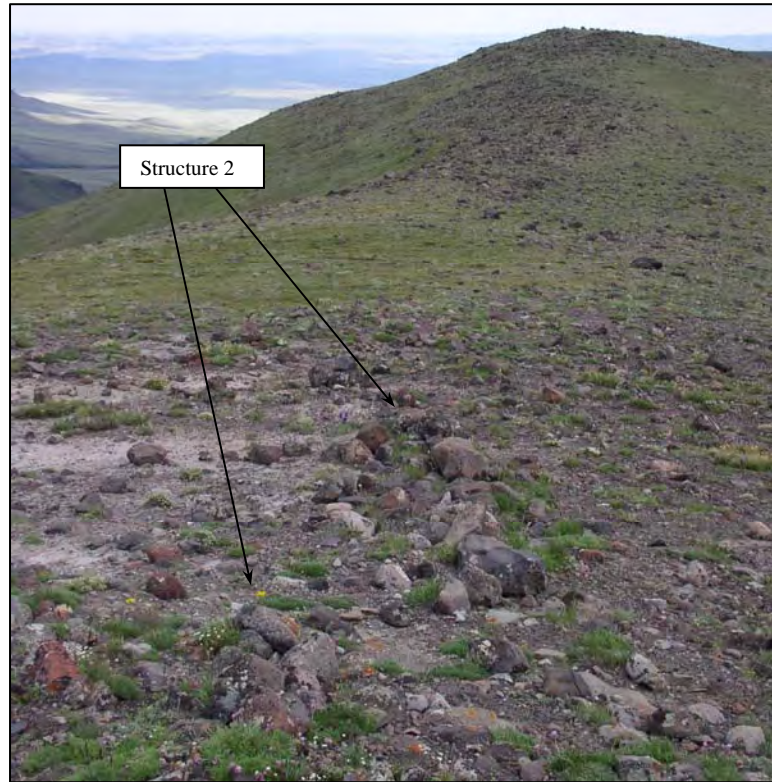


Figure 20. Structure 2 at site 48PA2820, facing east.

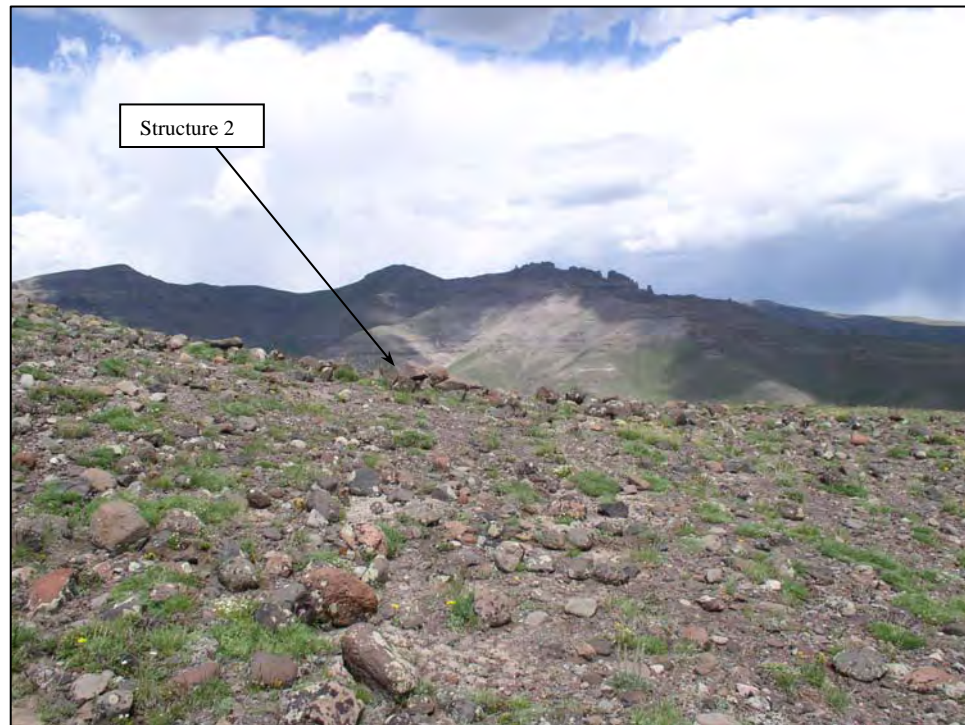


Figure 21. Structure 2 at site 48PA2820, facing north.



Figure 22. Structure 3 at site 48PA2820, facing east.



Figure 23. Structure 3 at site 48PA2820, facing west.



Figure 24. Structure 3 at site 48PA2820 showing the low wall, facing south.

toward the top. A short wall is present on the western edge of Structure 3 (Figure 24). This section of wall has been heavily disturbed, perhaps as the result of natural processes (e.g., freeze/thaw cycle shifting) or humans/animals disturbance. Many elements associated with this portion of the feature were observed as wall fall.

Structure 4 is identified as a blind based on its semicircular shape and position overlooking the large saddle to the west (Figure 25). This structure is 4 m in length, and has a maximum width of 1.7 m where it incorporates a large natural boulder about 1 m in diameter (Figure 26). Structure 4 has a maximum height of 90 cm. This horseshoe-shaped structure could have provided room for two hunters. Average sizes of cobbles integrated into the wall range from 40-50 cm.

Structure 5 is situated on a secondary ridge 300 meters north of and below Structure 4 (Figures 27-29). This wall is hook-shaped and extends south 33.5 m from a bedrock conglomerate outcrop towards the saddle. Two discontinuous sections of wall with respective lengths of 1.05 m and 2 m were observed on the opposite side of the saddle. A narrow open area of approximately 3-4 m separates these sections.

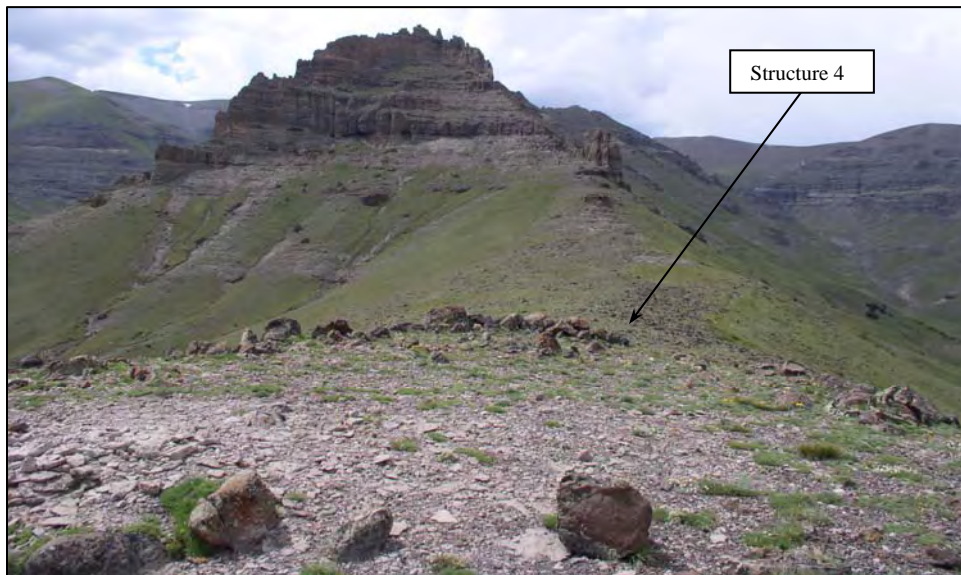


Figure 25. Structure 4 at site 48PA2820, facing west.

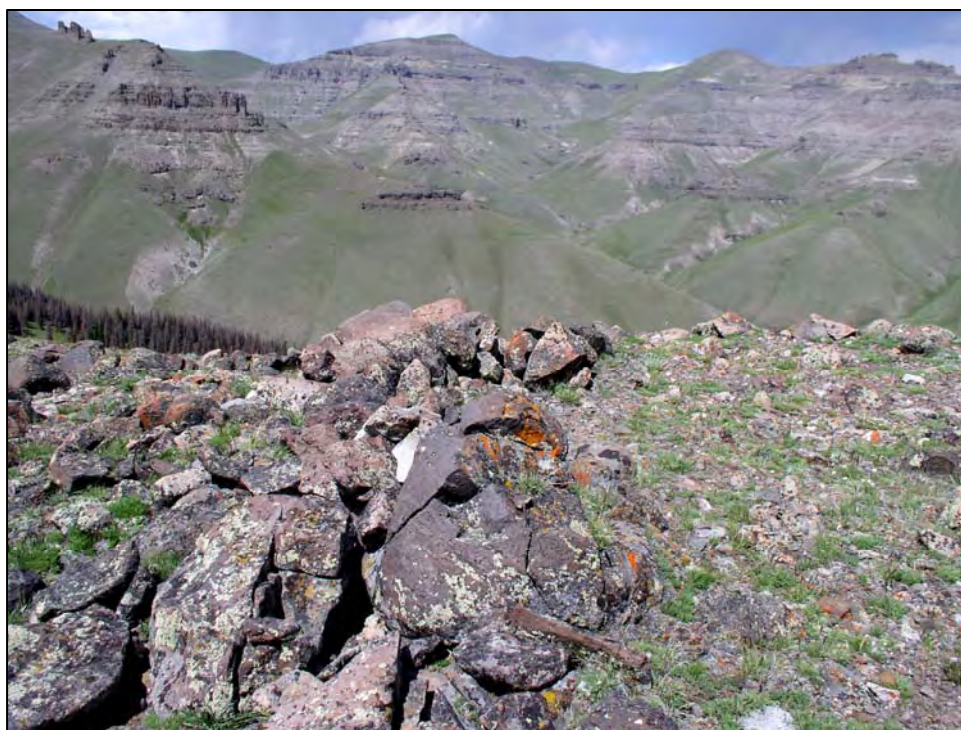


Figure 26. Structure 4 at site 48PA2820, in profile, facing north.

The longer portion of Structure 5 is in excellent condition with minimal amounts of wall fall surrounding the base. This wall has a maximum width of 90 cm and maximum height 75 cm. The adjacent shorter sections are no more than 27 cm in height and less than 50 cm in width. The entire wall is composed of 391 stones with average sizes of 30-40 cm, although naturally occurring in-place bedrock elements with maximum dimensions of up to 1.5 cm were noted.

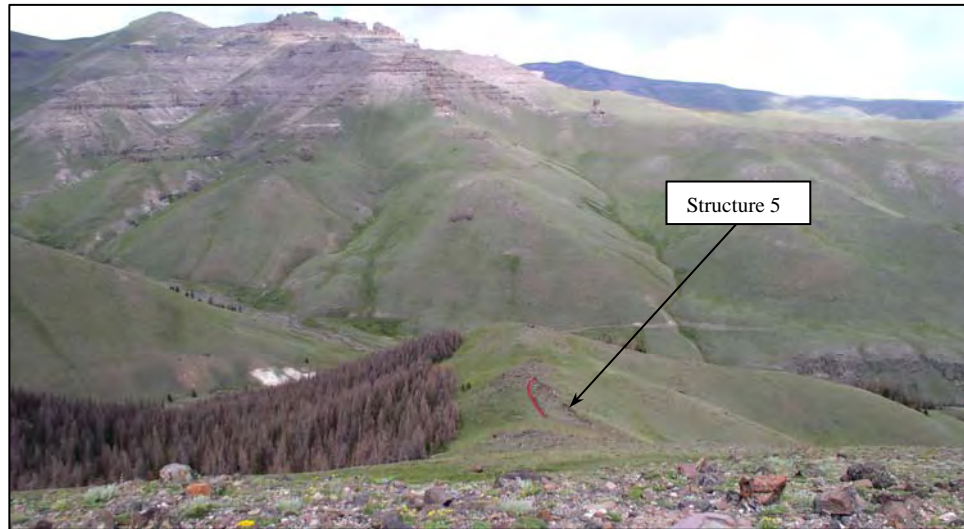


Figure 27. Overview of lower ridge and Structure 5 at site 48PA2820, facing northeast.



Figure 28. Structure 5 at site 48PA2820, facing north.



Figure 29. Structure 5 at site 48PA2820, facing south.

Structure 6 is a low semicircular blind composed of a small number of large cobbles. This structure is located on the upper ridge on a steep south-facing slope (Figure 30). Cobbles integrated in the structures were probably moved from the floor to create a shallow depression. This structure is 1.5 m in length with a maximum width of 75 cm and has a maximum height of 60 cm. In-place elements include cobbles with average diameters of 35 cm.

Two flakes and one flaked stone tool were recorded on site. One flake, composed of chert, is 20 mm long, 20 mm wide, 5 mm thick, and exhibits no cortex. The other flake, composed of chalcedony, is 22 mm long, 7 mm wide, 4 mm thick, and exhibits no cortex. A single flake tool was identified on the site, consisting of a small tested nodule of chalcedony. This tool is 61 mm long, 38 mm wide, 38 mm thick, and exhibits no cortex.

Discussion: These walls have not been definitively associated with prehistoric or historic Native Americans. However, there are qualitative data suggesting that humans, hunting without the aid of horses and guns, constructed the walls. First, the placement and orientation of the walls are not suited to



Figure 30. Structure 6 at site 48PA2820, facing north.

containing animals. In their present condition they can hardly be said to have functioned as pens or corrals for sheep herding or other historic ranching activities. Although some of the structures resemble blinds and windbreaks constructed by the modern hunters, other features, particularly the long, low walls, do not seem to be well suited to modern hunting techniques. Taken together as a unified complex of features, these structures may be well suited to directing the travel of animals to a predetermined point on the landscape.

The heavy incrustation of lichens on the upper surfaces (and not the bottom surfaces) of stones incorporated into the walls, and lichen bridging among the dry-laid stones indicate, that the walls were not constructed in the recent past (i.e., within the last 100 years). Only very small numbers of Europeans entered this portion of the Absarokas before the 1870's. The Wyoming Bureau of census reports that fewer than 10,000 people lived in the state in 1870 (State of Wyoming Historic Dates 2007). This portion of the Absarokas is known to have functioned as a hunting area for Protohistoric and historic aboriginal hunters, such as local Shoshone Indian groups (Eakin 2007; Finley and Finley 2004; Hughes 2000; Loendorf and Stone 2006; Nabakov and Loendorf 2004; Shimkin 1986). The argument for a prehistoric/protohistoric age for the site is strengthened by the associated lithic artifacts.

These structures may have been placed to take advantage of prevailing ground-level winds (Figure 31). Upon observing game animals in the trees or above the treeline but below the northern and eastern ridgelines, hunters could have intercepted game by placing themselves behind the animals to the south and east. From these upper vantage points the hunters could have remained hidden. A second

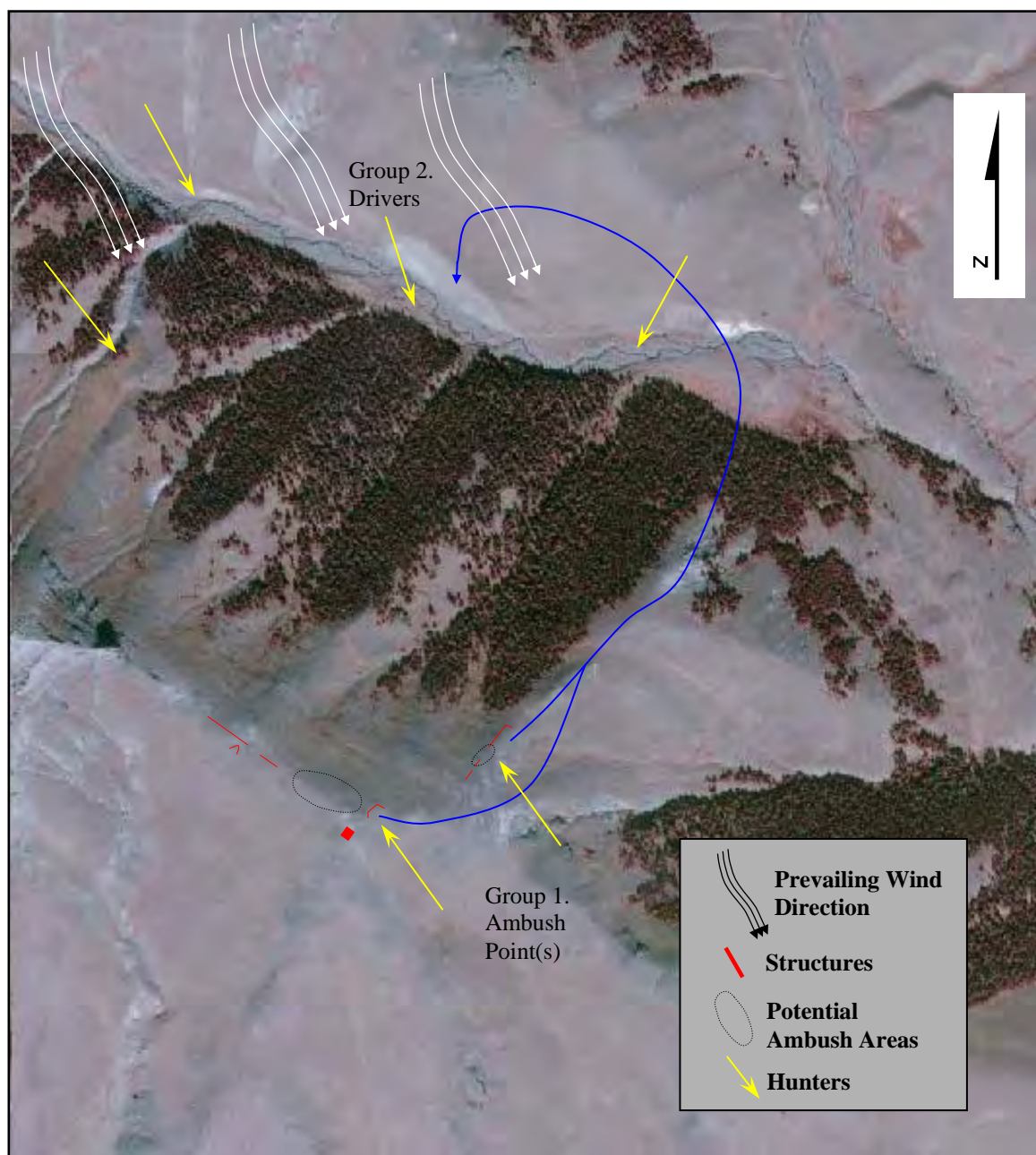


Figure 31. Planview of site 48PA2820 showing the locations of the walls and the possible locations of hunters using the area to drive game.

set of drivers, or beaters, have been necessary to push prey toward the ambush area. The drivers may have used the prevailing wind direction carry their scents towards the prey providing an additional incentive for prey to move towards the kill locations. Ethnographic information indicates that certain types of hunting systems are most effective if the prey animals move slowly towards the kill location (Benedict 1996: 2-3; Loendorf and Stone 2006). This slow pace gives the hunters more time to prepare and aim their shots. Hypothetically, game animals would forage upslope and upon reaching the walls would continue along the walls toward the kill location. Too much noise or disturbance by the drivers would increase the chances that the prey animals would bolt, giving the hunters less time to execute an effective ambush.

48PA2838 - Double D Ranch Structure (Figure 32)

Setting: This site is situated at an elevation of 2539, in the HNV range, on the flanks of a northwest-facing slope that descends from the crest of a long, low northeast-trending ridge. The north fork of the Wood River flows at the base of the slope 200 m directly to the north of the site (Figure 33). The site is located just below a long, flat east/west trending bench. The crest of the ridge is 40 m higher than the site and approximately 250 m to the southeast. The slope at the site location and within the area surrounding the site ranges from 5 to 10°.

The viewshed from the site is dominated by the Wood River drainage, which flows from southeast to northeast. The headwaters of the Wood River are 17 km to the southeast on the slopes of Dollar Mountain, and flows into the Greybull River 30 m northwest of the site. The Middle and South Forks of the Wood join the main channel east of the site at distances of 6 km and 8.5 km, respectively. The abandoned mining town of Kirwin is located 9 km upstream; the surrounding area was heavily used for a variety of mining activities throughout 20th century. The confluence of the Wood River and Jojo Creek is located 620 m northeast of the site below the DD Ranch. A stable supply of water is available from the Wood River, a permanently flowing drainage.

The geologic characteristics of the site and the surrounding area are attributable to Pinedale glacial activities. The surrounding geologic units consist of Wiggins formation volcanic materials, landslide areas,



Figure 32. Overview of site 48PA2838, facing southwest. Wood River, flowing from west to east, is located in the fore ground.



Figure 33. Overview of the Wood River valley from site 48PA2838, facing north.

intrusive igneous materials, and alluvial and colluvial deposits along the river (Love and Christiansen 1985). More specifically, the site is situated on Pitchfork Formation volcanic detritus composed of intrusive igneous stone, perhaps granodiorite. This stone is heavily fractured and forms a talus slope that is considered unique in the immediate the area. The ridge as a whole is believed to be an ice-core rock glacier that covers a terminal moraine of the Pinedale advance (Andrew Mueller personal communication 2007; Breckenridge 1974). A thin mantle of soil has accumulated in the cracks and voids of the talus slope, presumably from aeolian deposition.

Due to the lack of soil on this talus slope vegetation is sparse. Where pockets of soil have accumulated a small number of plants have taken root, and include mixed bunch grasses, sedges and woody shrubs, such as mountain gooseberry. Ground coverage is estimated to be less than 2%. Lichens of an unknown species are present on nearly all of exposed faces of the surrounding stone. Nearby timbers stands consist of lodgepole pine and spruce-fir forests, and include Engelmann spruce, limber pine, lodgepole pine and subalpine fir, and whitebark pine trees.

Site Description: This site consists of a single stone and wood enclosure with a few small fragments of bone of unknown origin. The structure is a circular to oval-shaped depression carved into the talus slope with interior stones removed and piled around the perimeter (Figures 34 - 35). The outer edges consist of a mixture of large in-place talus fragments, transported stone, and integrated wooden elements. From the outer wall edges the structure measures 7.8 m along the N-S axis by 6.1 m along the E-W axis. The lengths, thicknesses and heights presented in Table 2 represent rough estimates due to the amorphous nature of this structure.

Portions of the walls are in good condition (Figure 36). The eastern side is composed of several large pieces of stone that range from 1 to 4 m in diameter. This side is bolstered by the addition of small stones that have been placed to fill gaps between the larger stones. The rest of the outer wall is composed of small (5 cm) to medium (45 cm), dry-laid angular stones placed on top of other large *in situ* stones. These walls are 70 cm to 1 m in height as measured from the floor of the depression.



Figure 34. Overview of site 48PA2838, facing east.



Figure 35. Overview of site 48PA2838, facing northwest. Pack is located at the center of the structure.



Figure 36. Image showing the interior of the structure and the condition of the east wall at site 48PA2838, facing northeast.



Figure 37. Image showing the interior of the west wall and the integrated timbers at site 48PA2838, facing west.



Figure 38. Possible cut marks on integrated timbers at site 48PA2838.

Six pieces of wood are estimated to have been incorporated within and around the structure. These elements consist of fragments of coniferous trees that are 10-15 cm in diameter. Two upright poles occur at the northern and southern edges of the structure. The remaining four wooden fragments are integrated into the stone walls. One fragment in the western wall forms a transverse cross-beam upon which a large piece of talus has been placed (Figure 37). Another fragment appears to have been cut with an unknown implement (Figure 38).

Four fragments of bone that had been placed on top of one wall and two other fragments that were noted on the floor of the structure were in disturbed soils. These four items are moderately weathered fragments of medium-size mammal long bone. The context suggests that the enclosure has been disturbed at some point in the recent past. Disturbance is evidenced by a small area of uncontrolled excavation in the north eastern portion of the enclosure floor. Several stones exhibit freshly exposed surfaces that are light in color and not covered with lichens like all of the surrounding stones. Based on a previous visit to the site by William Dooley, an informant, this disturbance has occurred within the last several years (Lawrence Todd personal communication 2005).

Discussion: The age and function of this site are currently unknown. The bone fragments are of unknown origin and antiquity and may not even be related to the structure. However, it is presumed that this enclosure is relatively old based on several attributes that include the presence of bridging lichens, the relatively weathered state of the wooden elements that are integrated into the walls and the accounts from the recent past from the following two sources. The structure was initially reported to Lawrence Todd by William L. Dooley in 2005. Also, it is probably same structure described by Breckenridge (1974:38) as:

“...a crude semicircular structure of stones piled several feet high with upright pole lodges between them...It probably represents a hunting blind, possibly of sheep hunters, although its exact function is not known.”

As with site 48PA2795, this site does not appear to be the work of sheepherders or modern hunters. Although construction by Euroamericans at some point in the historic past cannot be ruled out, it seems unlikely based on the general appearance of the wooden elements and the degree of lichen bridging among the stones. This structure is tentatively associated with the Shoshonean groups that are known to have used the area during the Late Prehistoric and Protohistoric periods.

Loendorf and Stone (2006:140-142) describe a bighorn sheep hunting technique and structures that the Sheep Eaters built to ambush the sheep (see also Lowie 1909:185). This method was:

“.. premised on familiarity with sheep behavior. To escape from danger the Shoshone knew that bighorn sheep usually retreated from their meadows pasturage by leaping up to rocky precipices and higher outcrops where their sure, quick hooves allowed them to skip rapidly across rough terrain. Hunting in late winter or early spring, the native hunters searched for animals who were grazing in meadows below basalt crags and other dark-colored rocks. Warmed by the sun, the snow on these rocks and talus slopes melted well before the drifts on the flatter slopes. Preparing for this hunting event, the Indians scooped out hiding blinds from the rocky talus, producing circular pits about 5 feet in diameter and 3 feet in depth. Examples of these blinds can still be found in Yellowstone National Park and in surrounding ranges. On a remote spot high on Mount Everts, for instance, a backpacker friend of the park historian Lee Whittlesey told him of U-shaped and circular rocks and logs that sound much like pits seen on the slopes opposite the Gardiner River from Electric Peak. While a portion of the men concealed themselves here, their comrades got into position just below the grazing sheep. At a signal the drivers and their dogs broke out into yells and barking...

Frightened by the imminent danger, the alarmed sheep rapidly scaled the heights to the talus grade as the sought escape. The hunters hidden in the pits close by waited until the sheep were within range and then fired arrows at their white bodies that would have been clearly outlined targets against the darker rocks.

Other hunting-related functions for this structure are possible. It could have served as jump or trap. Game could have been driven from the east and were then corralled within the stone-walled enclosure. However, a highly uneven approach from all sides is presented due to the large gaps among the large broken talus fragments. Perhaps an approach could have been created during the winter months where gaps would be filled with snow and ice is possible. However, additional survey around the structure yielded no evidence of drive lines in the vicinity of the site. It is also possible that animals intentionally were trapped in deep snow drifts that accumulated in the depression (Nabokov and Loendorf 2004:169). This structure could have served as an eagle trap as has been described for site 48PA2795.

Non-hunting functions for this structure should not be ruled out. The walls provide a moderate amount of protection from wind and weather; and the internal area is large enough to have been occupied by several people simultaneously. So the enclosure could represent an expedient campsite or a point from which the Wood River valley could be monitored. The two upright poles are a curious addition and may be related to roofing using branches or materials temporarily transported to the site. No hearth remnants were observed in the structure, and the sorts of lithic materials sometimes found at hunting location, or short-term camp is absent.

48PA2888 - Alignment (Figure 39)

Setting: This site is situated at an elevation of 2888 masl, in the HMT range, on a long, low west-facing side slope. The slope is at the base of the ridgeline that separates the Jack Creek drainage from Willow Creek to the east. A shallow, north-south-trending swale, located 100 m to the east of the site, forms the upper margin of a landslide slump that has subsequently been reworked by erosional outwashing to the south. The landscape to the southwest, west and northwest is characterized by gently undulating slopes

with numerous small swales (Figure 40). This area gradually slopes to the west and terminates at a high bluff that overlooks the deeply incised Jack Creek drainage. Slopes on site are 9-11°. Above the site to the

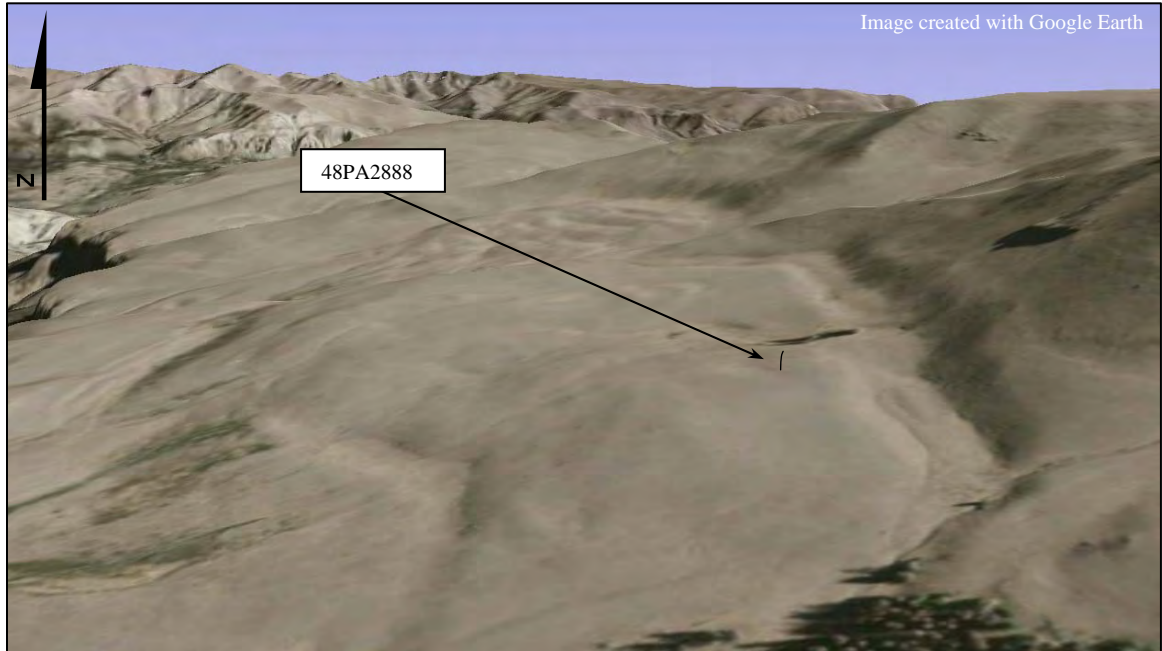


Figure 39. Overview of site 48PA2888, facing north. Jack Creek, which flows from south to north, is located at the left edge of the image.



Figure 40. Overview of site 48PA2888, facing southwest.

east the landscape ascends quickly, with slopes approaching 25°. Large outcrops of conglomerate bedrock project from the slopes that overlook the site area. On the undulating plain below the site the slopes range from 5 to 9° and descend to Jack Creek.

The Jack Creek valley dominates the western viewshed. The creek flows from south to north towards its confluence with the Greybull River 5 km north of the site. Tributary drainages of Jack Creek are located to the north and south of the site area. The surrounding plains to the west are poorly drained and encompass numerous ephemeral ponds, marshes, and grass hummocks. Two small perennial sag ponds are located 600 m to the northwest and southwest of the site. The nearest permanently flowing water source originates in one of these perennial ponds and is located 520 m northwest.

The surface geology surrounding the site is made up of Pleistocene/Holocene slump block/earthflow landslide deposits composed of conglomerate breccias derived from Wiggins Formation volcanoclastic deposits (Ollie 2008). The surface of the slope surrounding the site is covered with semi-buried cobbles of weathered conglomerate materials. Soil consists of medium brown to reddish brown sandy loam, with sands becoming coarser with depth. The soil is at least 25 cm deep along the structure, but deeper soils occur at the base of the slope and throughout the rolling plains to the west.

Dense bunch grasses, cushion plants, and sage brush occur on site. Beneath the vegetation lies a thin detritus. Ground coverage is estimated at 30-50%. Associated vegetation consists of similar shortgrass meadows along with small tree islands of subalpine fir and Engelmann spruce. One small stand of trees to the northeast of the wall appears to be dying rapidly.

Description: The site consists of a single alignment of stones and a small amount of lithic debitage. This alignment is a single course of 290 dry-laid stones that extend in a southwest-to-northeast direction for 122 m (Figures 41-42). Average spacing among the stones is 50 cm to 1 m although some gaps are as much as 3 m wide. In some cases two to four stones are piled together to form small cairns. The natural ground surface is composed of numerous cobbles, and many of the stones in the alignment (about 45) in natural non-culturally-transported positions. The stones used to construct the wall were probably carried a short distance and may have been moved only a few meters. Larger stones ranging from 60 to 90 cm in maximum length) and those that are more than half buried are inferred to be “in-place” elements as

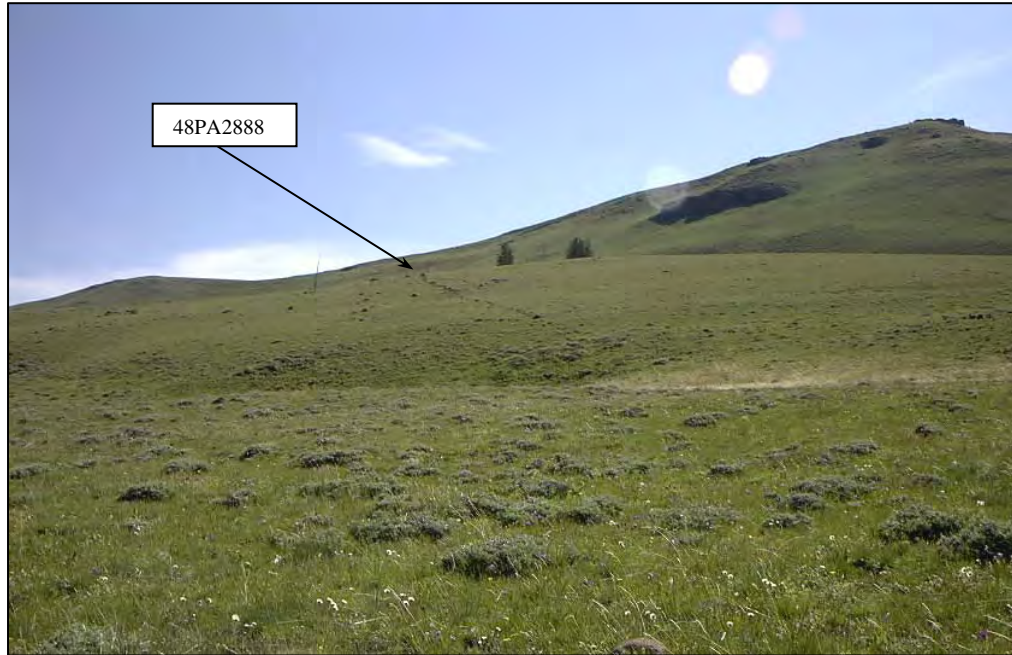


Figure 41. Overview of site 48SW2888, facing northeast.

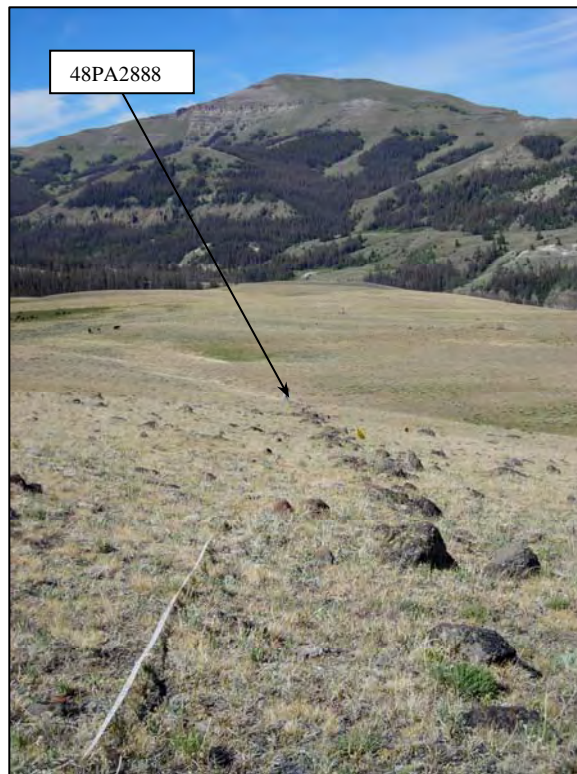


Figure 42. Overview of site 48PA2888, showing the alignment, facing southwest.

opposed to transported elements. Because smaller stones were more difficult to identify conclusively with respect to placement, stones below 5 cm in length were not included in the counts. Some portions of the alignment appear to have been moderately disturbed with some stones having been knocked out of aligned positions. Whether this disturbance is the result of frost heave, natural geologic processes, animal disturbance (either wild or domestic species), or human alteration is unknown.

The alignment is oriented 48° from true north and gradually runs up the slope at a low angle. The alignment begins on the toe of the slope immediately above a short, steep incline that defines the margin of a landslide, and continues up the slope, terminating approximately 60 m below the top of the slope. Slopes along the alignment are 18° at the base and decrease to 8° at the upper end. Above the alignment to the northeast the slope gradually levels off to $3\text{--}5^\circ$. This feature is visually obtrusive with respect to the surrounding landscape, and its orientation differs from the surrounding bedrock outcrops and cobble fields.

A few pieces of debitage were noted on site but were not formally analyzed. The artifacts consist of approximately 5-10 flakes of quartzite and chert. Most were located around the alignment stones; in one case a flake was placed on top of one of the small cairns, perhaps by a curious rancher.

Discussion: The age and function of the alignment are unknown but it is potentially associated with the site 48PA2893, a dense lithic scatter, or other sites in the surrounding area (Figure 43). Diagnostic artifacts at these sites range in age from Paleoindian to Late Prehistoric. The degree of lichen growth and the presence of transported stones with bridging lichens may indicate that the wall is relatively old. The amount of sediment deposited around the stones indicates that the wall has been in place long enough for significant pedogenic processes to have occurred (Figure 44). Testing is underway to determine the age of the alignment based on optically stimulated luminescence of the soils below a transported stone.

The alignment is similar in some ways to portion of the nearby Boulder Ridge Sheep Trap site (Figure 45). This site is tentatively associated with a Late Prehistoric or Protohistoric age. It is suggested that the converging alignments of the Boulder Ridge site were used to drive big horn to a kill site (Eakin 2005; Finley 2004; Frison 1978:257-285, 1991:248-249). The Jack Creek Alignment is far shorter and does not have any obvious pound feature at either terminus. These differences make functional comparisons with Boulder Ridge difficult to support. Perhaps the alignment was used in conjunction with

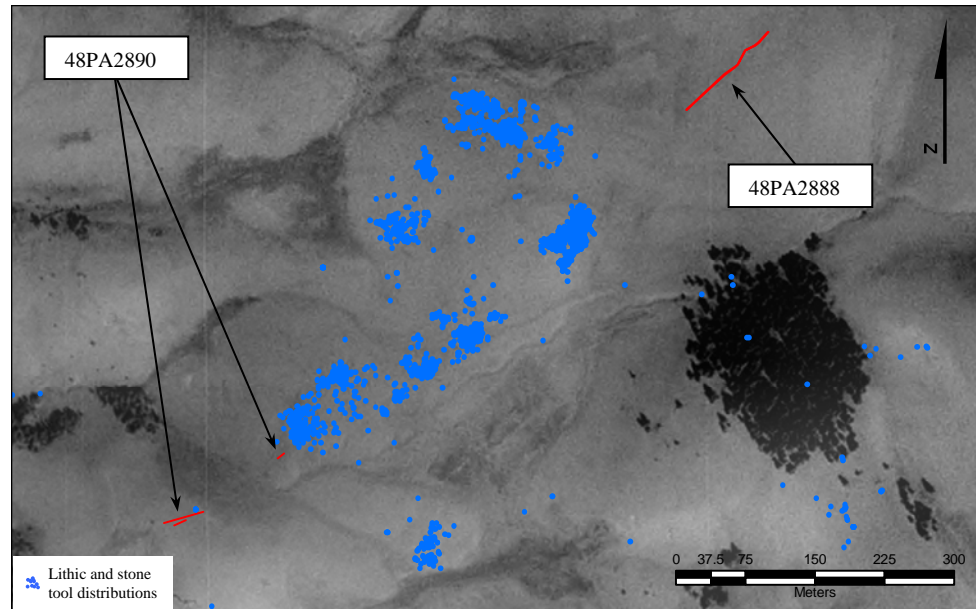


Figure 43. Map showing the relationship between sites 48PA2888 and 48PA2890, and the distribution of lithic materials throughout the surrounding area.

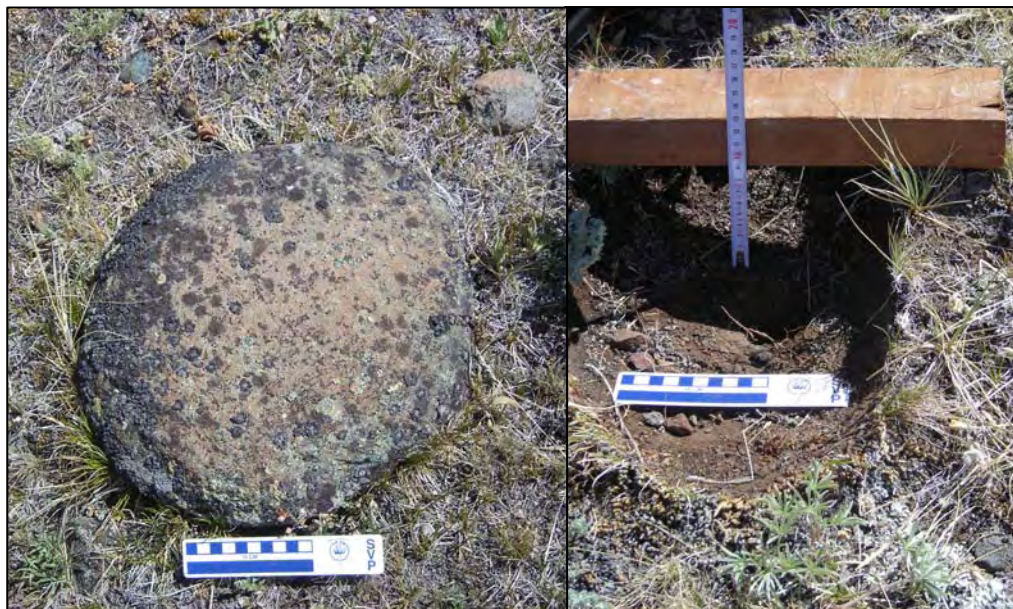


Figure 44. Image showing the sediment depth that surrounding stones at site 48PA2888. Photo taken during extraction of soils for dating using Optically Stimulated Luminescence

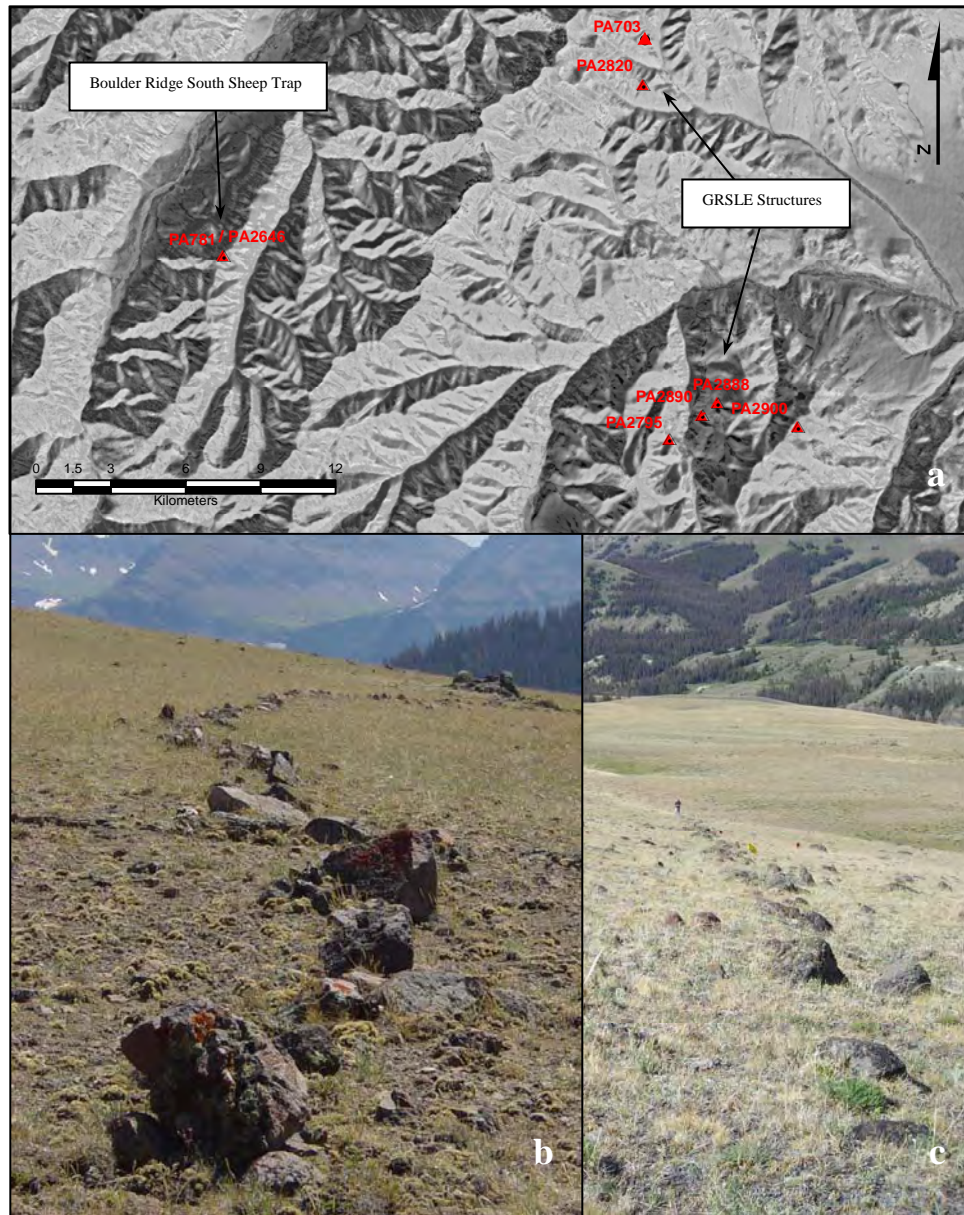


Figure 45. Showing a) the spatial relationship of the Boulder Ridge sites and the GRSLE sites; b) the alignment at Boulder Ridge South (48PA781) (Finley and Finley 2004:18) and; c) the alignment at 48PA2888.

perishable nets, or a pound constructed of tree branches (see Frison 1991). Other potential hunting-related functions could have involved the use of fire, large hunting parties, or wooden fences that have since been removed for other uses. Non-hunting-related functions are also possible.

48PA2890 – Three Alignments (Figure 46 and 47)

Setting: This site is situated at an elevation of 2812 masl, in the HVM range, in rolling terrain above the bluffs that form the eastern wall of the deeply incised Jack Creek drainage. The structures (Figure 46) are located on two surfaces which include a south-facing side slope and the crest of a low ridge that ends at the bluffs. The area is bounded on the north and south by numerous east/west-trending drainages that flow into upper Jack Creek and are responsible for the rolling character of the landscape. The narrow v-shaped valley below the site was created by intense down cutting action of Jack Creek.

The surrounding plains to the east are poorly drained and exhibit numerous ephemeral ponds and marsh areas with expanses of grass hummocks. A small pond is located 300 m to the southeast of the site. The nearest permanently flowing water source originates from this pond and passes below the site 180 m to the southeast.

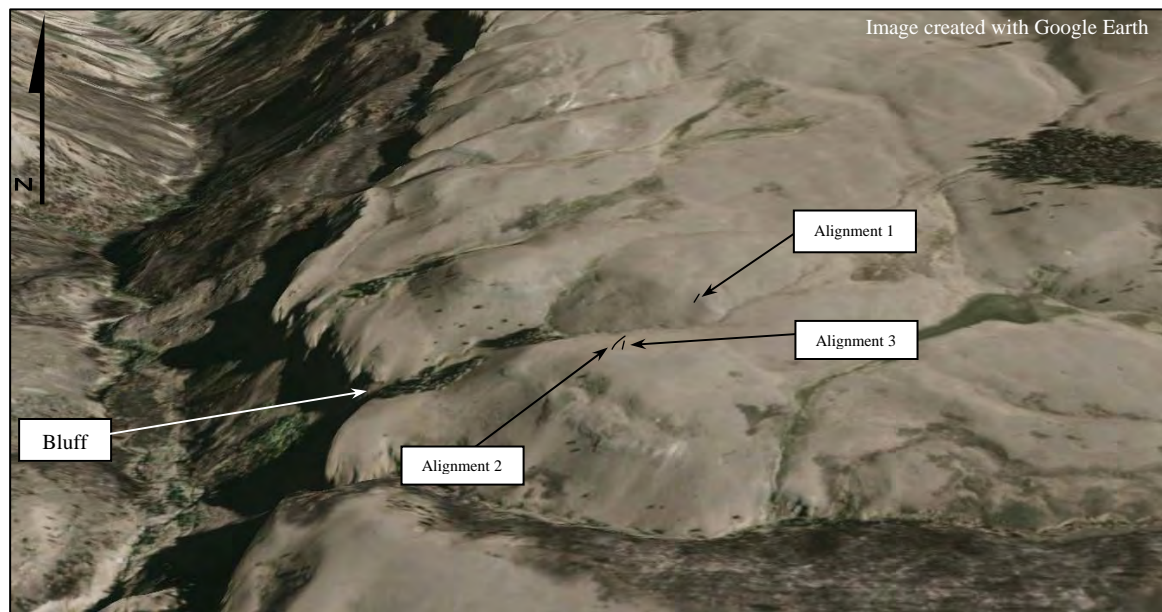


Figure 46. Site overview of 48PA2890, facing north. A low bluff that could have been used to jump prey is located at the western edge (center left) of the Jack Creek valley.

Surface geology and soils are to those of site 48PA2888. Surfaces of the slopes surrounding the site are covered with semi-buried cobbles of weathered conglomerate materials. Soil on the low ridge where two of the structures are located are composed of coarse sands and small gravels with minor amounts

of silt-size particles mixed throughout the matrix. The northern occupies constructed on a heavily eroded slope, and there is very little soil surrounding the stones. Vegetation surrounding site 48PA2890 is the same as site 48PA2888.

Description: The site consists of three stone alignments located on two sides of an ephemeral drainage. No artifacts are associated with this site.

Alignment 1 is situated on a steep south-facing talus slope and consists of an ephemeral line of stones running down the steep slope (Figure 47 and 48). It is 19.9 m long with a bearing of 55°. This alignment has a maximum width of 25 cm, and maximum height of 25 cm, and incorporates 88 cobbles with average size ranges from 30 cm. A few larger cobbles (up to 65 cm) were noted. On average, stones are stacked about 20 cm apart with some undefined gaps of up to 1 m. Because this alignment traverses a rocky slope it is difficult to determine if many of the stones were transported to the present location or are in place specimens. Lichen bridging among the stones was observed.

Alignments 2 and 3 are located on the crest of a low, gently sloping east/west-trending ridge south of Alignment 1. This ridge extends from the rolling plains to the east approximately 400 m to the bluffs west of the site. Alignment 2 is 45.35 m long and has a bearing of 75° (Figure 49). This alignment has a maximum width of 25 cm and a maximum height of 13 cm, and incorporates 128 cobbles with average size ranges of 25 cm. A few larger cobbles (up to 76 cm) were also noted. Alignment 3 is 12.81 m long and has a bearing 66° (Figure 50). This alignment has a maximum width of 20 cm and a maximum height of 11 cm, and incorporates 57 cobbles with average size ranges from 19 cm. The largest transported stone is 46 cm in diameter. Many of the stones in Alignment 2 and 3 were covered with lichens, and lichen bridging was noted among some transported elements. On average, the stones in these alignments are situated 20-35 cm apart with some gaps of up to 1 m.

Discussion: The age(s), function(s), and even the associations among these alignment are unknown. In general this site is presumed to be prehistoric for the same reasons as those stated for 48PA2888. Lichen bridging, and sedimentation around the stones indicate the alignments are old. These alignments are probably associated with dense prehistoric lithic scatters located immediately to the northeast (Figure 43).



Figure 47. Overview of site 48PA2890 looking north from alignments 2 and 3. Figures at center are positioned along alignment 1.



Figure 48. Overview of alignment 1 at site 48PA2890, facing southwest.

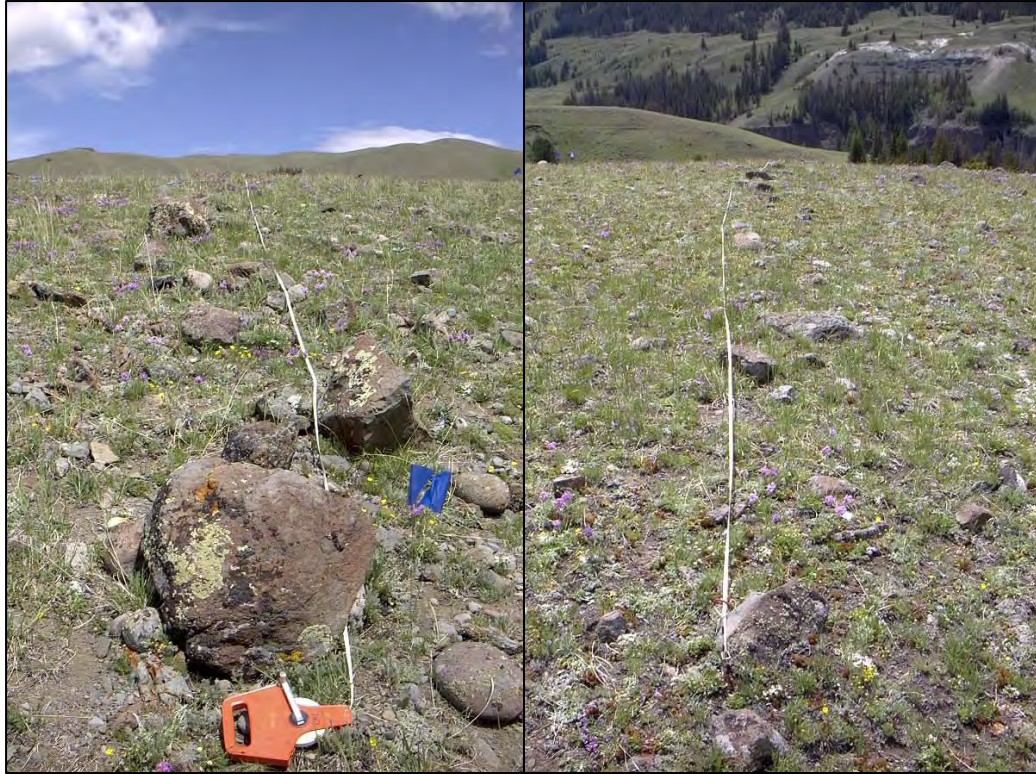


Figure 49. Overview of alignment 2 at site 48PA2890, facing northeast (left) and southwest (right).



Figure 50. Overview of alignment 3 at site 48PA2890, facing southwest.

48PA2888 and 48PA2890 - Intersite Comparison: It is unknown if the alignments at sites 48PA2890 and 48PA2888 are related. Based on the general similarity of their orientations, a potential relationship should at least be acknowledged. All of the alignments run roughly southwest to northeast, and appear to follow a similar course. It is possible that game animals were herded together to the northeast of 48PA2888 and driven towards a jumping site along the short bluffs that overlook Jack Creek (Figure 46). A hypothetical drive line could have been bounded on the northwest and southeast by marshy areas or shallow ponds (Figure 43).

48PA2900 - Kay Creek Wall (Figure 51)

Setting: This site is situated at an elevation of 3083 masl, in the APP range, on an open slope facing east – southeast that overlooks the Bighorn Basin. The site is located 200 m east of a low rise on a north/south-trending ridgeline. This ridgeline ascends to 3284 masl at the summit of Phelps Mountain located approximately 2 km southwest of the site. The site is situated on an open, rolling slope that ranges from 10 to 20°. A few small outcrops of conglomerate bedrock project from the surrounding slopes that overlook the site area.



Figure 51. Site overview of 48PA2900, facing northwest.

The site overlooks the headwaters of a small unnamed tributary drainage of the Francs Fork River (Figure 52). This tributary flows west to east, carrying melt water from the east-facing ridge 4.4 km to the river. Kay Creek begins below Phelps Mountain, to the south of the site, and flows west to east toward its confluence with the Francs Fork, 6 km east of the site, and there are numerous unnamed tributaries of the Francs Fork to the east of the site. A small perennial pond is located 1.3 km to the northeast of the site.



Figure 52. Site overview of 48PA2900, facing southeast.

The slope surrounding the site is covered with semi-buried cobbles of weathered conglomerate. Soil on the site consists of medium brown silts, with coarse sand, pebbles, and gravels. Vegetation consists of bunch grasses, cushion plants, sage brush and numerous mixed forbs. Ground coverage is estimated at 20-40%. This site lies approximately 50 m above the effective tree line of 3040 m.

Description: The site consists of a short wall segment, a cairn, and a single lithic tool. The wall is slightly curved with the arc opening to the west. This wall consists of 36 dry-laid stones stacked tightly together. This structure is 1.56 m in length, and has a minimum width of 30 cm and maximum width of 81 cm, and a maximum height is 66 cm (Figure 53 and 54). The average diameter of stones in this structure is 28 cm.



Figure 53. Overview the structure at site 48PA2900, facing southwest. Chaining pin included for scale.



Figure 54. Overview image showing the structure at site 48PA2900, facing south.

One potentially associated flaked stone tool was found 33 m southeast of and downslope from the structure (Figure 55). This tool, made of light gray fine-grained quartzite, is 64.4 mm long, 60.1 mm wide, and 19.3 mm thick and has no cortex. This item is a core or a cobble tool. Flakes have been removed from both faces. On one face nearly 75% of the edge has been flaked and the opposite side about 25% of the edge exhibits flaking.



Figure 55. Flaked stone tool located at site 48PA2900.

Discussion: The age of this structure is unknown. Freshly exposed surfaces on some of the stones and lack of heavy lichen cover and bridging suggests that it was built recently. It's possible that fresh stones have simply been restacked on an older incarnation. The surrounding area, especially the ridge to the west, is covered with numerous cairns. These cairns appear to have been built recently and may be related to the heavily traveled road that continues past the site from north to south along the ridge top. A small cairn was found to the east of the site approximately 140 m. No obvious cairn lines, alignments or stone walls were identified in the immediate area. If it is associated, the flaked stone tool may support a prehistoric age for this structure. The wall at site 48PA2900 may have functioned as a windbreak, hunting blind or as a location marker.

Galena Ridge Survey and Structure

Galena Ridge Survey: (Figure 56) Prior to the 2004 field season very few large scale surveys had been conducted in the higher elevation areas of the GRSLE Project area. As an initial step in this thesis project and in an effort to identify the background density and distribution of sites in the APP zone, a systematic sample survey of the Galena Ridge area was undertaken. Galena ridge is a large, relatively open and flat to gently rolling plateau with elevations that range from 3560 m to 3680 m. This ridge overlooks the Greybull River valley to the west, and Meadow Creek basin to the east. An area of 2.5 km² was surveyed over the course of three days by the CSU field school, with crews of between 9 and 11 surveyors walking transects at 10 m intervals. This survey identified numerous modern cairns, a modern trash scatter, a modern wall, and one prehistoric artifact consisting of small chert flake. The limited results of the survey suggest that prehistoric groups were not using Galena Ridge for intense lithic reduction and/or settlement activities; although the area may have been used in ways that simply do not leave an extensive archaeological footprint. Conversely, historic and modern groups appear to use the area more frequently. A prominent trail runs along the ridge and the numerous cairns and the modern wall are probably the remains of historic sheep herders and modern bighorn sheep hunters.

Galena Ridge Structure: (Figures 57-58)

Setting: This wall is situated at an elevation of 3568 masl, in the APP range, on Galena Ridge. It faces northwest and overlooks the headwaters of the Greybull River. This north/south-trending ridge undulates both vertically and to the east and west, eventually ascending to Francis Peak (4002 masl) approximately 6.8 km north of the site. Galena Ridge falls away rapidly to west, descending 500 m to the River, and Brown Mountain lies 1.6 km to the south. Areas of natural patterned ground and rock stripes are present across this surface. A narrow band of wet marshy ground to the east forms the headwaters of canyon creek which flows first to the south before bending to the east toward the Wood River.

Soil in the area is generally a thin mantle of sands and silts distributed in the interstices of the volcaniclastic materials. Vegetation surrounding the site consists of bunch grasses, cushion plants, and

numerous mixed forbs. Ground coverage is estimated at 5-20%. Associated vegetation communities consist of similar shortgrass meadows. The site lies 500 m above the effective tree line of 3040 m.



Figure 56. Overview of the Galena Ridge survey area. The red line indicates the approximate boundary of the survey area.

Description: The site consists entirely of a wall segment. This wall is slightly curved with the arc opening to the southeast. It is 2.28 m long, 1 m high, and has a minimum width of 28 cm on the southwestern end and maximum width of 82 cm on the northwestern end. The structure rests on a patch of outcropping bedrock. Lichens are located on the bottom surfaces of many of the stones.

Discussion: During field recording it was presumed that the wall was modern. No prehistoric artifacts were observed in association with the wall. Lichen on undersides of wall stones suggest that they were placed recently, and no rock-to-rock lichen bridging was noted. Very little fallen rock was observed around the around the base of the wall.

The field assessment was by Bill Dooley. Dooley reported that he had build the as a wind break during a hunting trip along the ridge during the 1990s. This site provides some useful information as an example of the differences among old and modern high altitude stone structures.



Figure 57. Overview showing the location of the structure on Galena Ridge facing southwest.

Chapter Summary

This chapter has described the seven sites within the GRSLE project area with stone and wood structures, which were recorded during the 2004-2005 field seasons. Each of these sites could have hunting related functions; however, other functional interpretations should not be dismissed. Of these sites, 48PA2795, the Pickett Creek site, 48PA2888, and possibly 48PA2900 have small associated assemblages of lithic artifacts. None of these sites exhibit temporally diagnostic artifacts, although, sites 48PA2795 and



Figure 58. Overview showing the location of the structure on Galena Ridge, facing southeast.

48PA2838 both include integrated wooden elements, which indicate that construction or reuse within the last 200 years is likely. The Pickett Creek site is the most complex and probably functioned as a system that allowed prehistoric/Protohistoric hunters to direct the movements of prey. The enclosure at site 48PA2795 is proposed as an eagle trap. The prehistoric/Protohistoric alignments at sites 48PA2888 and 48PA2890 are anomalous, but may have functioned as drive lines for direct prey. The structure at site 48PA2838 is proposed as a blind for hunting bighorn sheep. The construction of this site is tentatively attributed to Late Prehistoric or Protohistoric Shoshone Indians, also known as Sheep Eaters. The age of the structure at site 48PA2900 is ambiguous. The Galena Ridge structure is known to have been constructed recently based on evidence supplied by a local informant. This structure was included for comparison with the other six sites.

The presentation of these site data are a primary goals of this thesis. The functional interpretations that are proposed for each site are preliminary and should be reevaluated as more evidence and analytical techniques become available. The following chapter uses data gathered during the field investigations to explore analytical techniques that are less reliant on functional interpretations; also, an attempt is made to look for site patterning at a regional scale.

CHAPTER 5

SUMMARY DISCUSSION AND CONCLUSIONS

Regardless of function, stone structure sites have unique and often untapped data that should be more fully integrated into investigations and interpretations of prehistoric hunter-gatherer subsistence and landscape use. The summary discussion is oriented toward building a case for the collection of specific data types at sites with prehistoric stone and wood structures. No single data collection regime is proposed here as other investigators will undoubtedly have questions that require contextually specific data collection techniques. However, baseline landscape and structure data, as detailed in Chapter 3, should always be collected. Examples of how these data can be used are provided in the following three analyses. The first analysis compares stone and wood structure sites in northwestern Wyoming based on information from Wyoming site forms. Second, the structure measurements are used to generate baseline labor investments by using data collected from replicative construction of walls, alignments, and platforms. Third, landscape and structure data are used to explore the concept of a topographic signature for high altitude stone and wood structures. This discussion begins by exploring some of the limitations that currently plague data collection with regard to stone and wood structure sites.

I. Defining the Problem with Available Data and Data Collection

What more can be said about prehistoric human landscape use, subsistence, and behavior from piles of rocks that are, in many cases, functionally ambiguous? These types of sites have only been addressed in academic publications by a small number of researchers (Benedict 1975, 1981, 1985, 1990, 1996, 2000; Deaver and Peterson 1999; Eakin 2007; Frison 1991, 2004; Frison et al. 1990; Finley and Finley 2004, Hartley and Vawser 2005; Malouf 1961) and, in many cases, crucial details about the structures are lacking. Many of these sites were found on survey and were only visited once. This limits the data to the site forms and sometimes brief field notes. When assumptions are made about site functions, the datasets tend to support the assumed function. Finally, most archaeologists take the time to measure and quantify the structures and their internal composition, but they seldom attempt to use these

data to describe the site phenomena. In general there seems to be frustration about what types of data to record for these sites and what to do with the data once they have been gathered. I suggest that these perceived problems are an outgrowth of the narrow types of questions that are commonly asked about these anomalous stone and wood features, and that more thorough analyses can and should be attempted.

State Historic Preservation Office Site Forms: A Mixed Bag

Synthesis of the information gathered from site forms for high altitude stone structure sites was difficult because existing data were collected unsystematically and presented in numerous ways through time. Many of the data were buried in gray literature (e.g., cultural resource management site forms and project reports) and were difficult to access. During this research it became clear that the using Wyoming site forms to attempt quantitative comparison was not always possible. Very old “forms” sometimes consisted of little more than single sentence site descriptions. In some cases more recent forms lacked specific information about the features. Thus, the availability of quantitative and comparative data for structures was inconsistent. Often when measurements were provided they were inadequately defined. On the other hand, some of the forms contained large amounts of useful information, and indicated curiosity and interest in the sites and structures. However, quantitative data were not used for further analysis of structure attributes, and these sites were rarely discussed in terms of what they might represent with respect to broader archaeological questions, such as landscape use or subsistence.

Reviewing the Site Forms

A search of the Wyoming Cultural Records Office (WYCRO) database was conducted to identify comparable stone structure sites in the region. While it is possible that additional information about the following sites was available in actual project reports, it was not feasible to acquire a copy of each report.

The northwestern corner of Wyoming was used as the sample area for the site form review. This area encompasses and is roughly centered on the GRSLE project area and thus forms a practical sample area for exploring potential patterns of structure locations, types, and ages. This area encompasses a range of landscape types including mountains and intermountain basins. The sample area includes Big Horn, Fremont, Hot Springs, Park, Sublette, Teton, and Washakie counties and includes the Yellowstone area.

Within each county, stone structure sites were queried with keyword searches of the “Features” and/or “Site Type” categories. Keywords included: alignment, blind, cairn, circle, corral, drive, driveline, game, hunting, kill, medicine wheel, pound, ring, rock feature, stand, stone, structure, and wall. Sites were examined and sometimes removed from the results on a case-by-case basis. Reasons for rejection included insufficient information, site form errors, or a lack of comparable features. The individual site forms were reviewed for specific comparative information. This information is summarized in the Appendix B and represents fairly generic data points so that all sites could be compared effectively.

The site forms reviewed in this exercise exhibited a range of information. Infrequently forms included highly detailed site and feature level descriptions. More often, the site forms contained little information beyond a keyword or phrase (e.g., alignment). Ninety-six forms were culled from the original searches that yielded hundreds of potentially relevant sites. Information from site forms was reviewed and entered into a database, and locational information was compiled in a GIS. Data were generalized to allow for coarse-grained comparisons of structure types. Admittedly, the site types presented on the forms are inadequate as sites seldom conform to a single category, and more descriptive investment is placed on some features and less on others (Kalasz 1988:49-50). Comparative site data include: regional distributions, elevation zones, presence or absence of associated artifacts, temporal associations (when available), eligibility recommendations, and functional assessments (when available).

Results of the Site Form Review

The review of the 96 site forms yielded information for all of the categories listed above. However, the utility of the information is variable. Specific results for each category are discussed below.

Site Distributions: In general, the areas where the sample sites were identified are restricted to places where environmental compliance studies have been conducted (Figure 59). Many of these surveys are related to petrochemical exploration or transportation (e.g., pipelines and well pads). Other surveys were conducted as inventories of public lands (e.g., BLM or Forest Service). Very few of these studies were conducted strictly for academic purposes. These surveys include non-systematic exploration and

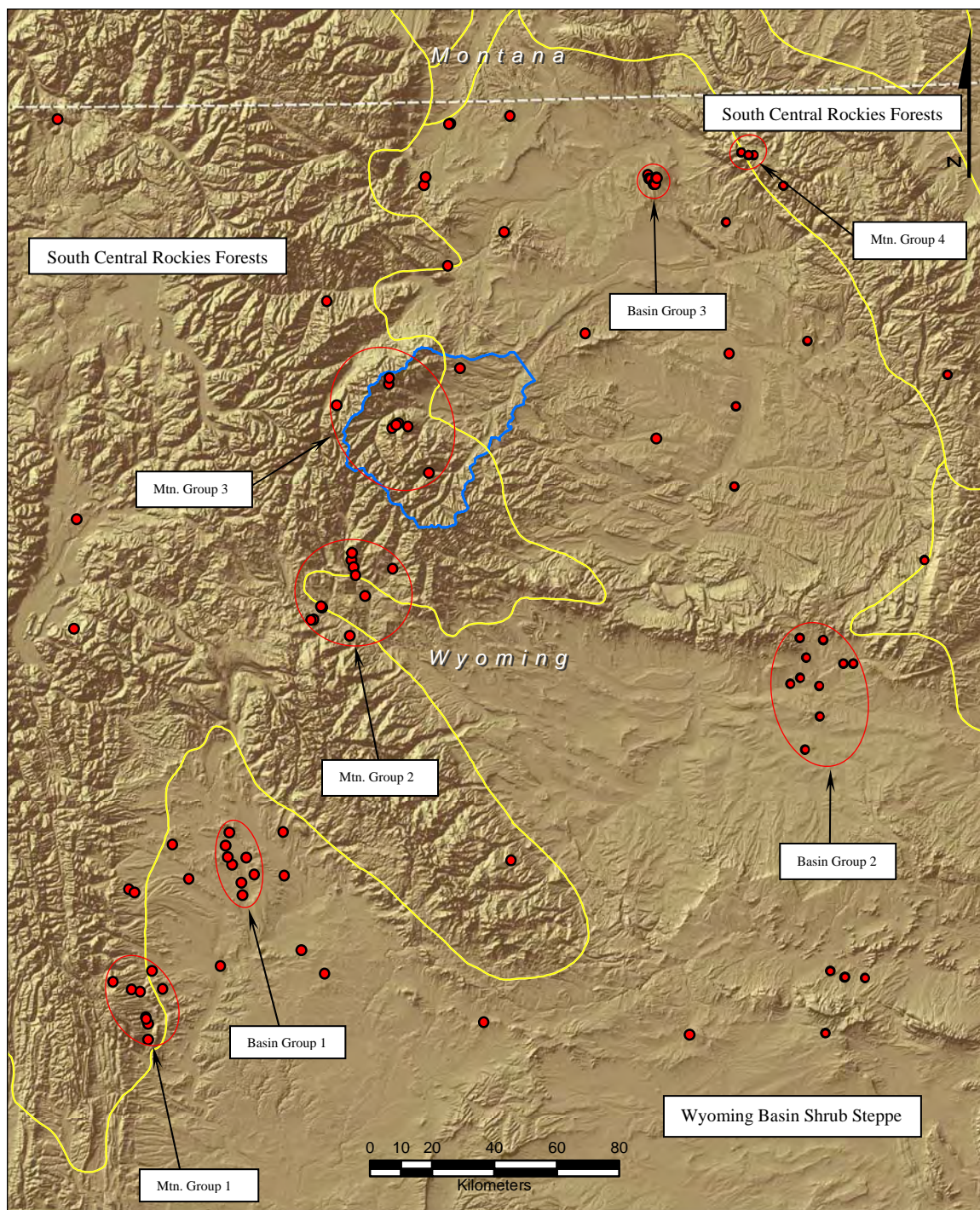


Figure 59. Overview of northwestern Wyoming showing the distributions of prehistoric stone sites across two eco-regions. The yellow line indicates the eco-region boundaries. The red lines indicate site groups. The blue line delineates the GRSLE project area.

prospecting by professional archaeologists, the Boulder Ridge project and the GRSLE project. Thus the locations of the sites depicted and discussed here were biased towards points on the landscape that are not randomly chosen, nor are they necessarily representative of the actual distribution of stone structure sites in the sample area. Site clusters were defined visually and are therefore subjective. Clusters with sites that straddle ecoregion boundaries are included with the region that encompassed the larger number of the sites.

Site locations that fit the parameters of this study are widely distributed with only several areas of clustered stone and wood structure sites. Unlike the high altitude stone structures along the Continental Divide of the Colorado Front Range, the Wyoming sites occur in a variety of environmental settings that include both basin (Wyoming Basin shrub steppe) and mountain (South Central Rockies forests) ecoregions (ESRI® Data & Maps 2004: World Wildlife Fund Terrestrial Ecoregions). The ecoregions are defined in the ESRI® metadata as large areas of land that contain distinctive sets of natural communities and tend to share a majority of animal and plant species, dynamics and environmental conditions (ESRI® Data & Maps 2004). It should be noted that these ecoregions are generalized and sometimes arbitrary with respect to assigning breaks in the landscape at local levels.

Wyoming Basin Shrub Steppe: Fifty-eight sites fall within the basin ecoregion. Far from being topographically homogenous, the areas encompassed in this ecoregion cover the Bighorn, Wind, and Green River Basins. In general, these areas are composed of dissected, open, flat to rolling plains that are punctuated by geologic features. Notably, most of the 58 sites are located on high points and prominent geologic features as opposed to flat open plains. Three clusters of sites were selected as descriptive sample groups based on their proximity to each other (Figure 60). Sites within the groups are compared based on internal composition and topographic placement.

Basin Group 1 is composed of a string of sites with stone structures situated along both the western and eastern sides of the Green River in the northwestern corner of the Green River Basin (Figure 59). This group includes eight sites (48SU1187, 48SU3140, 48SU3200, 48SU4163, 48SU4150, 48SU4257, 48SU4258, and 48SU5368). Two of these sites exhibit only one feature type; 48SU4258 (cairn), and 48SU4257 (alignment). The rest have combinations of stone circles, alignments and cairns.

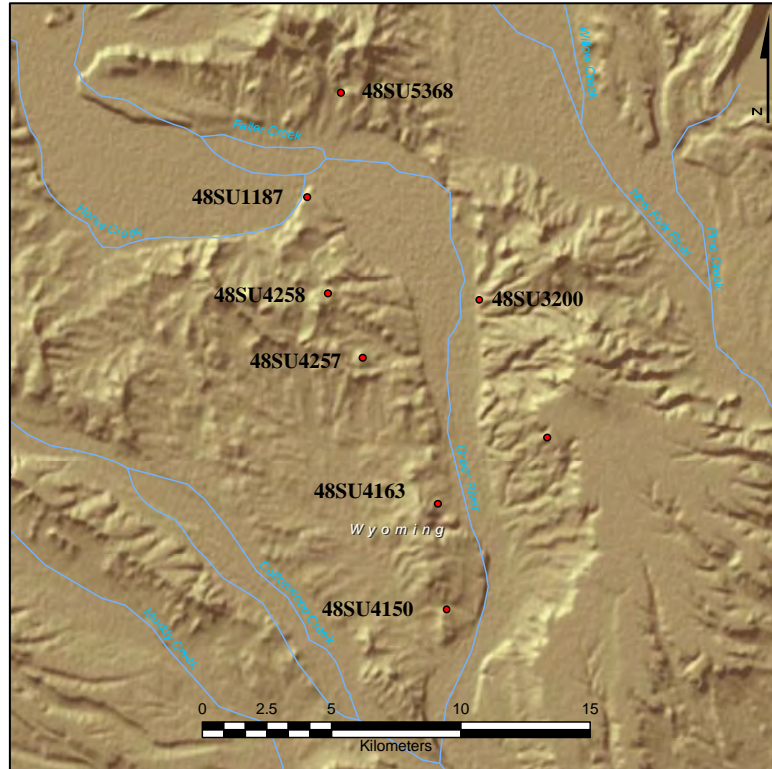


Figure 60. Overview of a portion of the Green River Drainage showing the distribution of sites in Basin Group 1.

These sites are inferred to have been placed so as to take advantage of both the prominent overlook and the proximity to water. Four of these sites are assigned ceremonial functions, while functions of the remaining four are unknown.

Basin Group 2 is located in the Wind River Basin immediately south of the pass between the eastern terminus of the Owl Creek Mountains and the southern tip of the Big Horn Range (Figure 61). This group includes ten sites (48FR3147, 48FR4070, 48FR4283, 48FR4868, 48FR4147, 48FR4274, 48FR4298, 48FR3079, 48FR4390, 48FR5309). One site (48FR4283) consists entirely of cairns, while the rest are composed of combinations of cairns, stone circles, and alignments. The sites are situated on a series of small intermittent creeks that flow westward to the Big Horn River. Many are positioned on prominent ridges and hills. The site distributions suggest that this area was a pinch point on a prehistoric travel corridor, and that the area was used by groups moving back and forth from north to south.

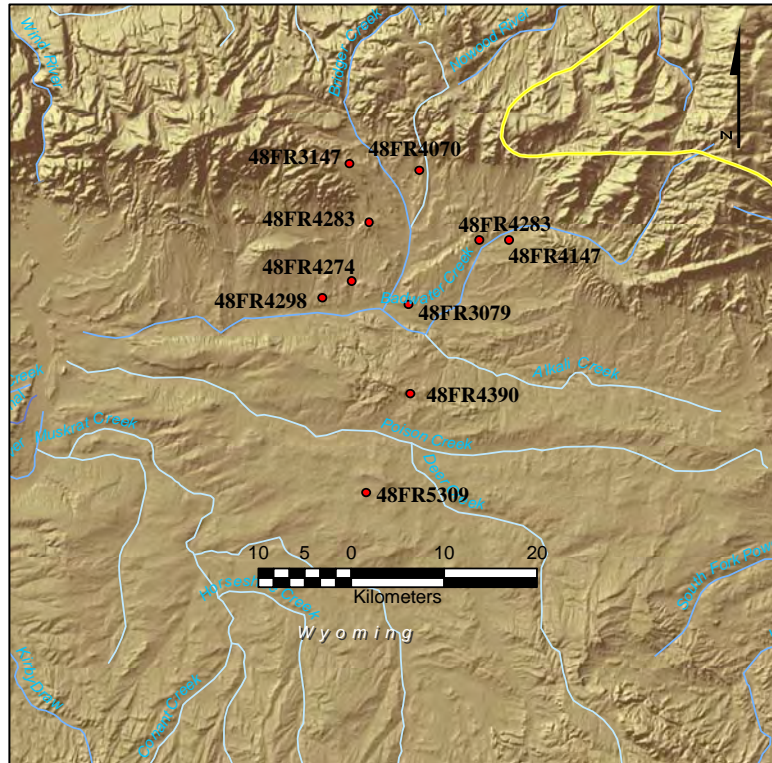


Figure 61. Overview of a portion of the Wind River Basin showing the distribution of sites in Basin Group 2.

With the exception of two sites, all are left functionally unassigned. Site 48SW5309 is assigned a habitation function. Site 48SW3147, which has blind and cairn alignments, is described as a drive line.

Basin Group 3 is the only notable cluster located within the Bighorn Basin (Figure 62). This grouping is situated in the northern portion of the basin approximately 7.5 km west of the Bighorn River channel. This group includes seven sites (48BH1623, 48BH1630, 48BH1656, 48BH1686, 48BH1693, 48BH1703, 48BH1705). These sites consist entirely of stone circles and alignments and are located in topographically diverse settings. Functions are unassigned for most of these sites; site 48BH1630 is described as a camp site, site 48BH1656 and 48BH1686 are associated with features and lithic debris, and site 48BH1705 is described as a lithic procurement area.

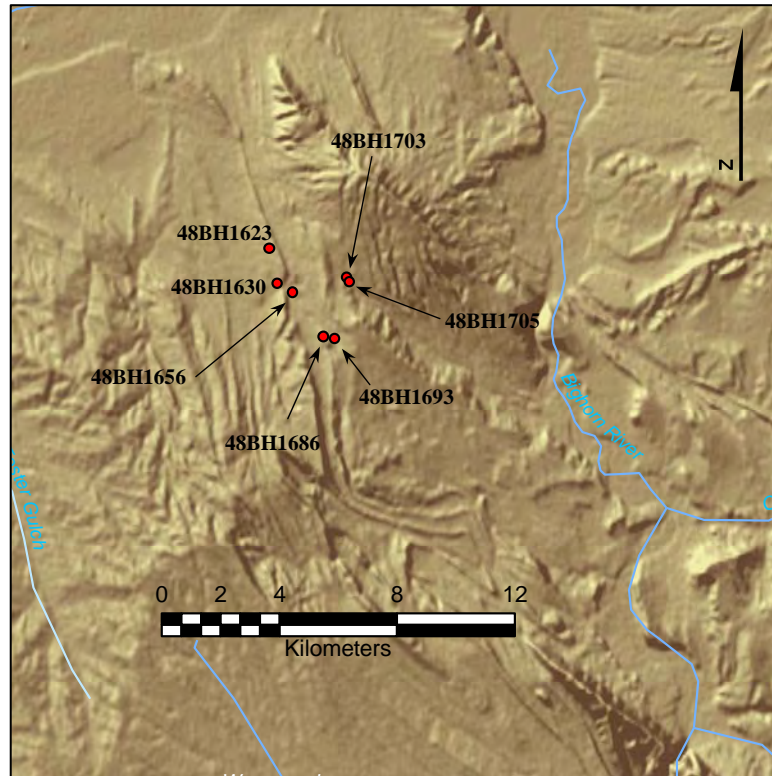


Figure 62. Overview of a portion of the Big Horn Basin showing the distribution of sites in Basin Group 3.

South Central Rockies Forest: Thirty-eight sites fall within the mountain forest ecoregion, and are distributed throughout the Absaroka, Washakie, and Owl Creek Mountains to the west of the Big Horn Basin, the Big Horn Mountains east of the Big Horn Basin, and the Wyoming Range on the western edge of the Green River Basin. This area is composed of foothill transitions from the surrounding basins with moderate slopes that gradually shift to steep slopes, uplands and high ridges. As with the basin groups, most of the stone structure sites in mountain ecoregion are located on highly visible and prominent points and ridges. Four groupings are discussed.

Mountain Group 1 is situated at the northern end of the Wyoming Range at the foothills transition with the Green River Basin (Figure 63), and includes nine sites (48SU505, 48SU678, 48SU878, 48SU938, 48SU911, 48SU1035, 48SU2363, 48SU5115, and 48SU5123). These sites all exhibit combinations of stone circles, alignments, cairns, and cairn alignments, and these sites are generally situated on east/west-trending ridges. In some cases the sites are located on minor bumps or points, while others are on open

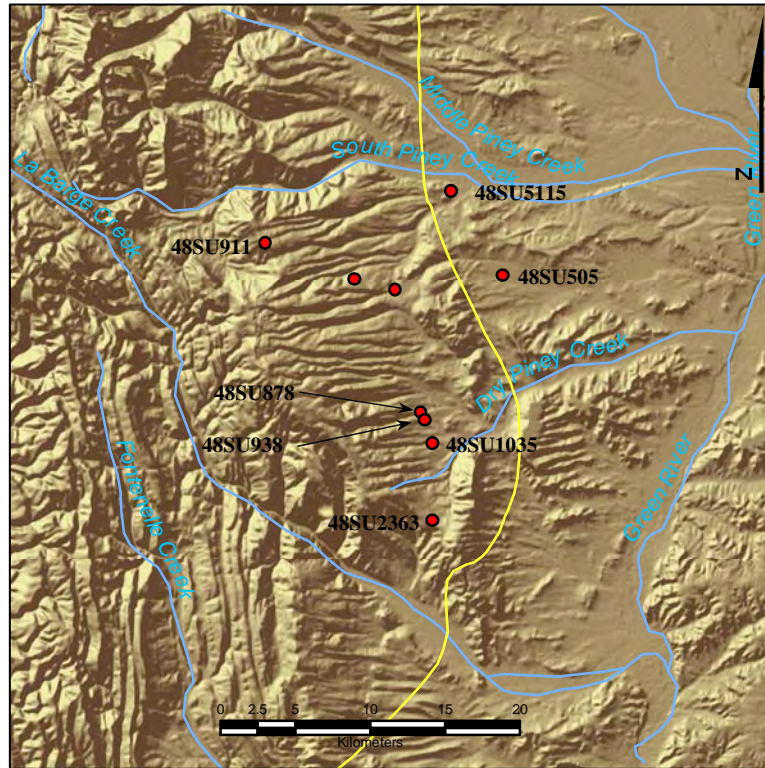


Figure 63. Overview of a portion of the Wyoming Ranges showing the distribution of sites in Mountain Group 1.

slopes. Two sites (48SU505, 48SU5115) are technically situated within the basin ecoregion, but were included because they occupy prominent features of the foothill transition. All of these sites are located at open points surrounded by tree stands with the exception of 48SU505 which is positioned in open terrain. These sites may have been placed so as to take advantage of the east/west-trending ridges. Two sites were assigned functions, and the rest were unassigned. Site 48SU505 is designated as a camp site with an ambiguous alignment, and site 48SU911 is suggested to be a drive line.

Mountain Group 2 is situated at the northern end of the Wind River Basin at the junction between the Wind River Mountains to the south and the Washakie and Absaroka Mountains to the northwest (Figure 64). This grouping is widely dispersed, and includes 12 sites (48FR307, 48FR309, 48FR311, 48FR493, 48FR494, 48FR1546, 48FR1547, 48FR1549, 48FR1814, 48FR2252, 48FR2253, and 48FR2254). Eight sites (48FR311, 48FR309, 48FR307, 48FR493, 48FR494, 48FR2252, 48FR2253, and 48FR2254) have preserved wooden and stone structures that are usually associated with sheep trapping (Frison 1991; Frison et al. 1990). This group is interesting in that it encompasses a nearly homogeneous set of structure types

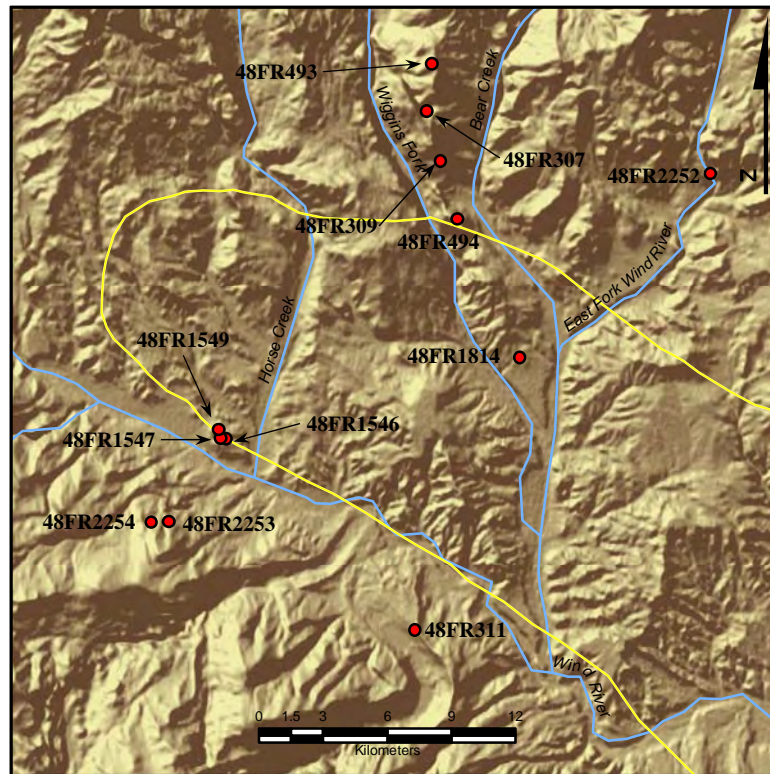


Figure 64. Overview of a portion of the Wind River Range showing the distribution of sites in Mountain Group 2.

that include timber fences, enclosures, alignments, and cairns. Site 48FR309 is unique because it has a stone circle, and this may be why a ceremonial function was assigned along with a hunting-related function. Associations with Late Prehistoric and Protohistoric hunters are premised on dendrochronology information and/or the level of preservation associated with the wooden elements. All of these sites are

Mountain Group 3 is situated in the central Absarokas along the Shoshone, Greybull, and Wood Rivers and encompasses the previously described GRSLE project sites (48PA2795, 48PA2820, 48PA2888, 48PA2890, 48PA2838, and 48PA2900) and three other, nearby sites (48PA703, and the Boulder Ridge Sites 48PA781 and 48PA2646) (Figure 65). This group excludes the modern Galena Ridge Wall. The sites in this grouping consist of a variety of structure types. It is interesting that the description of site 48PA703, a stacked wall, bears a striking resemblance to the structures at 48PA2820. In general, structures consist of alignments, cairns, and enclosures. Stone circles are rare. All of these sites are located on prominent ridges overlooking major drainages. The Boulder Ridge sites are ascribed to hunting. The GRSLE structure functions have already been discussed.

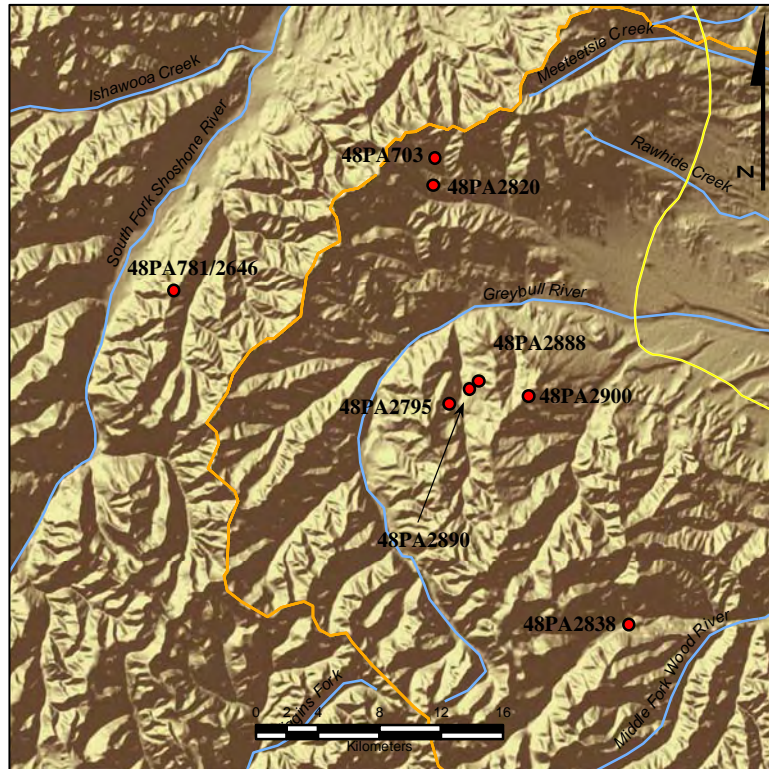


Figure 65. Overview of a portion of the Absaroka Mountains showing the distribution of sites in Mountain Group 3.

Mountain Group 4 is positioned at the northern end of the Big Horn Mountains and includes the Big Horn Medicine Wheel (48BH302) and three other sites (48BH338, 48BH1293, 48BH1995) (Figure 66). The medicine wheel site includes interconnected cairns and alignments; the other three include one cairn site (48BH338), one alignment (48BH1293), and a composite site with stone circles, alignments and cairns (48BH1995). All occur on prominent ridges and/or hill tops. It is difficult to determine if any these sites are related, although the medicine wheel and the cairn site (48BH338) are described as being part of the same complex. Two of these sites, 48BH302 and 48BH1995, are assigned to ceremonial functions. The other two sites (48BH338 and 48BH1293) are both considered trail markers. One of these, site 48BH1293, was originally assigned ceremonial significance but was subsequently associated with a historic CCC camp (circa. 1934), and the other (48BH338) is believed be part of the Bighorn Medicine Wheel complex.

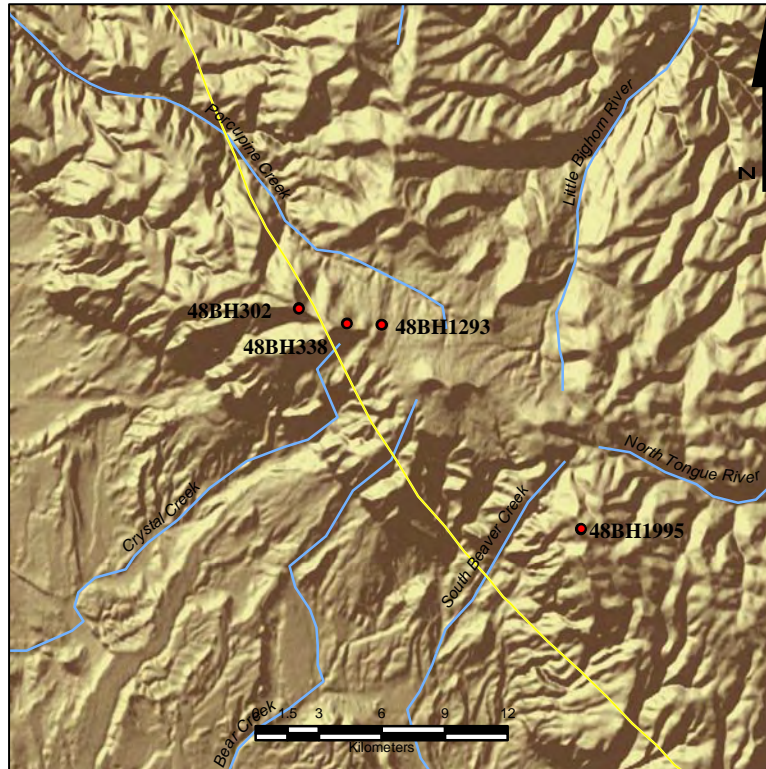


Figure 66. Overview of a portion of the Big Horn Mountains showing the distribution of sites in Mountain Group 4.

Site Elevations: Elevation data were available for all of the sites identified during the records search. Thus a review of the forms was conducted to see if sites with structures exhibit patterned internal variations that correlate with changes in altitude. Sites were divided into three zones. Zone 1 encompasses the Wyoming Basin Shrub Steppe from 1239 to 1857 masl. Zone 2 encompasses a transitional foothills and lowlands range (similar to the FL physiographic zone) and ranges from 1858 to 2347 masl. Zone 3 is the mountain group and includes all sites between 2348 and 3207 masl. Zone 3 corresponds roughly with the combined HMV and APP physiographic ranges.

Zone 1 (Basin): This zone includes 31 sites in Big Horn, Fremont, Park and Washakie counties. Alignments are situated in about equal proportions throughout this elevation zone. Five sites with stone circles only ranged in elevation from 1271 to 1448 masl. Thirteen sites are reported with alignments only and these ranged in elevation from 1284 to 1772 masl. The remaining 13 sites have combinations of stone

circles, alignments and cairns. Thus no strong relationships between specific site types and elevation were noted among the sites in this zone. However, the reports of stone circles tend to taper off slightly with increased elevation. The highest site in this zone exhibits an alignment of cairns and a hunting blind. Over half of the sites include stone circles and 75% have alignments. Very few of the site forms in this zone included descriptions of cairns, suggesting that either the number of cairns decrease in this zone or that alignments of cairns were identified only as alignments.

Zone 2 (Foothills): This zone includes 32 sites within Fremont, Park, Sublette, Teton, and Washakie counties, and Yellowstone Park. Distributions of structure types are mixed across this zone with respect to elevation. Two sites are composed exclusively of stone circles, five sites include only alignments, and three sites are made up entirely of cairns. One site includes what is described as a blind. The remaining 22 sites have combinations of stone circles, alignments, cairns, and blinds. One site has a lined pit and another has an enclosure. Structures described as blinds or enclosures first appear in this zone. Seventy-five percent of the sites in this zone have alignments. Stone circle sites are less prevalent in this zone and make up only 31% of the features. Nearly 60% of these sites exhibit cairns.

Zone 3 (Mountains): This zone includes 33 sites located in Big Horn, Fremont, Park, Sublette, Teton, and Washakie counties. Once again the distributions of structure types are mixed across this zone with respect to elevation and no clear stratification of feature types is evident. One site is reported as having only stone circles. Eight sites exhibit only alignments, and three sites only cairns. One site is reported as having only a blind. The remaining 20 sites are made up of combinations of stone circles, alignments, cairns, wooden elements, blinds, lined pits, enclosures, and one platform. Sixty-five percent of the sites in this zone have alignments, while stone circle sites are less prevalent, making up only 18% of the features. Fifty-three percent of these sites display cairns. Forty-eight percent of these sites are reported as having hunting functions, and a positive correlation between hunting functions is noted with increased elevation.

Zone Summary: Among the three zones some very general patterns are notable. First, stone circle sites are more numerous at lower elevations and decrease with elevation. Eighty-one percent of the sites with stone circles occur within Zones 1 and 2. If these features represent locations of prehistoric/protohistoric settlement (e.g., tipi rings) then this distribution pattern suggests that domestic settlement more often occurred at lower elevations.

On many of the forms the terms “alignment” and “stone circle” were used interchangeably so that stone circle sites may be underreported. Alignments make up 72% percent of the stone structures and are distributed evenly with respect to elevation zone. Cairns tend to occur in higher proportions throughout Zones 2 and 3. Features with wooden elements occur from 2351 to 3041 masl and often co-occur with blinds, walls and enclosures. Stone walls like those described at Dooley’s Pickett Creek Site (48PA2820) only occur above 3000 masl, but the sample size is much too small (n=2) for this to be considered an elevation pattern. In all cases consistent descriptive terminology, counts of feature types, and quantification of the attributes of the features would make this analysis more useful.

Artifacts and Temporal Associations: Fifty-six of the 96 sites with structures are reported as having associated artifacts. The remaining 40 sites (nearly 42%) had no associated artifacts. Prehistoric and other more general temporal associations are very often based on the presence or absence of associated artifacts. In most cases the artifacts types found on these sites include lithic debitage and non-diagnostic tools. With respect to the relatively high percentage of sites without artifacts, it is unclear if the lack of associated artifacts represents bias (e.g., survey error, or issues related to site preservation) in data collection. In general, the paucity of associated artifacts appears to be a characteristic of stone structure sites, and this is supported by the low quantities of artifacts associated with the GRSLE structure sites.

Of the 74 sites with temporal designations of “unknown,” 35 have no associated artifacts. These sites are typically presumed to be prehistoric for unstated reasons. Thirty-nine sites had prehistoric artifacts which were used as the basis for assigning prehistoric or Protohistoric temporal associations. Five sites are assigned to the Late Prehistoric period based on the presence of wood and/or on dendrochronology dates.

Fourteen sites are associated with temporal periods based on the presence of diagnostic projectile points. The oldest site with structures is 48FR4070. Based on the presence of a Pryor Stemmed point this

site may range in age from 8000 to 8500 rcybp. It features stone circles, alignments and cairns (Frison 1991:24). One stone circle site is associated with the Early Archaic period (48SU3352). One site (48FR4283) is assigned a general Archaic date, and has both stone circles and cairns. Ten sites placed within a range from the Late Archaic to the Protohistoric include stone circles, alignments and cairns. A Late Prehistoric projectile point associated with site 48FR1522, which includes a blind. No clear temporal distinctions based on structure types are evident in these data. Unfortunately, the sample of dated structure sites is far too small to be conclusive.

Reported Functional Assessments: Fifty-one site forms include assessments of function. In most cases these functions appear to represent best guesses, and little supportive evidence is provided. A range of functions is suggested, some very specific and others more generalized. Thirteen sites are interpreted to be ceremonial and include combinations of stone circles, alignments, and cairns. Twenty-four sites assigned hunting functions, and the stone features at these sites include all structure types. Sixteen of the 24 sites attributed to hunting are located in highest elevation zone (Zone 3/HMV/APP); none has stone circles. Three sites that are associated primarily with lithic procurement include stone circles, alignments and cairns. Stone circles, alignments and cairn structures at seven sites are proposed to have functioned as trails and/or locational markers. Only one site is associated with habitation. Of the 32 sites with stone circles, 60% were assessed with regard to function. Three of the stone circle sites were attributed to camping activities, one was associated with animal trapping and the rest are assigned ceremonial functions.

The Utility of Reviewing Site Forms

Unfortunately, it is not feasible to analyze measurement and orientation data for individual structures or sites. While some of the site forms yield data that could be compared quantitatively with the GRSLE sites, the majority do not include enough specific data about the dimensions, quantities and orientations of the structures to facilitate analysis. However, some information about general location, elevation, generalized type categories, and presence or absence of artifacts can be gleaned from site forms. Hence, this type of review is considered a partial success. Remedies to some of the problems with the

forms could include creating a specific form that would prompt the recorders to collect more detailed information or establishing a program of systematic site revisits to collect a wider array of data.

II. Generating Labor Investment Estimates

Can labor investment be quantified using count and size grade data collected during field investigations? If so, what does labor investment tell us about the sites? It has been noted in the previous discussion that metric attributes of stone structures are sometimes collected in the field. Several of the site forms from the previous review include simple measurements such as length, width, height, and count information. This information is typically presented in the form of an actual or estimated number of incorporated stones in a structure, as well as generalized and actual or estimated average diameters of stone size within a structure. For the most part, however, nothing is ever done with this information. The following section discusses one simple approach for using the commonly collected metric data to derive a rough estimate of labor investment for the construction of stone structures. The section first describes the replicative building experiment. The data collected during the experimental construction are then used to generate and compare labor investment for the stone structure sites identified in the Greybull project area.

Experimental Structure Types: Three structure types are chosen for this experiment, specifically a wall, an alignment, and a platform. These general structure types encompass all of the basic elements of the structures identified in the GRSLE project and can be used to generate labor investment for most types of stone structures. For this experiment a wall is defined as a line feature consisting of dry-laid stones oriented end-to-end (either making contact or nearly making contact) and with two or more stacked courses. A wall can be straight or curved, and may even form an enclosure when two ends meet. The next structure type is a stone alignment. An alignment is defined here as a single course of dry-laid stones oriented end-to-end but not necessarily touching. These stones can be separated by large distances, perhaps as much as several meters. The last structure type is a platform which consists of low wall that is back filled with stone, presumably to form a level surface on a slope.

Location: Initially the structures were to be built in a location that approximated both the elevation and landform type(s) found in the GRSLE project area. However, this was precluded by poor weather conditions in the mountains at the time of replicative construction. Instead the experimental structures were built at a low elevation on a hogback along the Front Range near Loveland, Colorado.

Materials: To eliminate raw material availability as a variable, the materials used for this preliminary experiment were derived from an existing stone pile. These materials consisted of tabular and angular blocks of sandstone that were collected from a nearby agricultural field and piled along the ridge during the 1940s and 1950s. The piles contained a variety of stone sizes ranging from small gravels to boulders.

Builders: The construction crew consisted of two builders but the collected data were recalculated so that labor investment represents the work of a single individual, and all times presented below represent person hours. It was assumed that structures would take twice as long to build with one person and thus the construction time was doubled. The builders attempted to move approximately the same amount of stone at roughly the same pace for each structure. All structures were built completely by hand.

Construction:

Replicated Wall (Figures 67-68)

The wall shown below (Figure 67) was built on a flat portion of the building site, oriented along the long axis of the hogback. It is modeled after walls at the Pickett Creek site (Figure 68). The length (10 m) and height (50 cm) of the wall were determined prior to construction. The width (30 cm) represents an average taken along the length of the structure and corresponds to the typical maximum length of the stones in the pile. Stones used in the construction were not picked at random. Instead it seemed reasonable to select the largest stones that could be carried comfortably, with one held in each hand. However, sometimes larger and smaller stones were used and thus the stone selection strategy was considered to be expedient rather than completely systematic.

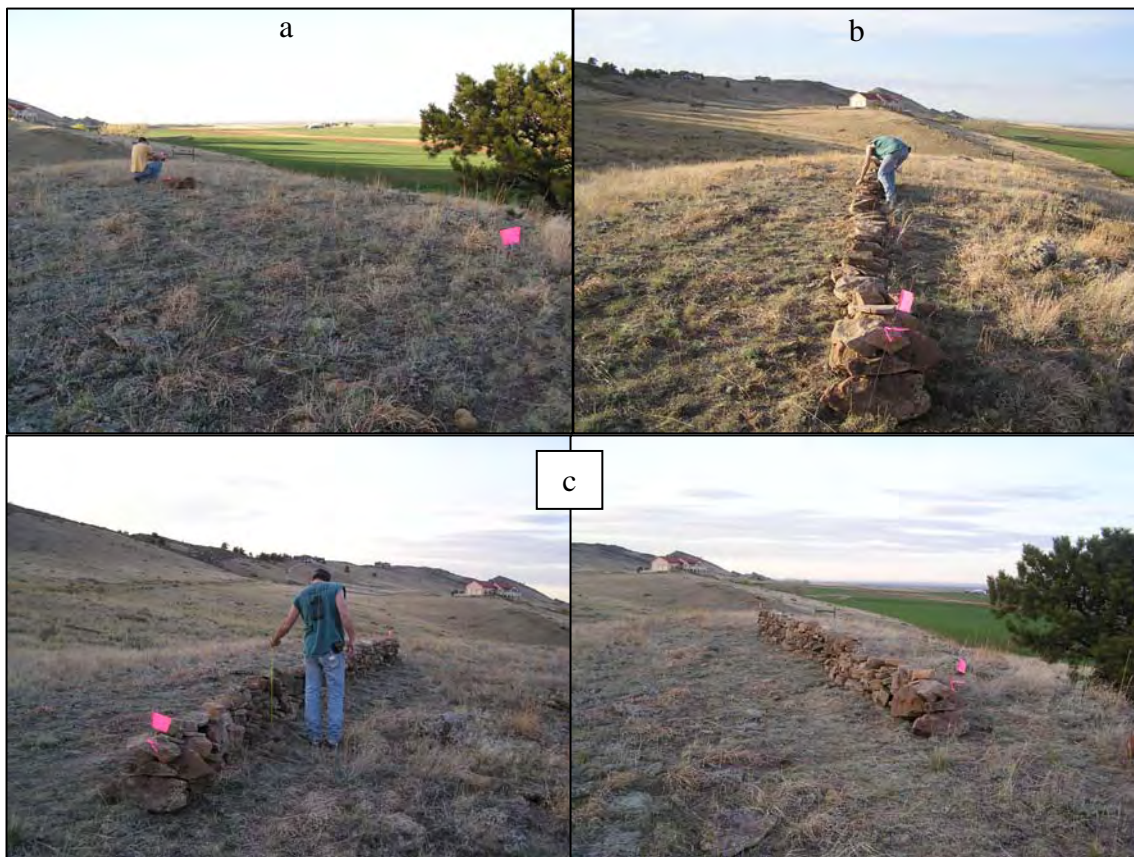


Figure 67. Overview of the replicated wall before (a), during (b) and after (c) construction.



Figure 68. Overview of a wall (Structure 5) at the Pickett Creek site (48PA2820). This wall served as the model for the replicated wall.

Replicated Alignment (Figures 69-71)

The replicated alignment (Figures 69 and 70) was built on an open west-facing slope running up the hogback from south to north at a slight angle to the grade of the slope. This structure is modeled after the alignment at site 48PA2888 (Figure 71). The length of the alignment (50 m) was determined prior to construction. The average height (10 cm) and average width (20 cm) represent the typical size of stones in the pile. The stone selection strategy was the same as that discussed for the wall.



Figure 69. Overview of the replicated alignment during construction, looking south along the hogback.



Figure 70. Overview of the replicated alignment after construction, looking northeast.



Figure 71. Overview of the alignment at site 48PA2888. This alignment served as the model for the replicated alignment.

Replicated Platform (Figures 72 and 73)

The platform (Figure 72) was built on an east-facing side slope atop a patch of exposed bedrock. This location exhibited a similar slope angle and distribution of stones on the surface to the platform at the Pickett Creek Site. This structure was built as a half-scale model of the platform at the Pickett Creek Site (Figure 73). However, the internal make-up of the platform at the Pickett Creek Site could not be determined without disassembly. It is possible that the entire perimeter of the Pickett Creek Site platform was not filled with stones but instead incorporated exposed bedrock. The interior portion of the experimental platform was completely filled with transported stone.

This platform was 2 m long and 2 m wide. Since the structure was built on a slope and ostensibly creates a surface level with the upslope end of the structure, the height was determined by dividing the maximum height of the Pickett Creek Site platform (90 cm) in half resulting in an average height of 45 cm.



Figure 72. Overview of the replicated platform before (a), during (b) and after (c) construction.



Figure 73. Overview of the platform (Structure 3) at the Pickett Creek Site (48PA2820). This alignment served as the model for the replicated platform.

The outer wall was built to the desired height first, and the interior portion was then backfilled to the height of the surrounding wall. The interior of the structure was filled with larger pieces towards the bottom and many small stones were used to fill the interior cracks near the top to create level surface.

Data Collection for the Replicated Structures

Each building event was timed to the nearest minute. As the structures were disassembled the stones were counted and the maximum dimension (typically the diameter) of each stone was measured. Each stone was placed into one of seven size grade categories. Size grades are in 10-cm increments from 0 to 69 cm, and ≥ 70 cm. An average mass for each size grade was calculated by weighing a sample of the stones during disassembly. This information was then compiled to form baseline construction rates. When data were available, the masses generated by weighing samples from each size grade of the experimental structures were used to quantify masses for corresponding types of GRSLE structures. Mass was calculated using estimates from other structure types when necessary. Due to the complexity of the site, the large quantity of stones within the structures, and the limited amount of time available for data collection at the Pickett Creek Site only averages of stone sizes were recorded. Total counts and weights were used to calculate estimates of build times and structure mass. The results are presented in Table 3.

Generated Labor Investment Estimates: The experimental results should not be construed as representing either a single construction or use event. Use-life relationships within and among the structures are unknown, and thus all of the structures may have been renovated, and/or had elements added or removed during their use histories. The labor investment estimates discussed here simply represent an alternate technique for comparing structures that is not based on functional assessments.

Table 3. Replicative Construction Results.

Site Number	Structure Name	Dimensons			Size Grade Count and Weight Data																	Build Time Data			Cubic Centimeters Constructed (per minute)
		Length (CM)	Width (CM)	Height (CM)	Cubic cm	0-10 Count	0-10 Weight	10-20 Count	10-20 Weight	20-30 Count	20-30 Weight	30-40 Count	30-40 Weight	40-50 Count	40-50 Weight	50-60 Count	50-60 Weight	>60 Count	>60 Weight	Total Count	Total Weight (kg)	Build Time (min)	Build Time (h & m)	Weight/Time (per minute)	
na	Exp. Wall	1000	30	50	1500000	0	0	11	17.16	164	595.32	114	1100	25	385	11	271.7	5	475	330	2844.18	174	2h 54m	16.3 kg/min	8620.7
na	Exp. Platform	200	200	45	1800000	155	99.2	280	436.8	159	577.17	39	376.35	4	61.6	10	247	1	95	648	1893.12	204.4	3h 25m	9.3 kg/min	8806.3
na	Exp. Alignment	5000	20	10	1000000	0	0	12	18.72	111	402.93	56	540.4	5	77	0	0	0	0	184	1039.05	74	1h 14m	14.0 kg/min	13513.5
48PA2820	2820.01 Wall	1544	45	45	3130000									247	3803.8					247	3803.8	362.7	6h 02 m	10.5 kg/min	8620.7
48PA2820	2820.02 Wall	700	25	40	700000			150	544.5											150	544.5	81.2	1h 21m	6.7 kg/min	8620.7
48PA2820	2820.03 Platform	400	400	45	7200000															972					8806.3
48PA2820	2820.04 Wall	400	45	90	1620000									28	431.2					28	431.2	187.9	3h 08m	2.3 kg/min	8620.7
48PA2820	2820.05 Wall	3655	35	75	9600000							391	3773.2							391	3773.2	1113	18h 33m	3.4 kg/min	8620.7
48PA2838	2838.01 Enclosure	780		1																na					
48PA2888	2888.01 Alignment	980	30	18	530000	17	10.88	112	174.72	69	250.47	55	530.75	22	338.8	5	123.5	4	380	284	1486.12	39.2	39m	37.9 kg/min	13513.5
48PA2890	2890.01 Alignment	1990	25	25	1240000	1	0.64	17	26.52	25	90.75	32	308.8	9	138.6	3	74.1	1	95	88	734.41	92	1h 32m	7.98 kg/min	13513.5
48PA2890	2890.02 Alignment	4535	25	13	1470000	0	0	52	81.12	44	159.72	22	212.3	5	77	3	74.1	2	190	128	794.24	109.1	1h 49m	7.28 kg/min	13513.5
48PA2890	2890.03 Alignment	1281	20	11	282000	2	1.28	35	54.6	18	65.34	1	9.65	1	15.4	0	0	0	0	57	146.27	20.9	21m	7 kg/min	13513.5
48PA2795	2795.10 Enclosure	1236	40	150	7420000	0	0	81	126.36	272	987.36	55	530.75	163	2510.2	55	1358.5	0	0	-626	5513.17	860.3	14h 20m	7kg/min	8620.7
48PA2900	2900.01 Wall	156	30	66	308000	1	0.64	11	17.16	10	36.3	9	86.85	5	77	0	0	0	0	36	217.95	35.8	36m	6.05 kg/min	8620.7

	Based on Experimental Mass Data		Based on Averages of Incorporated Stone Diameters
	Based on Experimental Build Time Data		Structure Type Precludes Quantification
	Data Not Available		

Build Time: (Figures 74) When calculated as a function of time, the experimental data indicate that the highest labor investment among the GRSLE stone structure sites occurred at the Pickett Creek Site. Structure 5 at this site (Figures 27-29) is estimated to have taken approximately 18 person hours to construct. The stone platform (Structure 3) is estimated to have involved a labor input of nearly 14 hours (Figures 22-25). However, this labor investment is probably an overestimation as the internal make-up of the real platform is unknown, and the volume calculations for the platform are probably inaccurate with respect to the amount of transported stone in the interior of the structure.

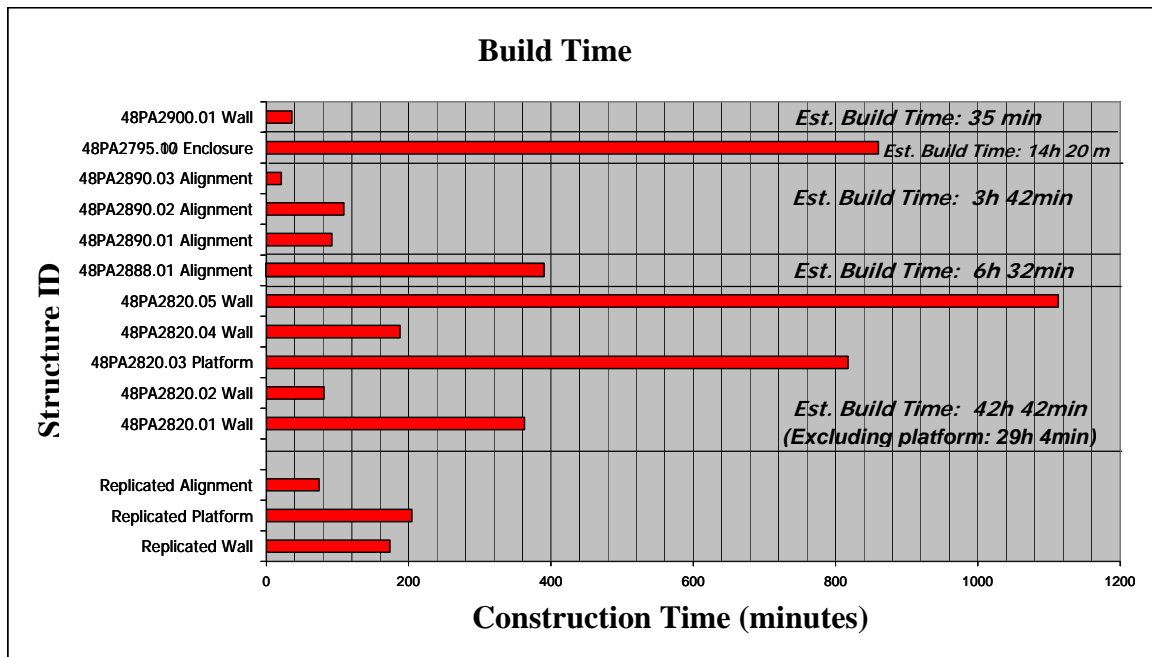


Figure 74. Build time estimates for all of the GRSLE structures. Each site is shown separately, and the total build time estimate for each site is provided on the right.

The enclosure described as an eagle trap (48PA2795) represents the second highest estimated labor investment according to this experiment. This estimate is based on the wall volume per minute build rate. Additional construction time would probably have been necessary in order to gather and prepare the wood elements.

Although not unexpected, the results show that construction of a long alignment involves significantly less effort than construction of a stone wall. The alignment at site 48PA2888 is by far the

largest feature in this study area in terms of total length, but would have involved a relatively low labor investment.

Structure Mass: Data for, structure mass indicate (Figure 75) that the greatest labor investment occurred during construction of the structures at the Pickett Creek Site (48PA2820), with an estimated 8550 kg of stone moved to create the structures. It should be noted that this labor investment estimate excludes the platform structure (Structure 5) because composition of the interior of the structure could not be accurately quantified. Notably, the eagle trap appears to represent a significant investment of labor with and estimated 5513 kg of stone used for construction.

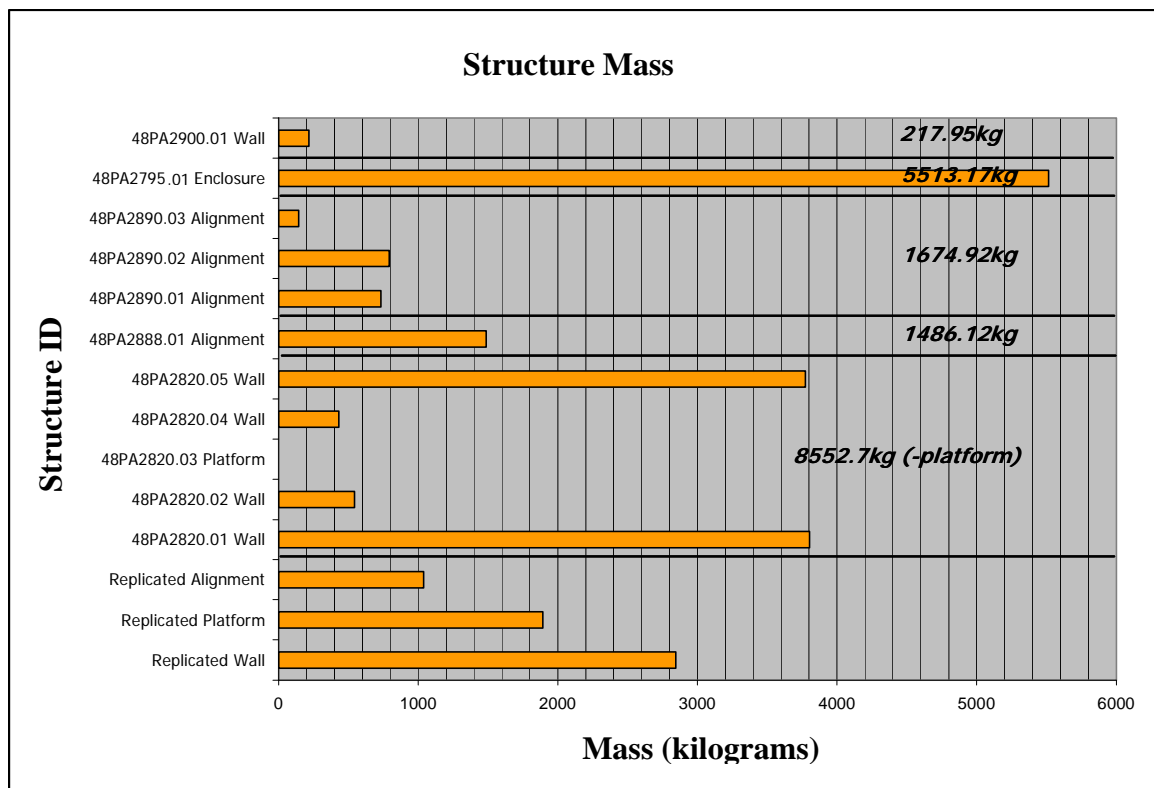


Figure 75. Mass comparisons based on the results of the replicative construction. Each site is shown separately, and the quantities on the right represent mass in kilograms for entire sites.

Build Time and Elevation: A scatter plot (Figure 76) is used to evaluate the potential relationship between the estimated labor investment and elevation. The predicted outcome for the labor investment estimates were hypothesized to favor higher inputs of labor at lower elevations where living conditions are

less extreme. In other words, it is expected that more time would be invested in building structures where temperatures are warmer, where water is more easily accessible, and where there are more areas of potential cover immediately available. However, site 48PA2820, which is located in the APP elevation zone at 3200 m and is higher than any other known stone structure site in the area, had the greatest estimated labor investment. Perhaps the large estimated labor investment at this relatively high altitude is a function of the availability of suitable construction material. Most of the site is located above treeline, and stone may have been used for construction because timber was less available.

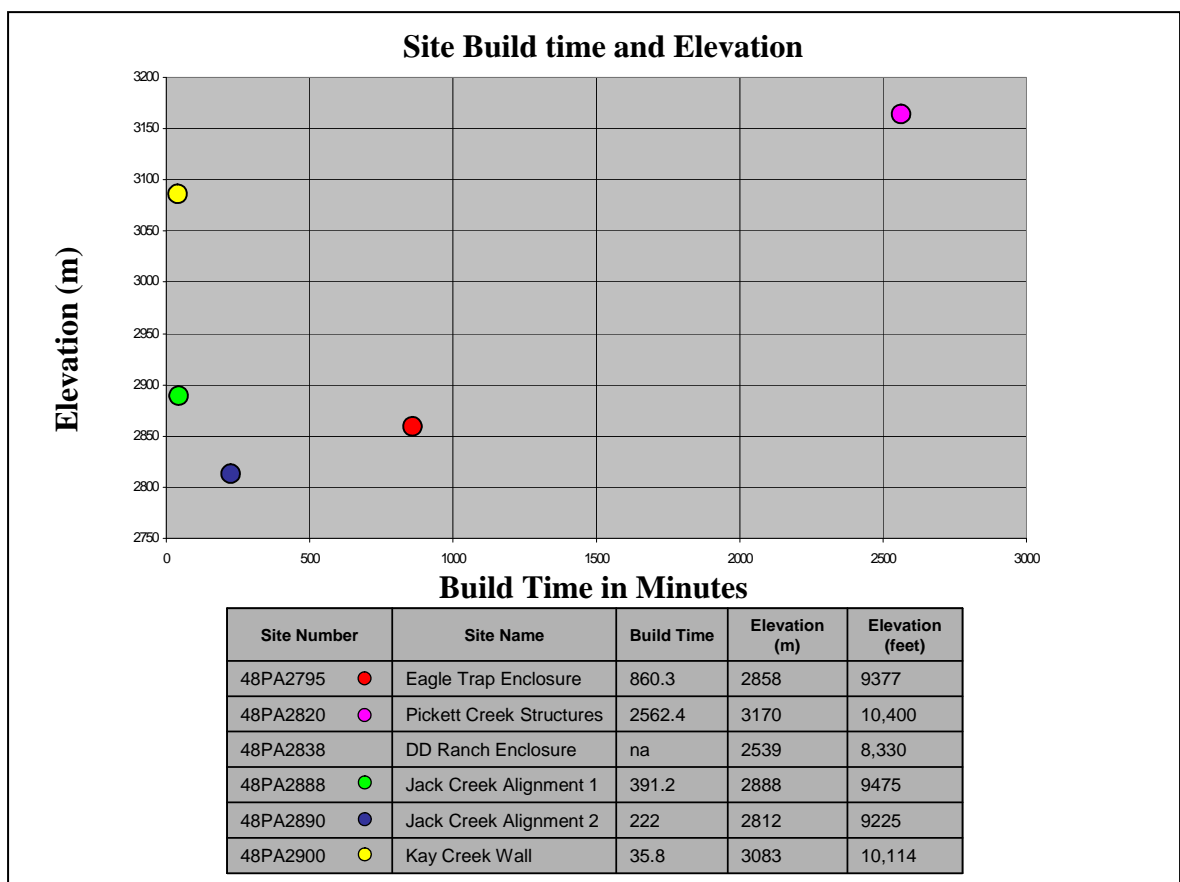


Figure 76. Scatter plot showing the relationship between build time and elevation based on the results of the replicative construction.

Build Time and Structure Mass: The following scatter plot (Figure 77) shows the relationships between the estimated construction time and the amount of stone moved during construction. Because mass of the platform could not be estimated it was excluded from this analysis. Two structures are

considered outliers with respect to mass and build time. Both the eagle trap from 48PA2795 and the longest wall from 48PA2820 are inferred to have involved almost as much overall labor as all of the other structures combined.

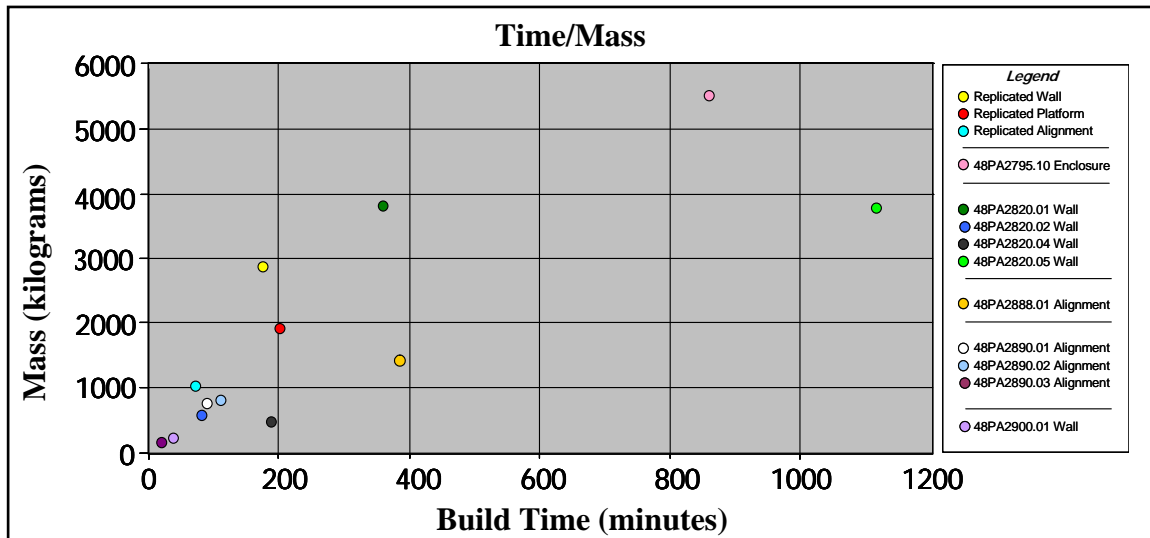


Figure 77. Scatter plot showing the relationship between build time and structure mass based on the results of the replicative construction.

The results of the comparisons of structures based on estimates of labor investment are not surprising. However, it is interesting that such a large amount of the total labor was invested in areas of marginal utility (i.e., at two the highest sites in the GRSLE project area). If the Pickett Creek Site did have a subsistence function, such as hunting, then perhaps a relatively large labor investment would have paid caloric dividends. Site 48PA2795, which would probably be considered either a ceremonial or vision quest site by many investigators, represents a relatively large investment of labor with no direct subsistence return. Perhaps this heavy input of labor means that a ceremonial function was very important to the group or groups that constructed the structure.

III. Exploring Potential for Topographic Signatures

Subsequent to the initial recording of the Pickett Creek Site in 2004, some general questions arose about the potential for using a combination of site and landscape data to identify areas with similar

topographic characteristics. The newly identified areas could then be subjected to field survey to evaluate the utility of the topographic signature concept. While in essence this process is similar to generating a predictive model, it does not include all of the elements of a true predictive model. Instead this analysis is oriented toward exploring the potential for identifying patterns of site distributions and what landscape attributes might be most predictive of site locations.

A predictive model, as defined by Kohler (1988:33), consists of either testing hypotheses about human behavior or evaluating empirical correlations. These hypotheses must attempt to predict the locations of past human activities that can be recognized by deposition of artifacts or other identifiable alterations of the landscape. The process of creating a predictive model can be broken into three parts or phases (Dalla Bona 1994). The initial phase includes developing a hypothesis, and collecting and organizing the salient data. The second phase includes model development and testing. The third phase is considered to be an ongoing process of applying and refining the model. The topographic signature discussed here focuses on building hypotheses and should be considered only as an initial stage of predictive modeling development.

The primary goal of developing a topographic signature analysis is to evaluate empirical correlations among the sites. With only nine structures in this group (the GRSLE stone structures, Boulder Ridge Sites, and site 48PA703), it is difficult to develop a predictive hypothesis about where other similar structures “should” occur, without first inferring functions. As has been stated, most of the structures in the GRSLE are functionally ambiguous. These structures are variable with respect to form, types of integrated materials, and distributions. Thus, it is reasonable to ask which structures might be expected to share more similar variables and which ones are expected to share fewer similar variables.

The Boulder Ridge sites are inferred to be the remains of a Late Prehistoric and/or Protohistoric hunting locales (Finley and Finley 2004; Frison et al. 1990). If the Pickett Creek Site, site 48PA703 (described simply as a single wall), and perhaps even the two Jack Creek Alignment sites (48PA2888 and 48PA2890) are related to hunting, then more similar variables might be evident within their topographic signatures. Likewise, fewer variables may be shared with the remaining sites.

What Types of Data Might Be Useful?

Problems have been noted with respect to the types and comparability of data that have been collected in previous attempts to identify patterns related to stone structure sites. Deaver et al.. (1999:2-8) discuss attempts to compare stone circle sites based on topographic setting and site attributes like ring size, number of rings, density an/or weight of the integrated stones in a ring, and/or the presence or absence of lithic artifacts on the surface. They suggested that these analyses have resulted in few statistically valid correlations that are not comparable with other projects in part because topographic data and description terminologies are inconsistent (Deaver et al. 1999:2-8 to 2-9). To reduce the ambiguity caused by subjective topographic descriptors, consistent and replicable sets of landscape data are used to quantify the landscapes surrounding the GRSLE stone structure sites.

Evaluation of potential topographic signatures of high altitude stone structures sites includes information from both the landscape and site data sets mentioned in Chapter 3. However, not all of these data are used to explore the concept of a topographic signature at this stage. Instead the main goal of this pilot study is to compare simple landscape variables that can be easily replicated. Hence, the data that can be obtained most reliably are used to test this utility of the concept. These data consist of elevation, slope, aspect, viewshed, surface geology, soils, permanent water, modern vegetation/landcover, temperature, and precipitation. The modern Galena Ridge wall was not evaluated. Figures illustrating the intersections of site locations and individual data sets (e.g., physiographic, climate, coverage themes) are presented in Appendix B.

Topographic Signature Results

One obvious problem with the group of structures used for this analysis is the small sample size. Eight sites located within a small, bounded area are likely to share many topographic, physiographic, and climatic attributes. However, the goal of this comparison is to evaluate patterns of similarities or differences within the sample group, thus allowing for attributes that are productive to be accepted and those that are unproductive to be rejected. Table 4-5 summarizes the results of the analyses. All of the figures used to generate this information are presented in Appendix C.

Table 4. Topographic Signature Attributes (1)

Site Number	Site Name	GRSLE Zones	Elevation	Circles	Alignments	Cairns	Wood Fences	Blinds	Walls	Lined Pits	Enclosures	Platforms	Function Assessment
48PA2795	Jack Creek Eagle Trap	HMV and APP	2800-2900								X		Suggested as an Eagle Trap/Vision quest
48PA2820	Dooley's Pickett Creek Structures	HMV and APP	3200-3300			X		X	X			X	Game drive, trail marker, boundary
48PA2838	DD Structure	HMV and APP	2500-2600								X		Suggested as a blind or trap
48PA2888	Jack Creek Flats Alignment	HMV and APP	2800-2900		X								Game drive, trail marker, boundary
48PA2890	Jack Creek Valley Alignments	HMV and APP	2800-2900		X								Game drive, trail marker, boundary
48PA2900	Kay Creek Structure	HMV and APP	3000-3100						X				Blind, wind break
48PA703	AC83-15-1	HMV and APP	3100-3200		X								Unknown
48PA781	Boulder Ridge Sheep Trap	HMV and APP	3000-3100		X	X	X	X					Sheep Trapping

Elevation: The sites are located with a relatively tight elevation range (2800-3300 masl) with the exception of site 48PA2838 (2500-2600 masl). The two most elaborate sites (48PA781 and 48PA2820), both of which may be related to hunting, are located at in the upper 200 m of this zone. Twenty-five (26%) of the 96 stone structure sites identified within northwestern Wyoming are located between 2500 and 3200 masl. Of the 24 sites ascribed to hunting, nearly 38% are located above 2800 masl. Whether the higher elevation is strongly correlated with hunting structures in this region is unknown. It may be the case that hunting functions are assigned to ambiguous stone features more often at higher elevation sites because living conditions are perceived by archaeologists to be more difficult. In the review of site forms only two stone circle sites were noted above 2800 masl and ceremonial functions are attributed to both.

Table 5. Topographic Signature Attributes (2)

Site Number	Slope	Aspect	Viewshed Direction	Surface Geology	Soils	Permanent Water (distance in m)	Landcover	Avg. Temp F°	Annual Precipitation (inches)
48PA2795	10-30	SE, E	E	l	PK05	490	spruce-fir	33	21
48PA2820	0-20	NW	SE	csR	PK05	742	Subalpine meadow	29	27
48PA2838	10-20	NW	NW	cgRG	PK01	253	Subalpine meadow	35	25
48PA2888	10-20	W	W	l	PK06	1149	Subalpine meadow	33	19
48PA2890	0-10	W	W	l	PK06	463	Subalpine meadow	33	19
48PA2900	10-20	SE	SE	srR	PK05	961	Subalpine meadow	31	19
48PA703	0-20	NE	E	csR	PK05	916	Subalpine meadow	29	29
48PA781	0-20	W	W	csR, srR	PK06	1410	Douglas fir	29	25

Slope: As expected, all of the sites, with the exception of the eagle trap (48PA2795), are situated on flat surfaces (0-20°). Benedict's (1996:4) description of the commonalities among the game drive sites along the Colorado Front Range/Continental Divide includes no direct reference to slope. However, common construction areas are benches, ridgelines, saddles, and ramps that tend to be relatively flat. Areas with slopes <20° should probably be considered more likely to encompass human activity areas in high elevation landscapes. Although this criterion is not revolutionary, it does present an obvious place to begin with regard to prospecting for high elevation sites.

Aspect: Aspect is variable for all eight site locations. Five sites face west–northwest and two face southeast. Site 48PA703 is situated facing north/northeast. No sites in the GRSLE area group are located on south-facing slopes. In this part of the Absarokas the south-facing slopes are nearly always relatively barren of vegetation due to a lack of moisture as snow pack rapidly evaporates. Aspect is most useful for predicting the locations of past and/or existing stands of timber. Nearly all of the north-facing slopes are currently forested or were forested in the recent past as evidenced by ghost forests. If some or all of these

stone structures were related to hunting, which used tree stands for some part of the hunting event, then using aspect as a predictor may be useful.

Viewshed: Viewshed directions were evenly split between the east-southeast and west-northwest (Figure 78). Site 48PA2820 had by far the best vantage of the surrounding mountains. While significant portions of this site's viewshed afford a person the ability to see down the Greybull River valley, a potentially more important characteristic of this viewshed is that a hunter could clearly view game catchment areas to the northwest. Site 48PA703 has a relatively restricted viewshed that overlooks the north-facing slopes to the southeast and small portions of the uplands to the north. Sites 48PA781 and 48PA2646 have a large viewshed that overlooks the Shoshone River valley. The sites in the Jack Creek drainage have restricted viewsheds but each site is within the viewshed of the other two sites. Site 48PA2900 affords a good view of the Big Horn Basin to the east. The viewshed from site 48PA2838 primarily includes the Wood River valley floor and could have presented hunters with clear views of game animals moving along the drainage.

Surface Geology: No clear relationship is evident between site placement and surface geology. Most sites are located on either colluvial or landslide deposits. Land forms with exposures of bedrock may have slightly higher potential for stone structure sites as the building material is the dominant surface feature and thick vegetation is less likely to be present. The relationship of the surface geology and soils is straightforward. Soils at each site are broadly characterized as thin soils that overlie a lithic contact developed within approximately 50 cm. As noted in the section on local surface geology (Chapter 1) the soils are often colluvially deposited except where landslides have occurred. The soil matrices often includes sulfuric horizons and are composed of materials of volcanic origin including pumice and cinders, much of which has become cemented into conglomerate stone.

Landcover: Based on comparison of site locations with landcover data, there may be a positive correlation between the subalpine meadow landcover type and the locations of stone structure sites. However, subalpine meadow is the dominant landcover type in the area. The subalpine meadows are generally open,

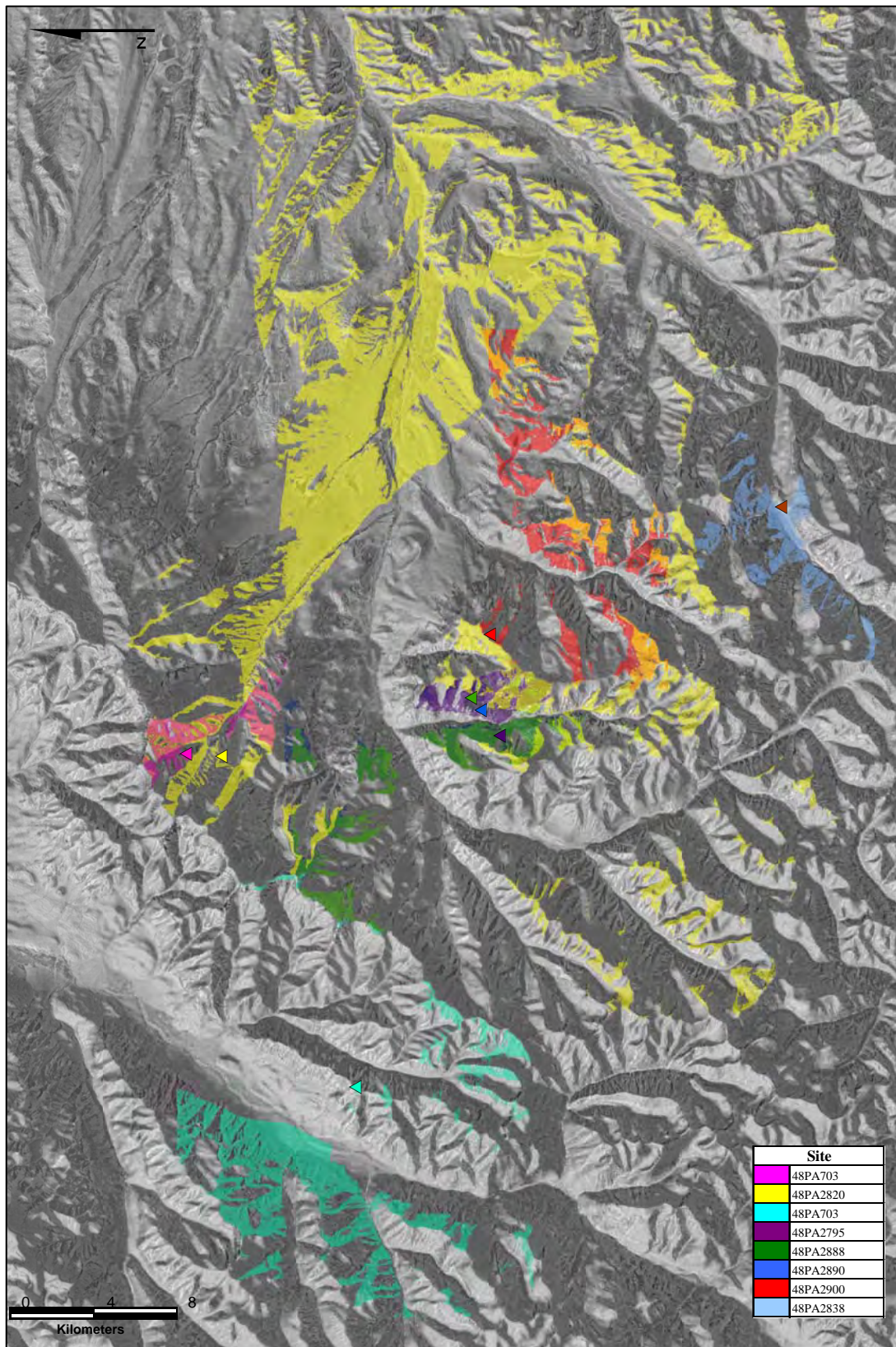


Figure 78. Overview of the GRSLE Project area showing the results of the viewshed analysis. This analysis was conducted with a 2 m horizontal offset from ground level to replicate a human in a standing position.

offer good views of the surrounding area, and are more likely to have exposed stones on the surface that can be used as building materials. Subalpine meadow landcover is useful for predicting stone structure locations when considered in combination with other factors like slope. Not surprisingly, two sites with integrated wooden elements, the Jack Creek eagle trap (48PA2795) and the Boulder Ridge South Sheep Trap (48PA781), are both associated with forest landcover types.

Precipitation and Temperature: No clear relationships were noted among the sites with regard to precipitation or temperature. These attributes can be disregarded for sites that are located close together. However, temperature and precipitation may play important roles in predicting site distributions and types at large regional scales.

Topographic Signature Discussion

There are many problems with topographic signature landscape analysis. The available data tend to be coarse. In some cases (e.g., landcover, surface geology, temperature and precipitation) the coarse nature of the electronic datasets has the potential to obfuscate patterns of site placement. In terms of elevation, the problems with accuracy (± 16.1 m) are the result two factors. First, the USGS National Map Accuracy Standards are only accurate to 6 m. Second, the resolution of a DEM (e.g., 10 m per pixel) introduces an additional error nearly equal to the resolution, as a pixel can only have one associated elevation and thus a 10 m square area could be inaccurate by as much as 16 m.

However, useful information can be pulled from these coarse landscape analyses. The most useful attributes are slope and elevation gradient, and these two datasets have been used to identify areas with higher site potential. For example, an elevation and slope map of the APP ridge to the north of Phelps Mountain was created prior to pedestrian survey. Areas of low slope ($<10^\circ$) were assigned a distinctive color, as was the target elevation range (2800-3300 m). The target ranges were adjusted to 50% transparency and then layered. The areas where target slope and elevation ranges coincided were then surveyed, and this survey succeeded in identifying site 48PA2900.

The example below (Figure 79) shows how attributes can be layered to show higher potential areas. Individual layers are made transparent so that underlying attributes can be compared visually. In this example the red areas near blue tree islands are probably worth investigating. The next step in this type of investigation would use these same attributes to compare all of the northwestern Wyoming sites that were subjected to review in the first portion of this chapter. Also, it might be useful to compare a similar suite of attributes for other sites with similar characters, such as the drive line sites positioned along the Continental Divide of the Colorado Front Range.

In general, the utility predictive modeling conducted with a GIS and topographic data will become better as finer-grained data sets are created. Until such data are available, exploration of topographic signatures for high altitude structure sites should be scaled up spatially to match the coarseness of available data sets. Thus topographic signatures should be investigated at large, topographically diverse scales such as the county, region or state. This type of large scale investigation could yield important results with regard to what groups or cultures were responsible for constructing high altitude structures.

Who Built the Structures?

The ongoing archaeological research in the GRSLE project area is beginning to yield significant information about the densities and durations of human occupation in the valleys that surround the headwaters of the Greybull River. Burnett's (2005) synthesis of surface distributions of diagnostic projectile points and lithic artifact clusters provides the most robust prehistoric chronology for the area.

Based on the low numbers Paleoindian projectile points, all of which are associated with later Paleoindian periods (10,000-8,000 rcybp), initial use of the area may correspond with amelioration of inhospitable conditions in the mountains commensurate with the onset of Altithermal xeric conditions around 8200 rcybp (Benedict 1979; Burnett 2005:85; Frison 1975).

Early Archaic sites (8000-5000 rcybp) appear to be rare based on known surface assemblages. However, without excavation on numerous landforms throughout the area, the potential for deposition cannot be fully evaluated. Burnett (2005:87) suggests that Early Archaic groups may have been

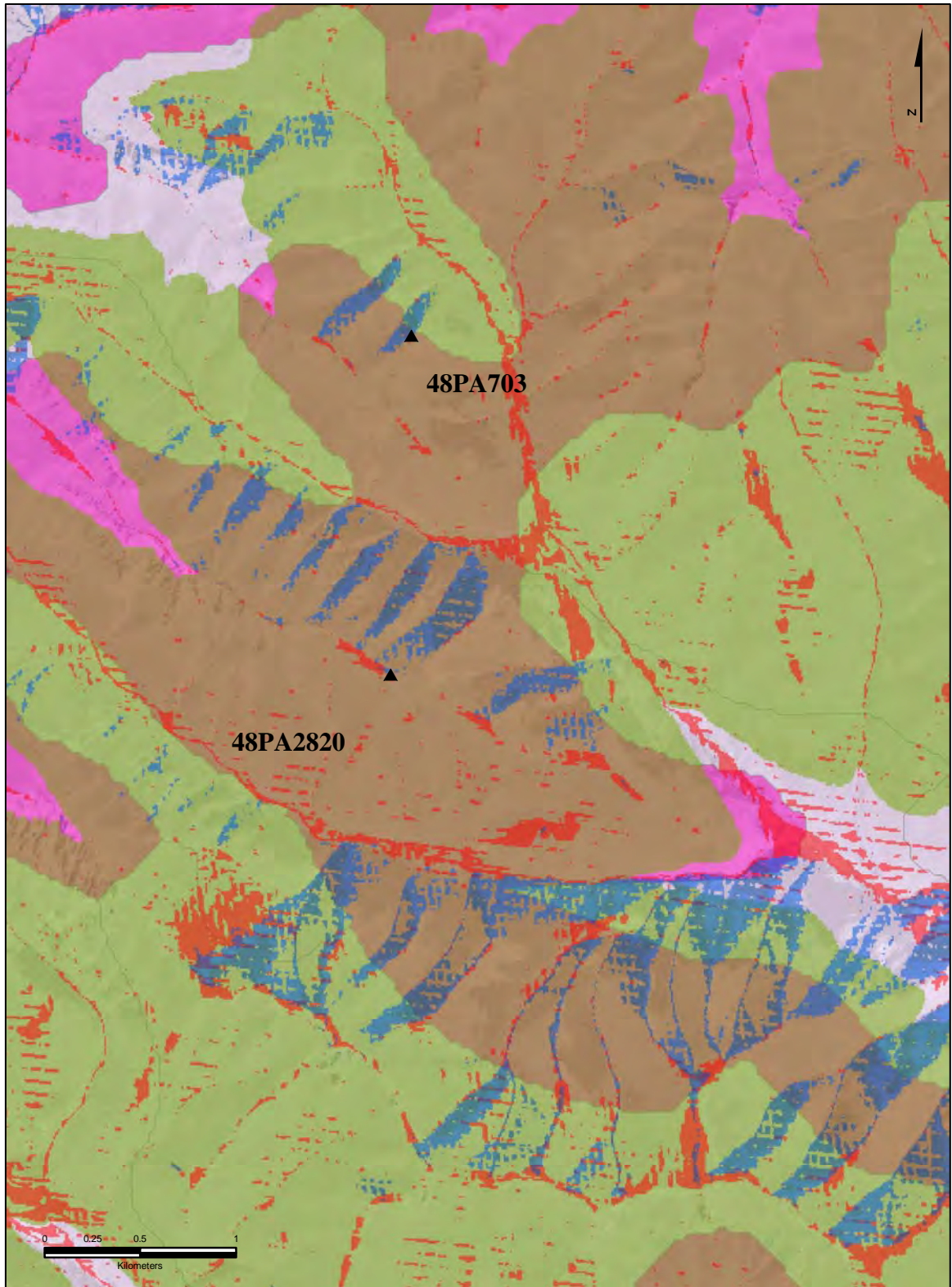


Figure 79. Overview of the North Fork Pickett Creek area showing layered topographic attributes including elevations between 2800 and 3300 m represented in green, slopes of $<10^\circ$ slope in red, north facing aspects in blue, and colluvium/bedrock surfaces are indicated in brown within the target elevation range.

the first to use higher elevation APP areas in a significant way, based on an Early Archaic projectile point that was found near Dollar Mountain at the head of the Wood River (Reitze 2004: 95-96).

Middle Archaic occupation (5000-3000 rcybp) is not well understood in the area. Middle Archaic sites are not well represented in comparisons to sites of other periods based on the occurrence projectile points identified on the surface. Middle Archaic groups may have been more transient, based on the presence of at least two obsidian projectile point bases (Burnett 2005:88).

The quantity of Late Archaic projectile points recovered within the project area suggests that populations and/or intensity of landscape use may have been robust during the time period between 3000 and 1500 years rcybp. Sites are heavily clustered within the HNV range and exhibit large amounts of lithic debitage (Burnett 2005: 83). The Late Prehistoric period (1500-500 rcybp) is also well represented in the GRSLE area and includes the first chronometrically dated site, located in Piney Creek (48PA2811), with an age of 1070 rcybp (Ollie 2008).

The high altitude stone structures in the GRSLE area may be associated with any or all of these time periods. The lack of associated diagnostic projectile points makes it difficult to rule out any temporal associations. Perhaps Early Archaic hunter-gatherers built some of these structures while experimenting with high altitudes hunting techniques. If the juniper bark net found on Sheep Mountain was used for hunting, it may be suggested that Late Paleoindian people were using a wider range of hunting techniques than those involve thrusting spears and atlatls (Frison et al. 1990:208). However, it seems likely that at least some of the sites with stone structures in the GRSLE area are associated with much later groups such as the Eastern Shoshone. This assertion is conjectural but premised on two factors. First, there are wooden elements integrated in the structures at sites 48PA2795 and 48PA2828. Second, the associations of Late Prehistoric and Protohistoric groups with other sites in the immediate area (e.g., the Boulder Ridge Sites) make an Eastern Shoshone association plausible (Eakin 2007; Finley and Finley 2004; Nabokov and Loendorf 2004).

Nearly all of the sheep trapping sites reported near Dubois (Figure 5) have wooden elements and have been dated through dendrochronology to around A.D. 1800 (Frison et al. 1990; Frison 1991:258). Frison et al. (1990:237) estimate that wooden elements will not survive in the open for more than two and a half centuries. An important difference between the timbers at 48PA2795 and the Dubois sheep traps is

that the specimens at 48PA2795 were cut using a metal stone blade, whereas those at Frison's sheep traps were collected as deadfall (Figure 13) (Nabakov and Loendorf 2004: 160). The presence of metal axe-cut wood would lend credence to a late date for this structure.

Recent fires on Boulder Ridge that burned away detritus from the ground surface near the sheep trapping sites have exposed dense accumulations of Protohistoric/historic artifacts including metal trade goods and glass trade beads (Eakin 2007: 5-7). These sites exhibit historic artifacts in direct association with bighorn sheep bone and feature conical lodges that appear to be similar in age to the cribbed wooden structures along Boulder Ridge (Eakin 2007; Finley and Finley 2004).

During the 2007 GRSLE field season eight Protohistoric sites were found in the Upper Greybull River valley, several of these within a few kilometers of the Jack Creek stone structures discussed above. These sites yielded a strikingly similar assemblage of Shoshone artifacts to those reported at Boulder Ridge, and include numerous bison and sheep processing areas and conical wooden habitation areas. Artifacts include glass trade beads and metal arrow points (Lawrence Todd, personal communication 2007). All of these sites were recorded during one field season, and primarily as a result of exposure related to forest fires. Reports of other Shoshone sites in the area are currently being investigated by Colorado State University.

There are still too few data available about the high altitude structure sites to draw firm conclusions about the builders. However, it seems clear that sites 48PA2795 and 48PA2838 were at least modified in the recent past, as evidenced by the preserved timber elements. The group or groups responsible for altering sites 48PA2795 and 48PA2838 are most likely the Eastern Shoshone. The group associations for the remaining four sites must remain a mystery until more is known about the prehistoric populations in the GRSLE area through time. It seems reasonable to begin looking for connections among the high altitude structure sites and the groups that occupied the valley during the later time periods. The density of sites attributed to the Late Archaic through Protohistoric time periods suggests that this portion of the Absaroka Mountains was being used much more intensively from 3000 BP to present. The Pickett Creek site has one well preserved wall that could indicate a later period of use or refurbishment. Also, an argument can be made for associating the alignments located along Jack Creek with higher HNV site densities that occurred during the Late Archaic.

Conclusions and Future Directions

More intensive analysis of structures and sites can be accomplished by increasing the volume and quality of data that are collected for stone structure sites. Estimating labor investment is one novel way to use data that can be collected in the field expediently. However, structure attribute measurement data are not consistently available for these types of sites. Functional interpretations of the stone structures sites have not been dramatically changed by the recording and analytical procedures that are advocated here. However, an attempt has been made to analyze the GRSLE stone structure sites without leaning quite so heavily on functional interpretations. Field methodologies have focused on data collection strategies that are consistent and purposeful, and analysis is oriented toward recognizing general patterns within and among the sites. The outcome of this research suggests that more questions need to be intensively investigated.

Investigations of sites that are similar to those in the GRSLE project area, such as the Boulder Ridge site and the sheep traps in the Wind River Mountains, suggest that wood may be the main structural elements of game driving and trapping structures. Frison et al. (1990:237) conclude that stone alignments and game blinds in the foothill and mountain environments may represent only a small part of more elaborate systems that were used for hunting. It is possible that the Pickett Creek site had wood or other perishable elements that have since been removed or have decomposed.

Simple count and measurement information that can be quickly and easily collected during basic site recording have been shown to yield useful comparative data, and these data should be collected more consistently in the future. This information was used to generate estimates of labor investment, which can elucidate unexpected patterns of landscape use.

The development of a topographic signature is considered a partial success. Certain landscape attributes (e.g., slope, elevation zone, aspect) are similar and may be useful to identify areas with higher or lower potential with respect to stone structures sites. While the regional site data gleaned from site forms are of limited utility, there are apparent patterns with respect to the distributions of stone structure sites across northwestern Wyoming. However, much more systematic research needs to be conducted and more

intensive, systematic collection of stone structure data needs to be incorporated into field survey methodologies.

Much more work needs to be done to fully gauge the usefulness of the concepts discussed here. Although the old site forms provided some baseline information, additional research (e.g., review of the project reports that discuss these sites, and in-field revisits) could be conducted for the all of the stone structure sites in northwestern Wyoming that were identified in this research. The portion of Wyoming used for this investigation is admittedly arbitrary. Investigation of the broad range of stone structure site distributions and the concomitant environmental context should focus on delineating study areas so that they can be more objectively compared. Further work in the Central Rockies and the surrounding basins and plains is expected to result in the identification of a much wider distribution of stone structure sites. Numerous sites with stone structures have been identified in the Great Divide Basin and it seems likely that more structures like those along the Colorado Front Range are waiting to be found in the intervening areas between northern Wyoming and the Front Range.

Investigators from CSU and the University of Washington are currently attempting to unravel the chronology problems for the GRSLE structures by using a dating technique called optically stimulated luminescence (OSL) (James Feathers, personal communication 2006). Soil samples were extracted from underneath stones in 48PA2888 alignment. These samples will be processed to determine if a time period can be assigned to the structure based on a measurement of the accumulated radioactivity in the soils.

In the future, quantification of the metric attributes of stone and wood structures should involve counting and measuring all, or at least a sample, of the stones incorporated into the structures. Such information can be used for estimating labor investment and will give investigators an additional and less biased way to compare structures. Additional replicative builds could be conducted to refine the technique. Future replicative build events could be accomplished at FL, HMT, and APP elevation zones to determine what effect elevation may have on the timing and energy expenditure. Cribbed wooden structures could also be constructed to quantify the labor investment.

GIS analysis of the landscapes surrounding stone and wood structure sites could be conducted to determine if patterning exists. It might be very useful to begin with the game drives along the Colorado Front Range as they are relatively discrete and share many attributes. Additional comparisons among the

Wyoming mountain and basin sites could also provide insight into whether site distributions are patterned with respect to the broadly defined eco-regions.

Another analytical approach that should be considered is the use of minimum cost analysis. Minimum cost analysis uses data derived from digital elevation models to identify the least accumulative cost path. This path can be based on a variety of data types, but for analysis of archaeological sites would probably use changes in slope over a given distance. Slopes values are recognized as differences in elevation among the cells that make up a DEM (Valdez and Dean 2000). The path that results in the least accumulative cost would represent a travel corridor with higher potential for use by humans and/or animals. Hence, the minimum cost pathway provides analysts with an objective way to evaluate the landscape, and at a variety of scales. Minimum cost analysis could be useful for exposing relationships between and among sites. For example, stone structure sites that are connected by minimum cost pathways might represent wider systems of prey acquisition, with multiple elements that are constructed on pathways that are repeatedly used by prey species. Also, there is potential that sites interpreted as hunting locations could be linked with processing or settlement areas, allowing investigators to begin associating multiple aspects of human behavior and landscape use to the archaeological record. Best of all, these types of investigations could be conducted with data that are currently available.

High altitude stone structure sites have not been ignored by archaeologists. The review of site forms has shown that these sites are being identified and recorded. Archaeologists often appear to be intrigued by the sites enough to record specific information about the individual structures, but are often frustrated with the difficulties in assessing ages of the structures. However, these sites are often ascribed functions based on assumption; investigators tend to collect data that support these assumed functions. This thesis has shown that there are objective ways to analyze sites with stone and wood structures, and these analyses are not premised on the assumed functions. Data that are often recorded, such as the sizes and numbers of stones in a structure, and overall structure dimensions, can be used objectively to compare sites. Future investigations should attempt to take some of the admittedly simple approaches described here to begin the important task of regional site comparison and synthesis. The majorities of the stone structure sites remain functionally and temporally ambiguous, and have not been sufficiently or systematically integrated into our concepts of prehistoric technology and human behavior. This is

unfortunate because they represent an important class of archaeological site that offers unique information about their prehistoric builders, with the potential to expose a more complete picture of prehistoric human landscape use and subsistence.

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APPENDIX A:

**Game Drive Sites Recorded Along the Continental Divide of the
Colorado Front Range and the Locations of Published Information**

Site Number	Site Name	Center for Mountain Archaeology Volume #	Journal or Other Publication	Radiocarbon Dates Available
5BL65	Murray Game Drive		PA 20(69)	yes
5BL66		1		
5BL67	Hungry Whistler	1		yes
5BL68	Game Drive Overlooking Scratching Deer		PA 20(70)	yes
5BL69	Scratching Deer		PA 20(70)	yes
5BL70		1		yes
5BL73	Albion Boardinghouse		SW Lore 41(3)	yes
5BL94	Coney Lake	5		yes
5BL95		5		
5BL96		5		
5BL97		5		yes
5BL102	Devil's Thumb Hearth	8		
5BL103	Devil's Thumb Pass Game Drive	8		yes
5BL103	Deveil's Thumb Pass Game Drive	8		
5BL114	Arapaho Pass Game Drive	3		
5BL120	Fourth of July	2		yes
5BL127	Bob Lake Game Drive	8		
5BL141	Blue Lake Valley		SW Lore 45(4)	yes
5BL153	Fourth of July Mine	8		
5BL170	Ptarmigan	2		yes
5BL171		5		
5BL172		5		
5BL173		5		
5BL174		5		
5BL186		5		
5BL523	Sawtooth Game Drive	5,8		
5BL688		5		
5BL3440	Devil's Thumb Valley Game Drive	8		yes
5BL3937		8		
5BL6904	Devils' Thumb Trail	8		
5GA20	Devil's Thumb Pass Game Drive	8		
5CF373/5GN1936	Water Dog Divide	7	Hutchinson 1990 (M. A. Thesis) and Morris 1990	
5CF499/5GN1934		7	Hutchinson 1990 (M. A. Thesis)	
5GA22	Caribou Lake	3,8	SW Lore 55(2)	yes
5GA55	Sawtooth Game Drive	5,8		
5GA1095	Mt Ida Fasting Bed/Game Drive		SW Lore 53(3)	
5GA1483	Fox Park Sites	8		
5GA1484	Fox Park Sites	8		
5GA1487	Fox Park Sites	8		
5GA1493	Fox Park Sites	8		
5GA1494	Fox Park Sites	8		
5GA1495	Fox Park Sites	8		
5LR6	Flatop Mountain Game Drive	7		yes
5LR15	Trail Ridge Game Drive	7		yes
5LR1089	Mt Ida Fasting Bed/Game Drive		SW Lore 53(3)	

5LR1370	Bode's Draw	6		yes
5LR10260	Ute Trail Game Drive		SW Lore 68(1)	
5LR12	Old Man Mountain	4		

PW	<i>Plains Anthropologist</i> Journal of the Plains Anthropological Society
SW	<i>Southwestern Lore</i> Official Publication, The Colorado Archaeological Society

APPENDIX B:

**Stone Structure Sites in Northwestern Wyoming:
Data Compiled from Site Forms**

**Appendix B: Stone Structure Sites in Northwestern Wyoming:
Data Compiled from Site Forms**

Site Number	Site Name	USGS 7.5" Quadrangle	Elevation (m)	Circle(s)	Alignment(s)	Cairn(s)	Wood Fence(s)	Blind(s)	Wall(s)	Lined Pit(s)	Enclosure(s)	Platform(s)	Associated Artifacts	Site Age	Age Determination	Potentially Eligible	Function Assessment
48 BH 302	Big Horn Medicine Wheel	Medicine Wheel	2938	X	X	X							Y	Late Prehistoric/Protohistoric	NA	Y	Location marker/Ceremonial/Vision Quest/Celestial
48 BH 338	Travois Trail Cairns	Medicine Wheel	2879			X							Y	Late Archaic	Projectile Point	Y	Trail/location marker
48 BH 913	B-52	Flitner Reservoir	1432	X									Y	Prehistoric - Unknown	NA	Y	Unknown
48 BH 1189	Dobie Buttes Enclosure	Schuster Flats NE	1239		X	X							Y	Prehistoric - Unknown	NA	N	Unknown
48 BH 1293	Porcupine Creek Rock Alignment	Bald Mountain	2739		X								Y	Historic - 1934	CCC camp records	N	Trail corridor from CCC Camp and poss. latrine
48 BH 1623		Lovell Lakes	1284		X								N	Prehistoric - Unknown	NA	N	Unknown
48 BH 1630		Lovell Lakes	1283	X	X								Y	Prehistoric - Unknown	NA	Y	Camp site
48 BH 1656		Lovell Lakes	1289	X	X								Y	Prehistoric - Unknown / Proto/Historic	NA	N	5 alignments with both lithic and glass debitage
48 BH 1686		North Emblem Reservoir	1373	X	X								Y	Prehistoric - Unknown	NA	Y	stone circles with FCR, lithic clusters, features
48 BH 1693		North Emblem Reservoir	1345		X								Y	Prehistoric - Unknown	NA	N	Unknown
48 BH 1703		Lovell Lakes	1310	X	X								Y	Prehistoric - Unknown	NA	N	Unknown
48 BH 1705		Lovell Lakes	1314	X									Y	Prehistoric - Unknown	NA	N	Lithic Procurement area
48BH1995	Hunt Mountain	Leavitt Reservoir	3093	X	X	X								Late Archaic/Later Prehistoric/Protohistoric	Projectile Points/Informant	Y	Vision Quest
48 BH 3321		Bear Creek Ranch	1340	X									N	Prehistoric - Unknown	NA	Y	Unknown
48 FR 96	Green Mountain Arrow	Sagebrush Park	2313	X	X	X							Y	Prehistoric - Unknown	NA	Y	Ceremonial
48 FR 307	Bull Elk Pass Sheep Trap	Indian Point	2756				X						Unk	200 BP	Dendrochronology	Y	Hunting
48 FR 309	Wiggins Peak Sheep Trap	Indian Point	2619		X		X	X					Unk	Prehistoric/Protohistoric - Unknown	Wood elements	Y	Hunting Ceremonial

Site Number	Site-Name	USGS 7.5" Quadrangle	Elevation (m)	Circle(s)	Alignment(s)	Cairn(s)	Wood Fence(s)	Blind(s)	Wall(s)	Lined Pit(s)	Enclosure(s)	Platform(s)	Associated Artifacts	Site Age	Age Determination	Potentially Eligible	Function Assessment
48 FR 493	Indian Point Trap and Procurement	Indian Point	3041		X	X		X					Unk	Prehistoric/Protohistoric - Unknown	Wood elements	Y	Hunting
48 FR 311	Torrey Lake Sheep Trap	Torrey Lake	2351		X		X						Y	7000-1000 BP	Petroglyphs	Y	Hunting
48 FR 494	Black Mountain Sheep Trap	Indian Point	2501		X	X	X	X		X	X			Late Prehistoric/Protohistoric	Dendrochronology	Y	Sheep Trap
48 FR 1491	MGL-9	Split Rock	1963	X	X	X							Y	Unknown	NA	Y	Unknown
48 FR 1522		Split Rock	2007					X					Y	Late Prehistoric	projectile point	Y	Hunting blind
48 FR 1546		Dubois	2273			X							N	Prehistoric - Unknown	NA	N	Locational or Ceremonial
48 FR 1547		Dubois	2272			X							N	Prehistoric - Unknown	NA	N	Unknown
48 FR 1549		Dubois	2241		X								Y	Prehistoric - Unknown	NA	N	Lithic Procurement and Hunting
48 FR 1814		Basin Draw	2222		X	X							Y	Archaic/Late Prehistoric	projectile point	Y	Unknown
48 FR 1837		Olson Springs	2240	X	X					X			Y	Prehistoric - Unknown	NA	Y	Eagle Trapping
48 FR 2252	East Fork Sheep Trap	East Fork Basin	2519				X						no	Late Prehistoric	Wood decay	Y	Sheep trap drive lines and catch pens
48 FR 2253	Amos Welty I	Dubois	2619		X	X	X				X		no	Late Prehistoric	Wood decay	Y	Sheep trap drive lines and catch pens
48 FR 2254	Amos Welty II	Dubois	2669		X	X	X				X		no	Late Prehistoric	Wood decay	Y	Sheep trap drive lines and catch pens
48 FR 2788		Split Rock	1992			X		X					N	Prehistoric - Unknown	NA	N	Hunting Blind
48 FR 3079		Lysite	1640		X								Y	Prehistoric - Unknown	NA	Uneval.	Lithic Scatter
48 FR 3147		De Pass	1834			X		X					Y	Prehistoric - Unknown	NA	Y	Drive Line
48 FR 4070		Arapahoe Butte	1769	X	X	X							Y	Paleoindian	Pryor-stemmed point	Y	Unknown
48 FR 4147		Lysite SE	1772		X								N	Prehistoric - Unknown	NA	Uneval.	Unknown
48 FR 4274		Gates Butte	1591	X	X								Y	Prehistoric - Unknown	NA	Uneval.	Unknown
48 FR 4283		Lysite	1770	X		X							Y	Archaic	projectile point	Uneval.	Unknown
48 FR 4298		Gates Butte	1589		X								N	Prehistoric - Unknown	NA	Uneval.	Unknown
48 FR 4390		Moneta	1728		X								Y	Prehistoric - Unknown	NA	Uneval.	Unknown
48 FR 4652		Split Rock	1995		X	X							Y	Prehistoric - Unknown	NA	Uneval.	Unknown
48 FR 4868		Lysite SE	1745		X								Y	Prehistoric - Unknown	NA	Uneval.	Unknown
48 FR 5309		Squaw Butte	1725	X	X								Y	Late Archaic	projectile point	N	Habitation

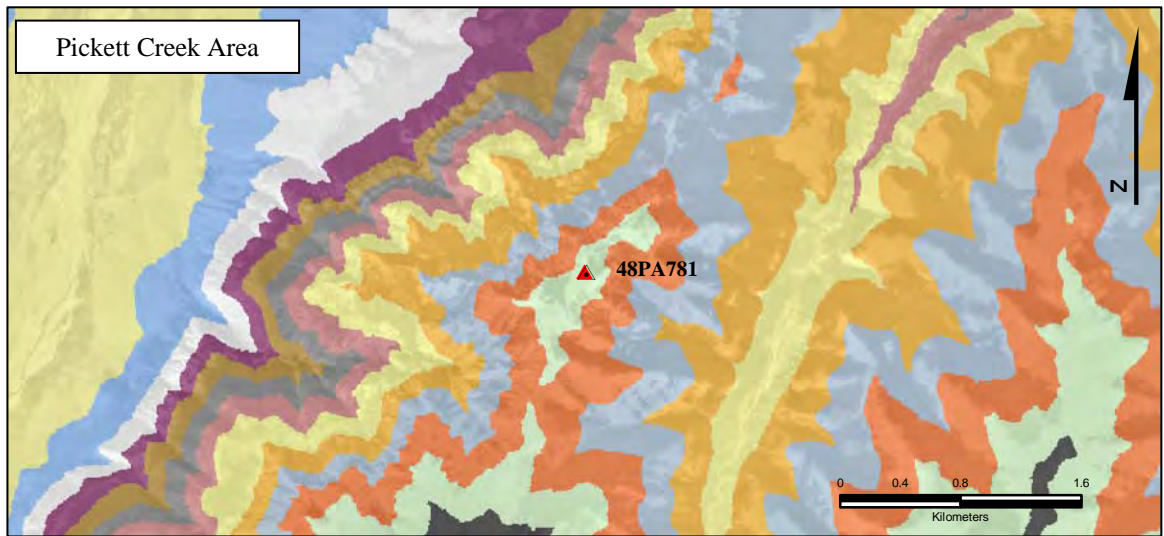
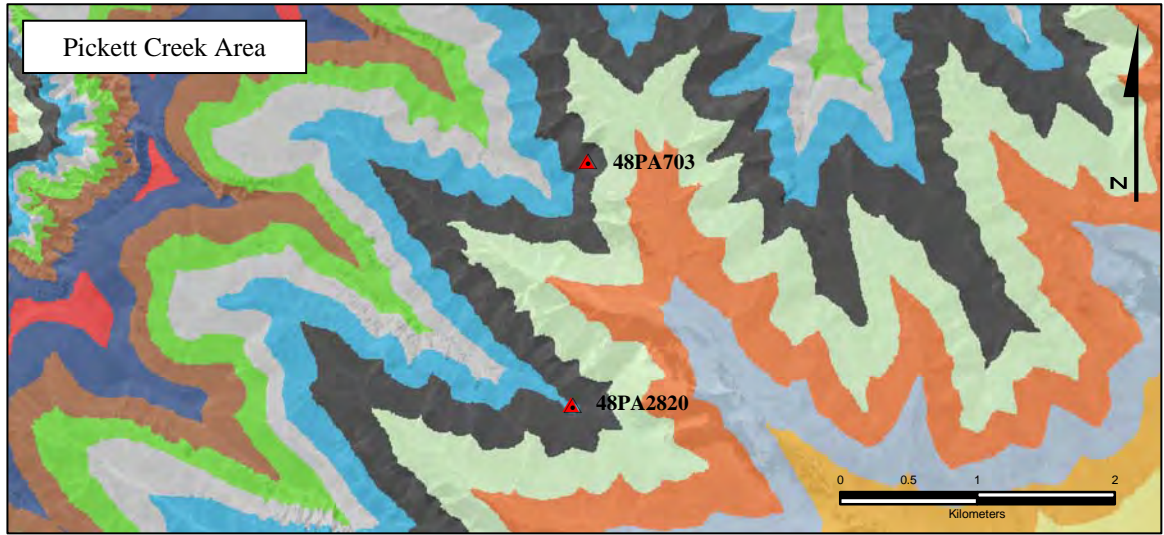
Site Number	Site-Name	USGS 7.5" Quadrangle	Elevation (m)	Circle(s)	Alignment(s)	Cairn(s)	Wood Fence(s)	Blind(s)	Wall(s)	Lined Pit(s)	Enclosure(s)	Platform(s)	Associated Artifacts	Site Age	Age Determination	Potentially Eligible	Function Assessment
48 FR 2860	Shoshone Lake Road #3	Mount Arter	2669		X								N	Prehistoric - Unknown	NA	N	Unknown
48 PA 703	AC83-15-1	Pickett Creek	3166		X								N	Prehistoric - Unknown	none associated	N	Unknown
48 PA 781	Boulder Ridge Sheep Trap	Valley	3033		X	X	X	X					Y	Late Prehistoric/Protohistoric	Dendrochronology projectile points	Y	Sheep Trapping
48 PA 830		Clayton Mountain	2331		X								N	Prehistoric - Unknown	NA	N	Unknown - trail marker, driveline for sheep trap
49 PA 914	Beam Me Up, Scotty	Corbett Dam	1681		X								N	Prehistoric - Unknown	NA	Y	Unknown
48 PA 1240	South Chapman Bench Stone Circle Site	Chapman Bench	1478	X	X	X							Y	Prehistoric/Protohistoric	inferred	Y	Unknown
48 PA 1261	Two Dot Drive Lines	Chapman Bench	1460	X	X	X							Y	Prehistoric - Unknown and Historic	historic artifacts	Y	Animal Trapping
48 PA 1304		Elk Basin	1495		X								N	Prehistoric - Unknown	none associated	Uneval.	Vision quest structure
48 PA 1365		Badger Basin	1271	X									N	Prehistoric - Unknown	NA	Uneval.	Hunting blind, vision quest structure, modern "fort"
48 PA 1366		Badger Basin	1346		X								N	Prehistoric - Unknown	none associated	Uneval.	Unknown
48 PA 1387		Tonopah Ridge	2186		X	X							Y	Prehistoric - Unknown and Historic	NA	Y	Unknown, modern fenceline association
48 PA 1714		Cody	1588		X								N	Prehistoric - Unknown	NA	N	Trail marker or animal drive line
48 PA 2669		Tatman Mountain	1631	X	X								Y	Late prehistoric	projectile point	Y	Unknown
48 PA 2795	Jack Creek Eagle Trap	Phelps Mountain	2879								X		Y	Prehistoric/Protohistoric	lichens and reports	Y	Unknown - suggested as an Eagle Trap/Vision quest
48 PA 2820	Dooley's Pickett Creek Structures	North Fork Pickett Creek	3207			X		X	X			X	Y	Prehistoric - Unknown	lithic artifacts	Y	Unknown - game drive, trail marker, boundary
48 PA 2838	DD Structure	Dick Creek Lakes	2536								X		Y	Prehistoric - Unknown	NA	Y	Unknown - suggested as a blind or trap
48 PA 2888	Jack Creek Flats Alignment	Phelps Mountain	2903		X								Y	Prehistoric - Unknown	lithic artifacts	Y	Unknown - game drive, trail marker, boundary
48 PA 2890	Jack Creek Valley Alignments	Phelps Mountain	2825		X								N	Prehistoric - Unknown	NA	Y	Unknown - game drive, trail marker, boundary
48 PA 2900	Kay Creek Structure	Phelps Mountain	3086						X				Y	Prehistoric - Unknown	NA	Y	Unknown - blind, wind break
48 SU 285	Aspen Ridge Stone Alignment Site	Halfway	2347	X	X	X							Y	Prehistoric/Historic	dates may exist	Y	Unknown - ceremonial association TCP






















Site Number	Site-Name	USGS 7.5" Quadrangle	Elevation (m)	Circle(s)	Alignment(s)	Cairn(s)	Wood Fence(s)	Blind(s)	Wall(s)	Lined Pit(s)	Enclosure(s)	Platform(s)	Associated Artifacts	Site Age	Age Determination	Potentially Eligible	Function Assessment
48 SU 343		Big Piney East	2105		X	X							N	Prehistoric - Unknown	NA	Y	Unknown
48 SU 505	AR 82-211, 4	Cretaceous Mt	2236		X								N	Prehistoric - Unknown	NA	Y	Camp site, structure is functionally ambiguous
48 SU 556		Hay Meadow Reservoir	2312	X	X								N	Prehistoric - Unknown	NA	Uneval.	Unknown
48 SU 572		Red Castle Creek	2434		X								N	Prehistoric - Unknown	none assoicated	Y	Unknown
48 SU 678		Pine Grove Ridge	2429	X		X							Y	Prehistoric - Unknown	NA	Uneval.	Unknown
48 SU 837		Red Castle Creek	2469	X									N	Prehistoric - Unknownw	none associated	Y	Possible grave, TCP
48 SU 858		Olsen Ranch	2241	X									Y	Archaic/Late prehistoric	projectile point	Uneval.	Unknown
48 SU 878		The Hogsback	2403		X	X							Y	Archaic/Late prehistoric	projectile points	Y	Unknown/Lithic reductions site
48 SU 911		Pine Grove Ridge	2965		X								N	Prehistoric - Unknown	NA	Y	Drive line
48 SU 938		The Hogsback	2387		X	X							Y	Prehistoric - Unknown	NA	Y	Unknown
48 SU 1035		The Hogsback	2380	X		X							N	Prehistoric - Unknown	NA	Y	Unknown
48 SU 1093	Narrow Ridge Site	Fremont Lake South	2275		X	X							Y	Prehistoric - Unknown	NA	Y	Unknown
48 SU 1187	Fr. Desmet Prehistoric Locality	Daniel	2220	X		X							Y	Late Archaic/Late Prehistoric	projectile points	Y	Unknown
48 SU 1798		Onion Springs	2311	X	X								Y	Late Prehistoric	projectile point	Y	Unknown
48 SU 2363		The Hogsback	2535		X	X							Y	Prehistoric - Unknown	projectile point	Y	Unknown
48 SU 3140		Mount Airy	2299	X	X	X							Y	Prehistoric - Unknown	NA	N	Unknown
48 SU 3200		Mount Airy	2195		X	X							Y	Prehistoric - Unknown	NA	N	Unknown
48 SU 3352		Pinedale	2224	X									Y	Early Archaic	projectile point	Y	Unknown - campsite
48 SU 3868		Stud Horse Butte	2220		X								Y	Prehistoric - Unknown	lithic artifacts	Y	Campsite, Blind
48 SU 4150		Mesa Spring	2164		X	X							N	Prehistoric - Unknown	NA	Y	Unknown - suggested ceremonial site
48 SU 4163		Mount Airy	2182	X	X								Y	Prehistoric - Unknown	NA	Uneval.	Unknown - ceremonial/TCP
48 SU 4257		Daniel	2231		X								N	Prehistoric - Unknown	NA	Uneval.	Unknown - ceremonial
48 SU 4258		Daniel	2256			X							Y	Prehistoric - Unknown	NA	Uneval.	Unknown - Sacred site

Site Number	Site-Name	USGS 7.5" Quadrangle	Elevation (m)	Circle(s)	Alignment(s)	Cairn(s)	Wood Fence(s)	Blind(s)	Wall(s)	Lined Pit(s)	Enclosure(s)	Platform(s)	Associated Artifacts	Site Age	Age Determination	Potentially Eligible	Function Assessment
48 SU 5115		Deer Hill	2284		X	X							N	Prehistoric - Unknown	NA	Uneval.	Unknown - ceremonial
48 SU 5123		Pine Grove Ridge	2615		X	X							N	Prehistoric - Unknown	NA	Uneval.	Unknown
48 SU 5368	Bucky Neely Alignment	Daniel Junction	2248		X	X							N	Prehistoric - Unknown	NA	Y	Unknown
48 TE 1345	Curtis Canyon Cairn Alignment	Cache Creek	2568			X							N	Prehistoric - Unknown	NA	Y	Unknown
48 TE 1537	Potholes Rock Alignment	Moran	2107		X	X							N	Prehistoric - Unknown	NA	Y	Unknown
48 WA 575		Meadowlark Lake	2870			X							Y	Prehistoric - Unknown	NA	Y	Unknown
48 WA 605		Zimmerman Buttes	1384		X								N	Prehistoric - Unknown	NA	N	Unknown
48 WA 744		Worland	1291		X								Y	Prehistoric - Unknown	NA	Y	Unknown
48 WA 1001		Dutch Nick Flat	1448	X									Y	Prehistoric - Unknown	NA	Y	Unknown
48 WA 1678		Mahogany Butte	1927		X	X							N	Prehistoric/Historic	NA	N	Ceremonial Native American/Shepherdherd Cairns
48 YE 208		Mammoth	1858		X						X		N	Prehistoric - Unknown	none associated	Y	Unknown

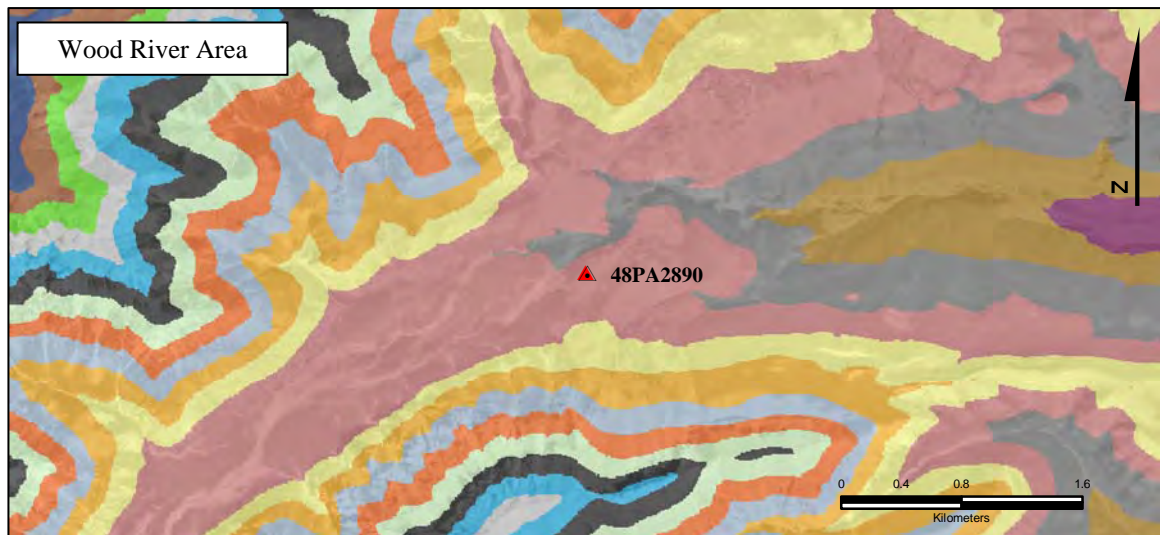
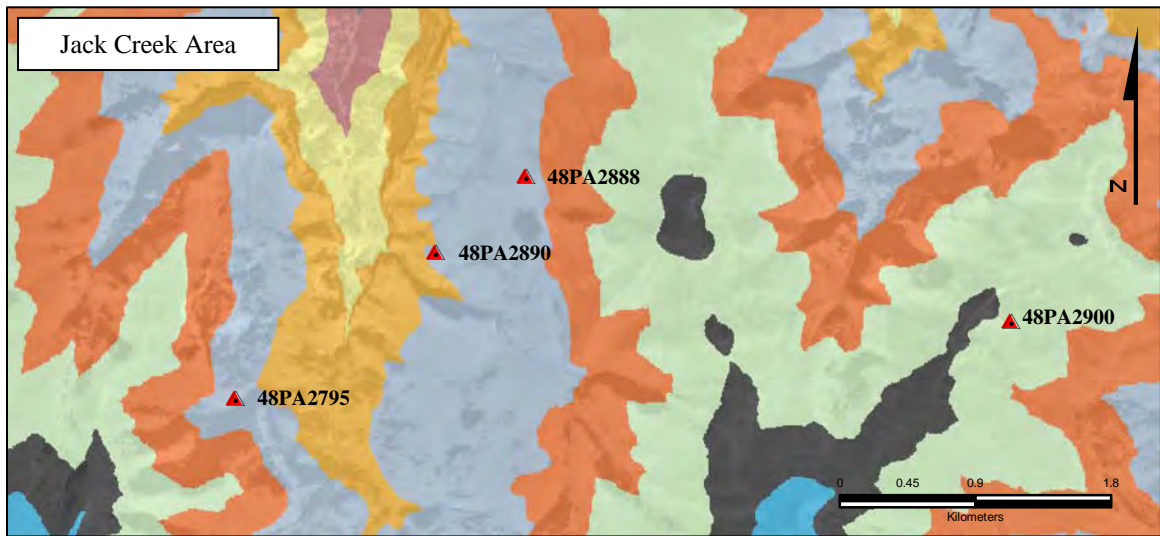
APPENDIX C:
Topographic Signature Figures

Elevation Grades (100 m)



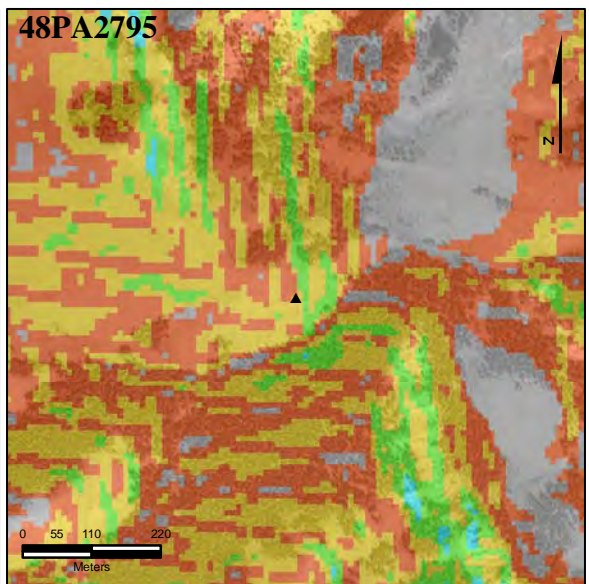
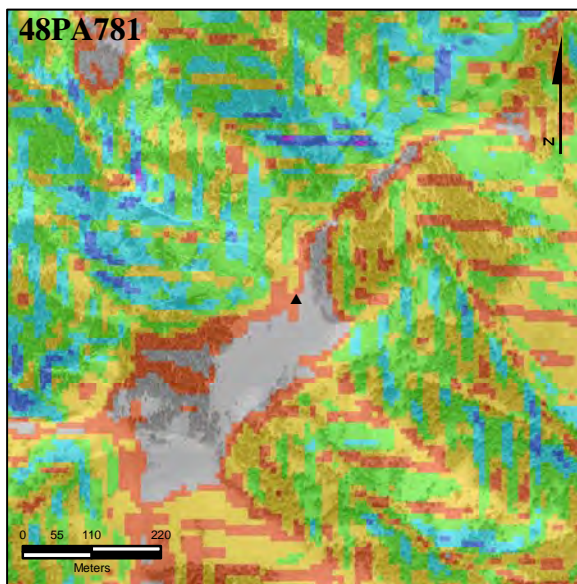
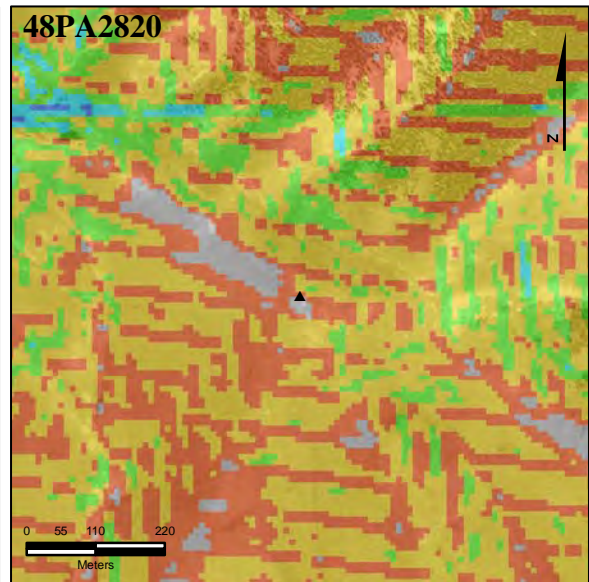
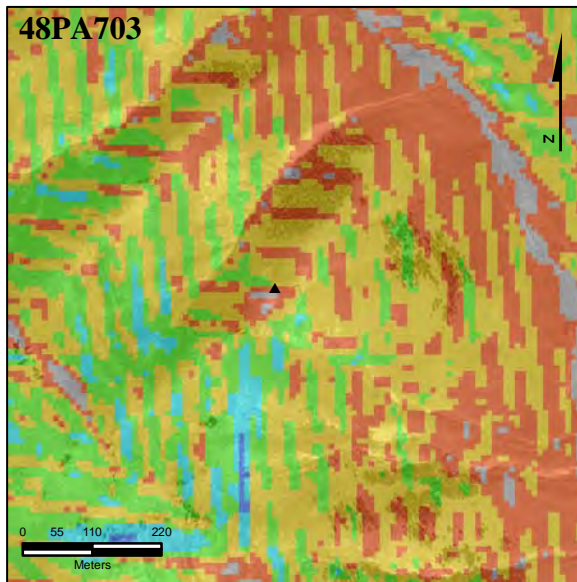
Elevation grades – various scales – 100 m increments		
 1,463.412476 - 2,000	 2,600.000001 - 2,700	 3,300.000001 - 3,400
 2,000.000001 - 2,100	 2,700.000001 - 2,800	 3,400.000001 - 3,500
 2,100.000001 - 2,200	 2,800.000001 - 2,900	 3,500.000001 - 3,600
 2,200.000001 - 2,300	 2,900.000001 - 3,000	 3,600.000001 - 3,700
 2,300.000001 - 2,400	 3,000.000001 - 3,100	 3,700.000001 - 3,800
 2,400.000001 - 2,500	 3,100.000001 - 3,200	 3,800.000001 - 3,900
 2,500.000001 - 2,600	 3,200.000001 - 3,300	 3,900.000001 - 4,005.481689

Elevation Grades (100 m)



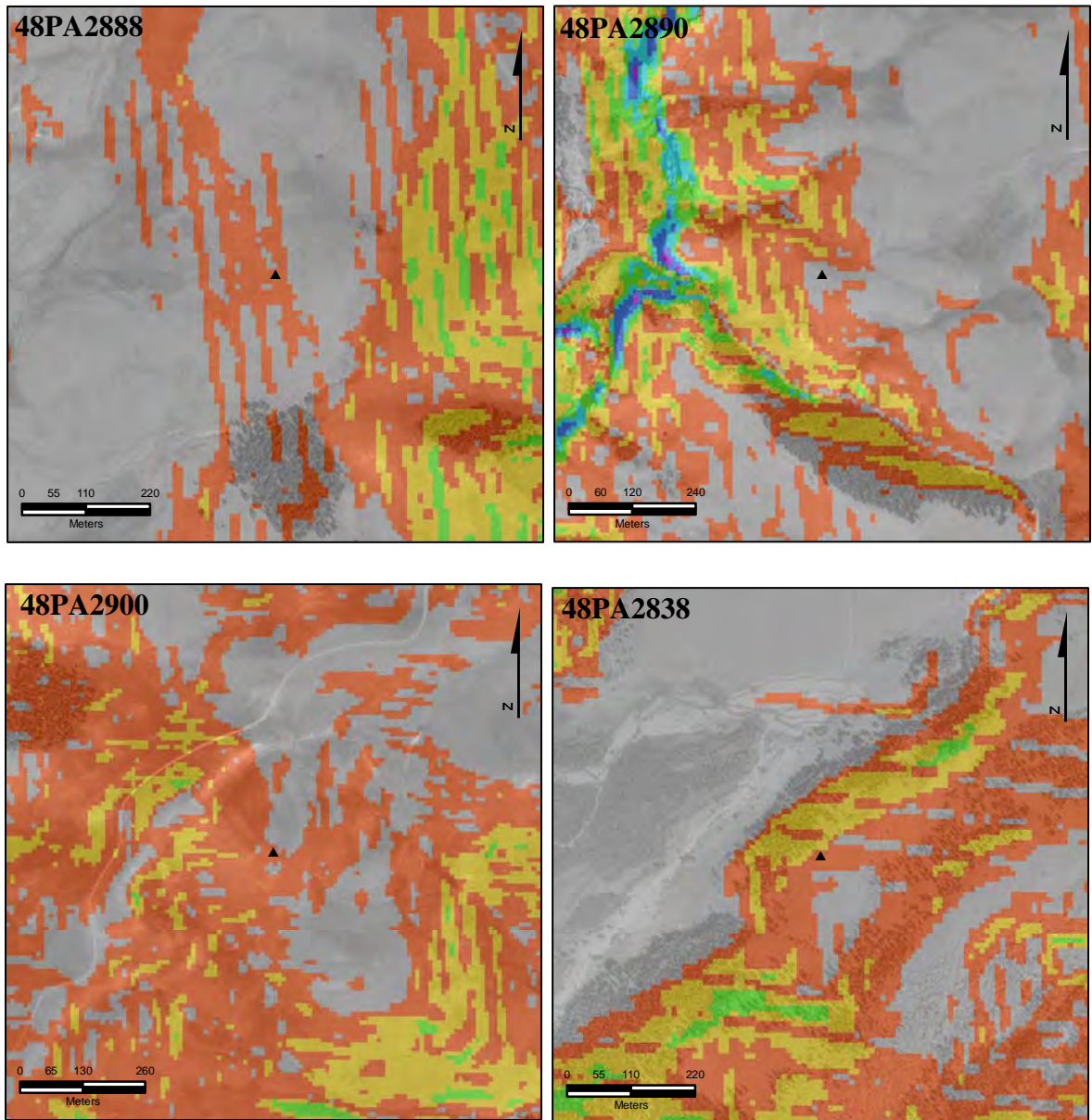
Elevation grades – various scales – 100 m increments					
1,463.412476 - 2,000	2,600.000001 - 2,700	3,300.000001 - 3,400			
2,000.000001 - 2,100	2,700.000001 - 2,800	3,400.000001 - 3,500			
2,100.000001 - 2,200	2,800.000001 - 2,900	3,500.000001 - 3,600			
2,200.000001 - 2,300	2,900.000001 - 3,000	3,600.000001 - 3,700			
2,300.000001 - 2,400	3,000.000001 - 3,100	3,700.000001 - 3,800			
2,400.000001 - 2,500	3,100.000001 - 3,200	3,800.000001 - 3,900			
2,500.000001 - 2,600	3,200.000001 - 3,300	3,900.000001 - 4,005.481689			

Slopes



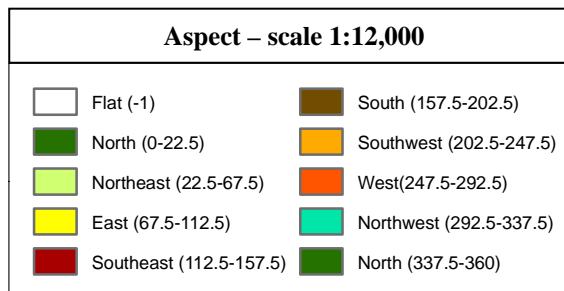
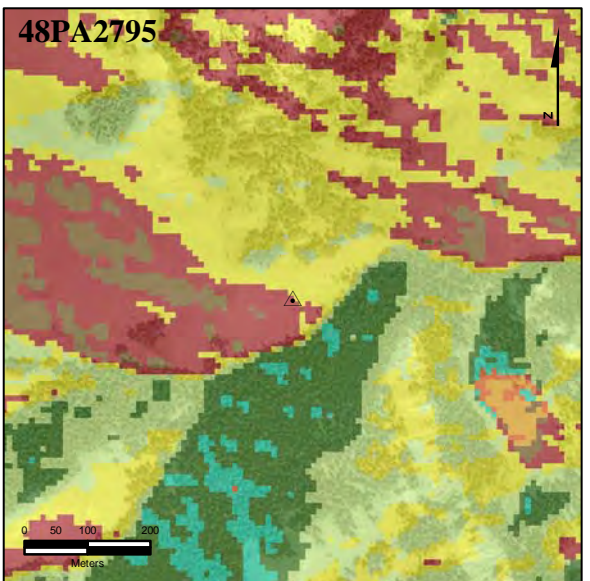
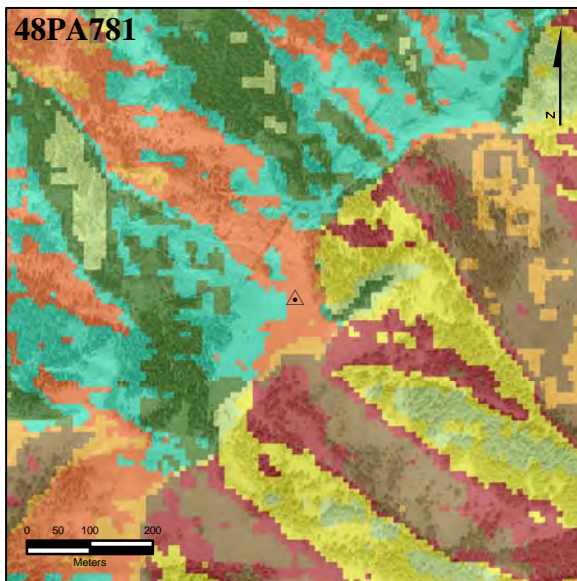
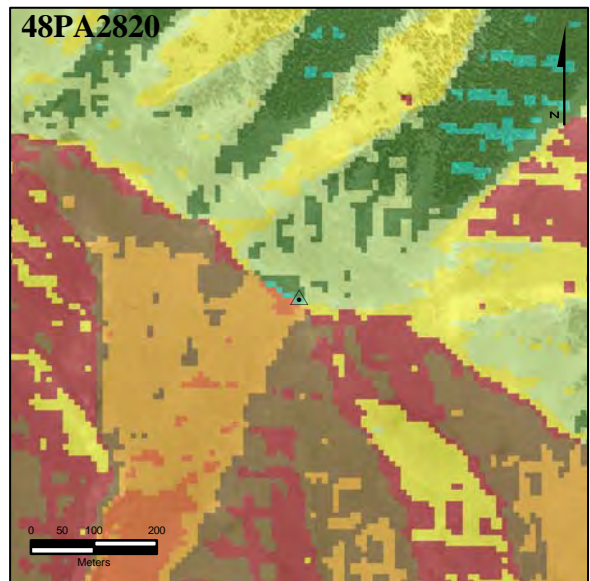
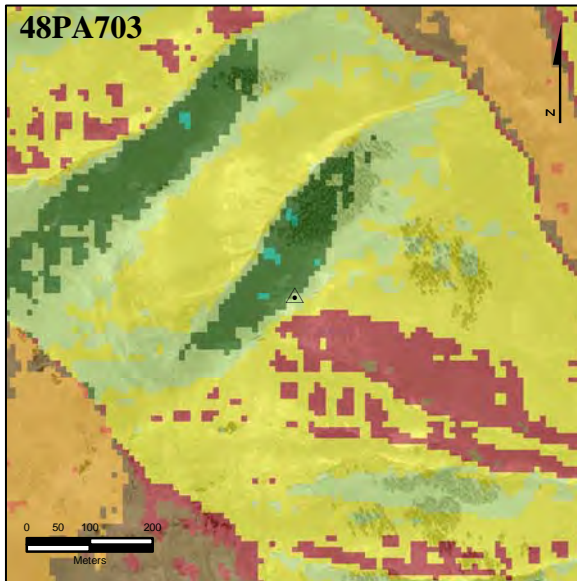
Degrees Slope – scale 1:12,000	
0 - 10	40.00000001 - 50
10.00000001 - 20	50.00000001 - 60
20.00000001 - 30	60.00000001 - 70
30.00000001 - 40	70.00000001 - 80

Slopes

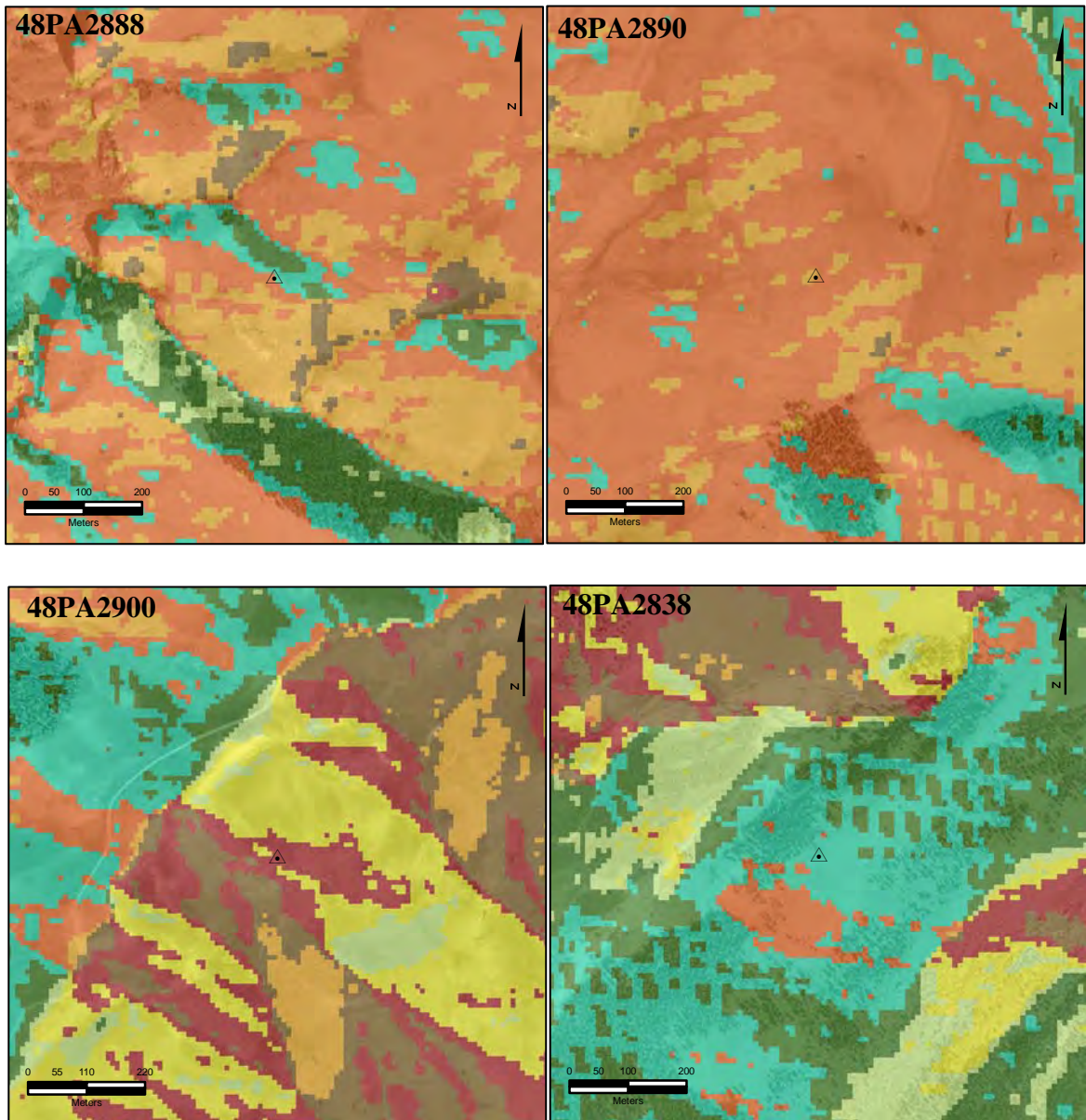












Degrees Slope – scale 1:12,000	
0 - 10	40.00000001 - 50
10.00000001 - 20	50.00000001 - 60
20.00000001 - 30	60.00000001 - 70
30.00000001 - 40	70.00000001 - 80

Aspect

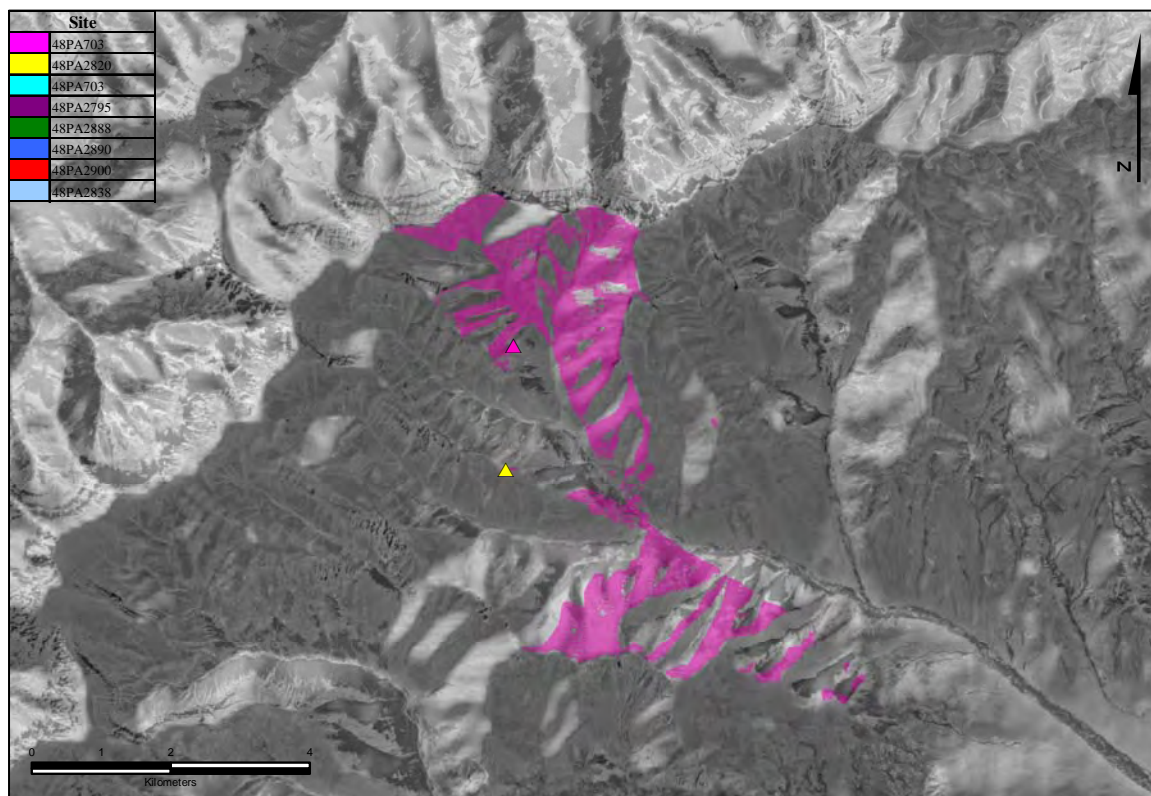


Aspect

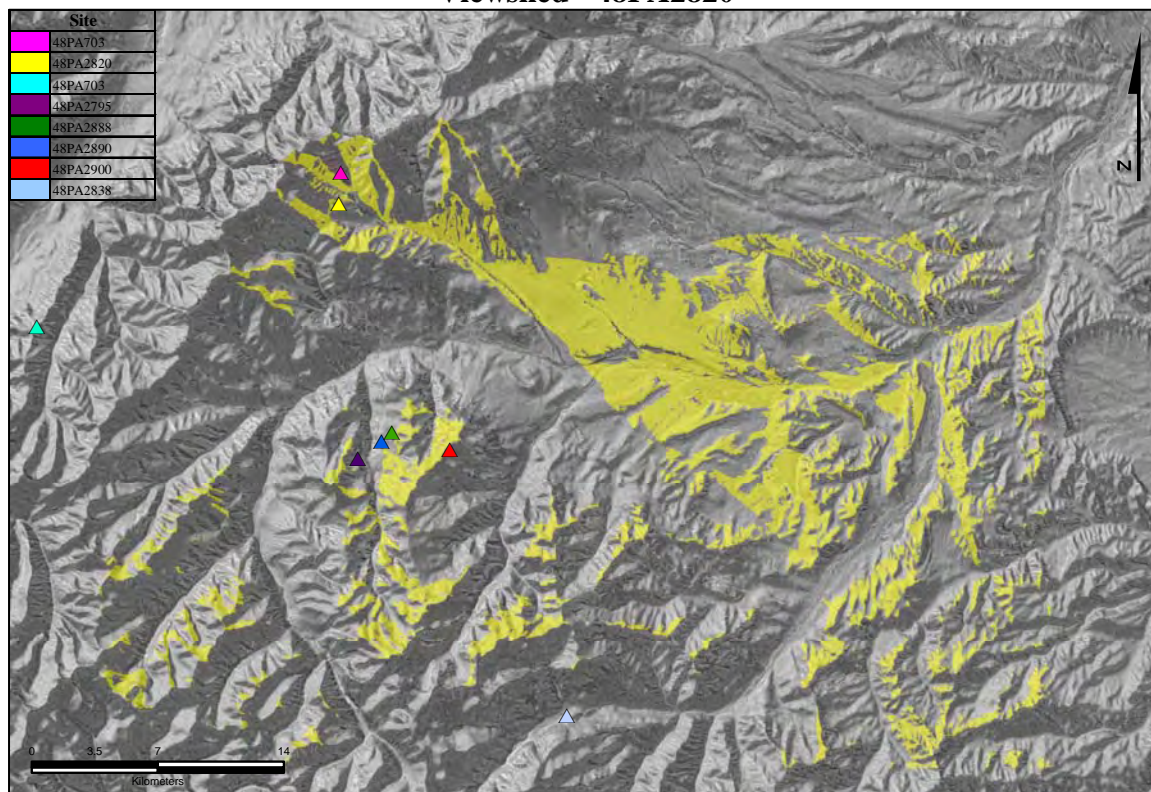


Aspect – scale 1:12,000 k	
	Flat (-1)
	North (0-22.5)
	Northeast (22.5-67.5)
	East (67.5-112.5)
	Southeast (112.5-157.5)
	South (157.5-202.5)
	Southwest (202.5-247.5)
	West(247.5-292.5)
	Northwest (292.5-337.5)
	North (337.5-360)

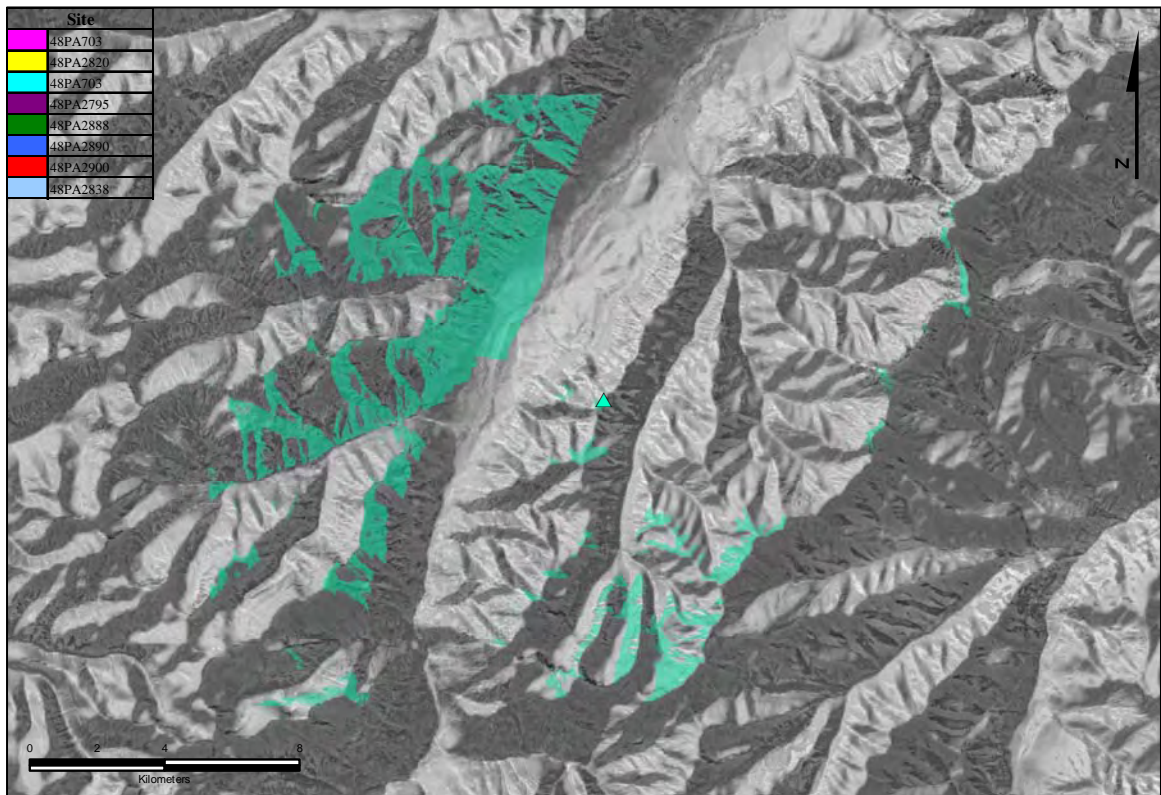
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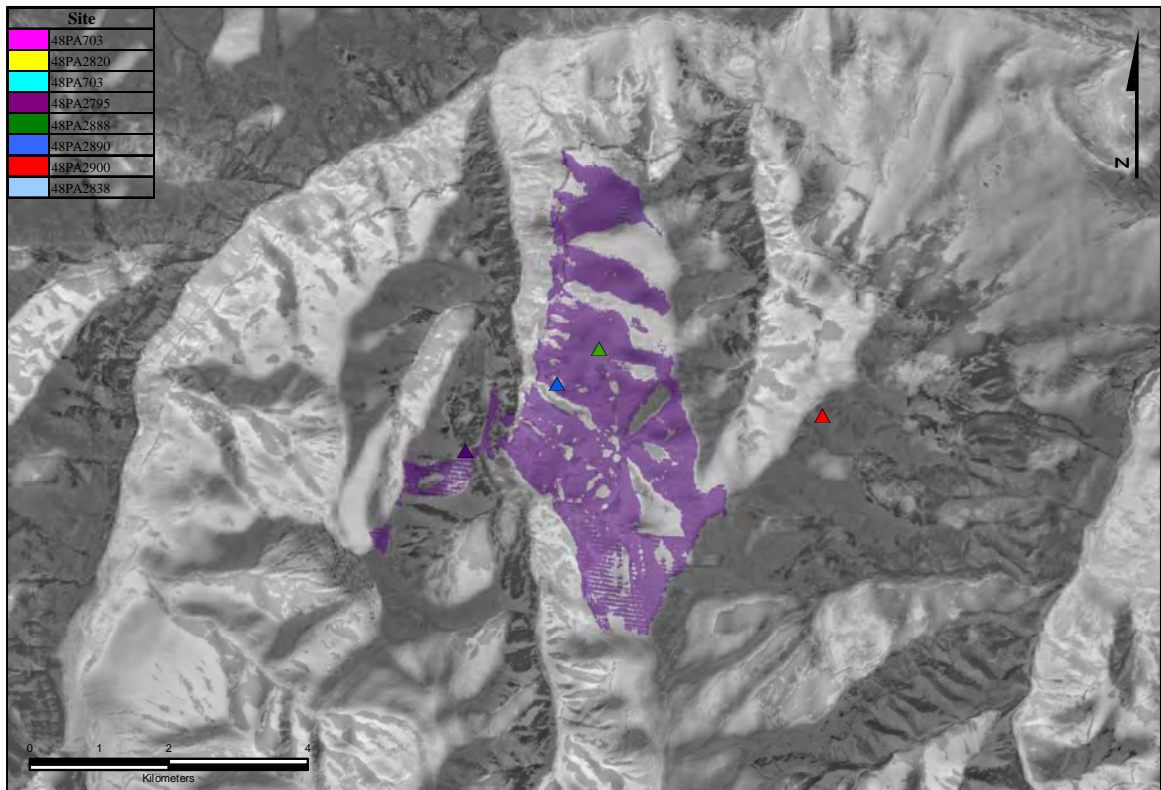
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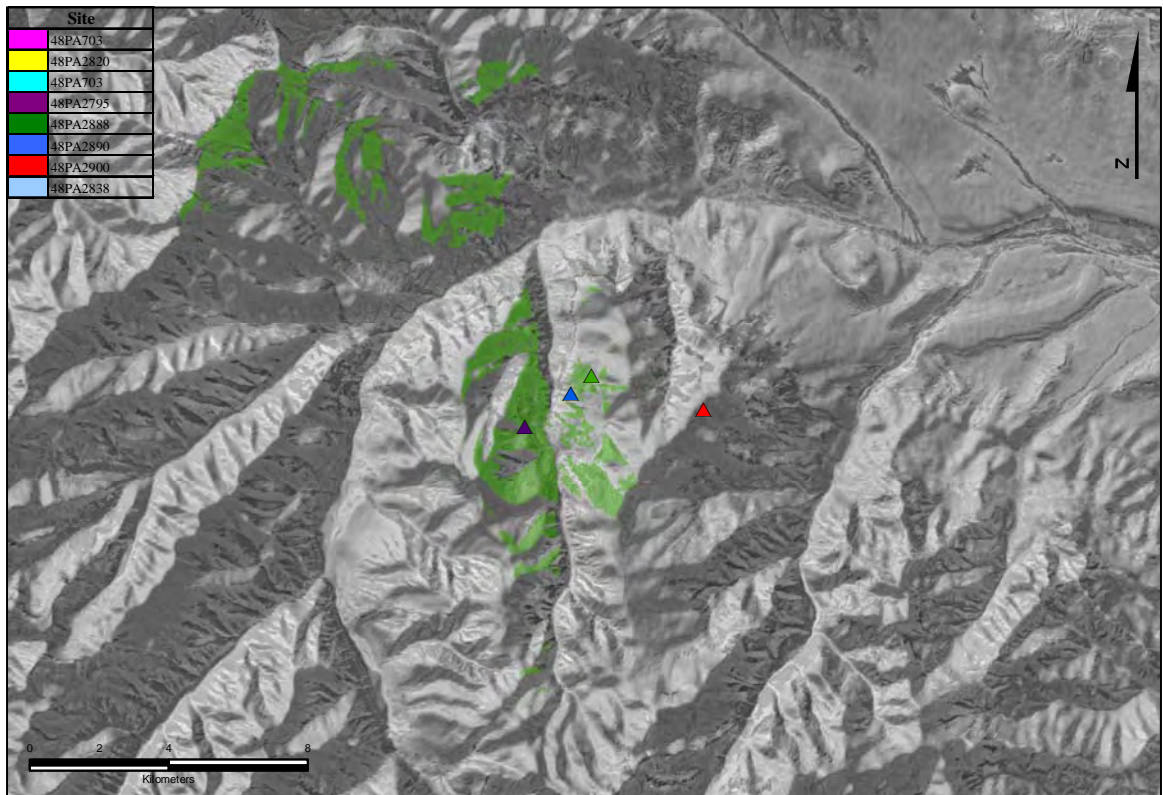
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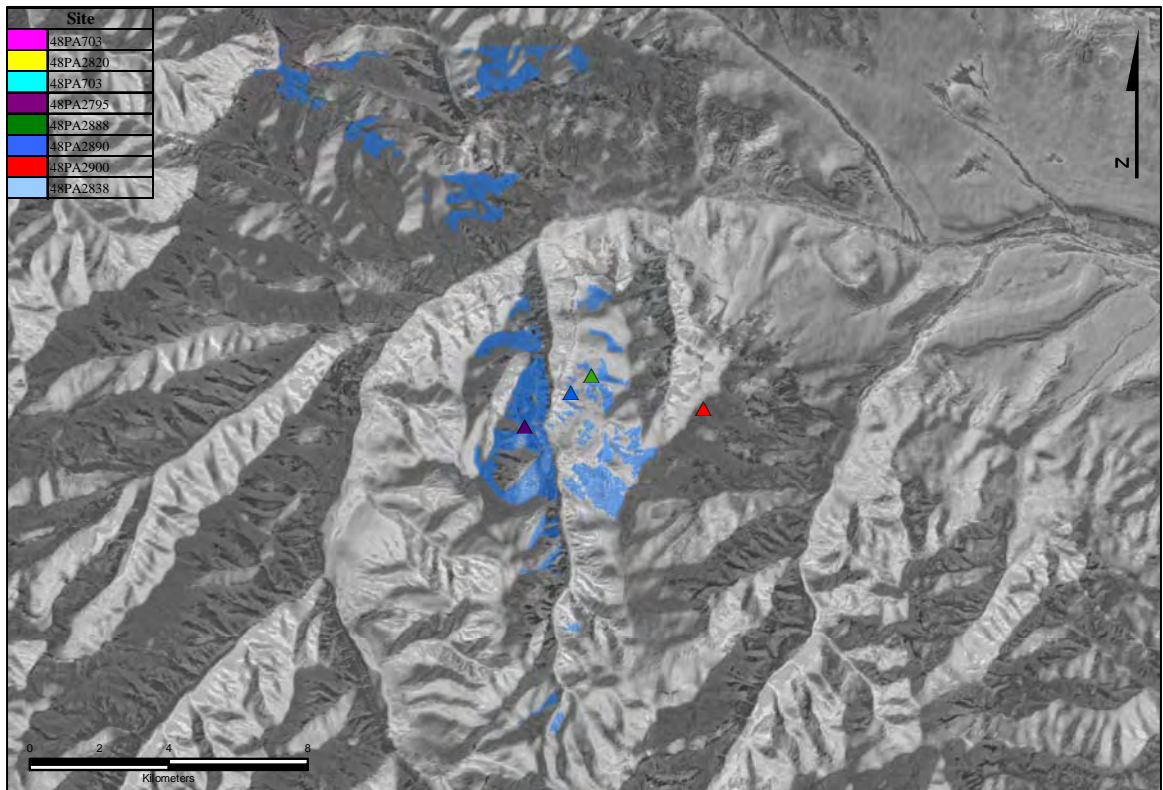
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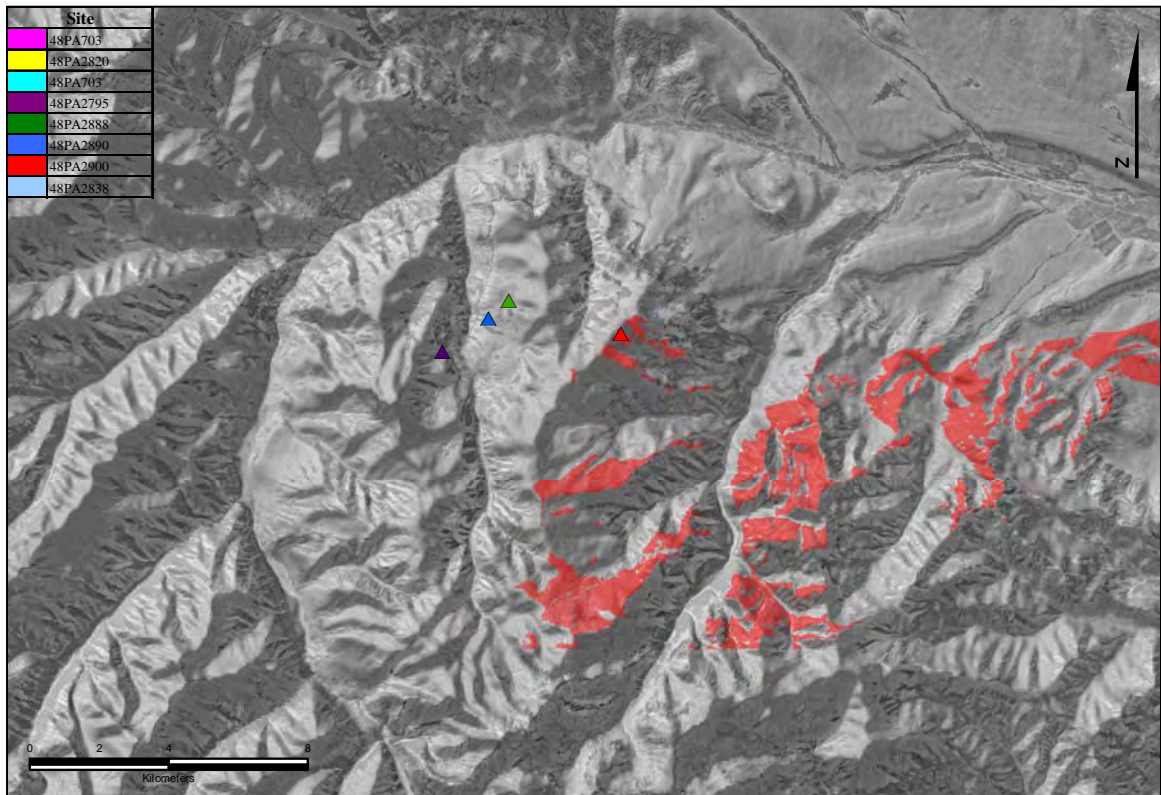
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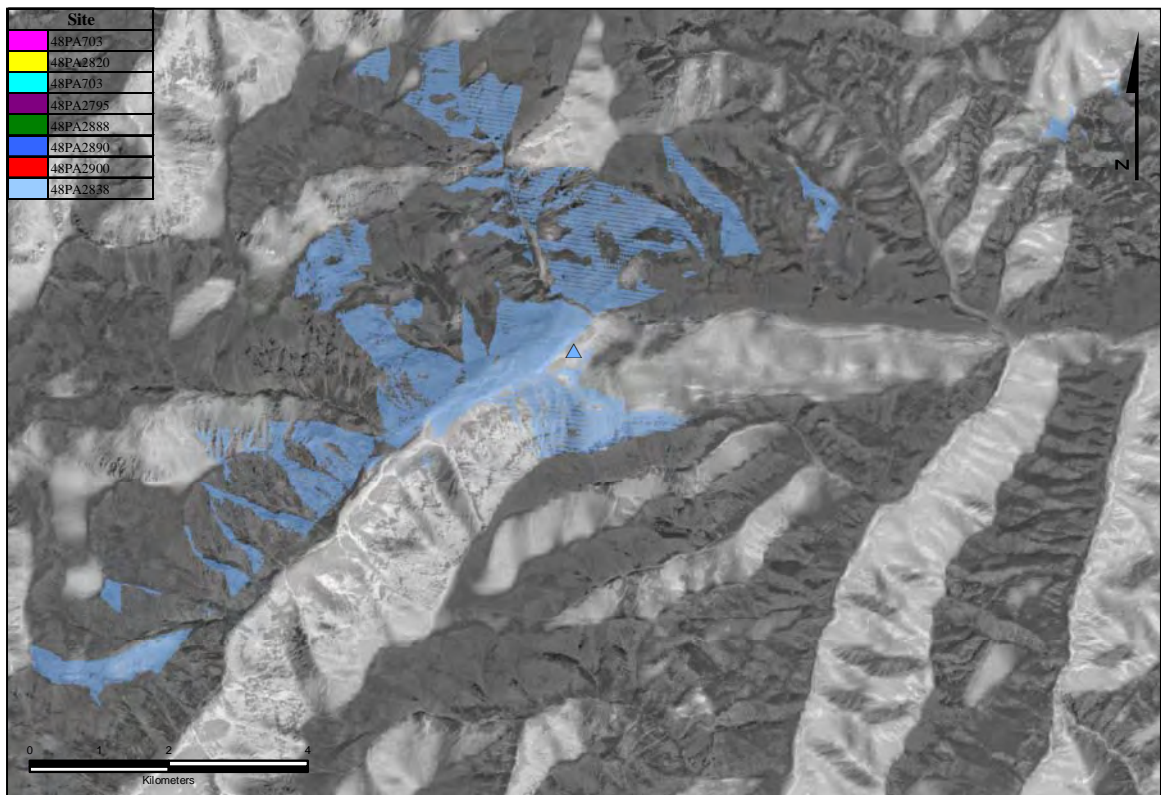
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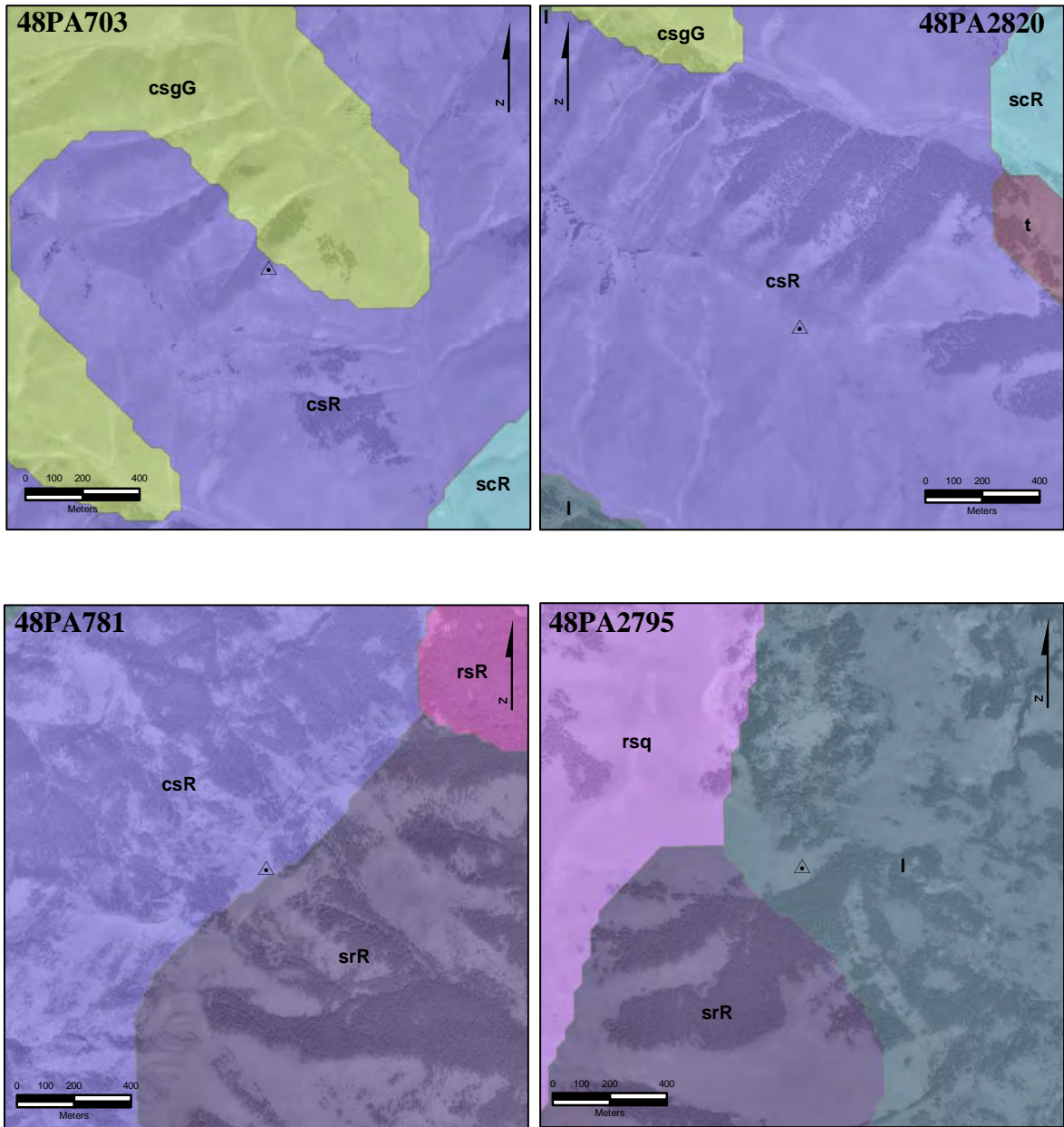
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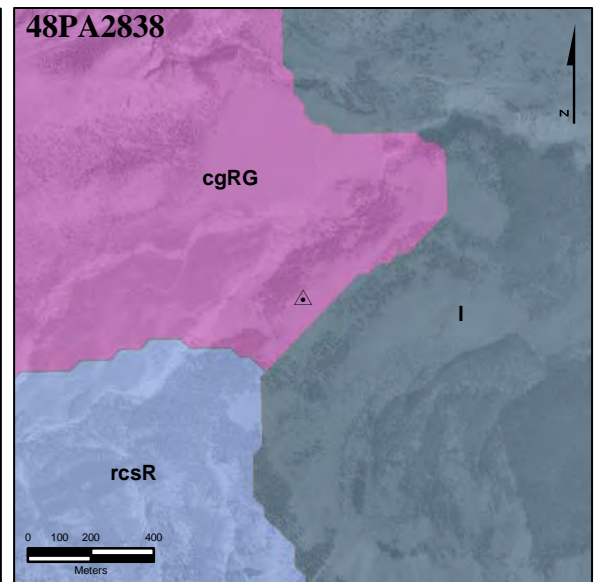
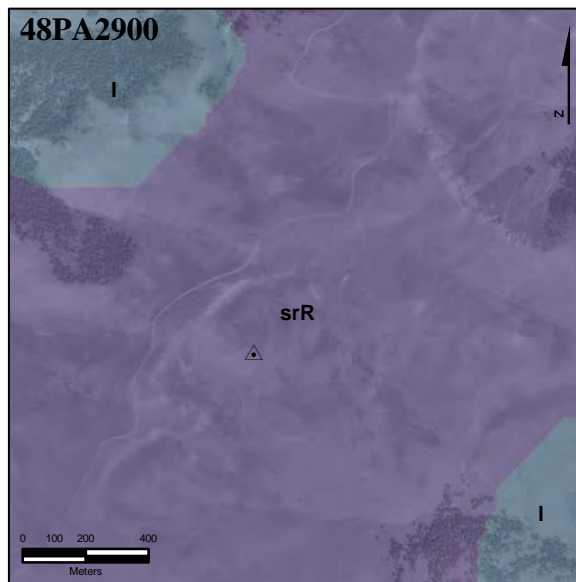
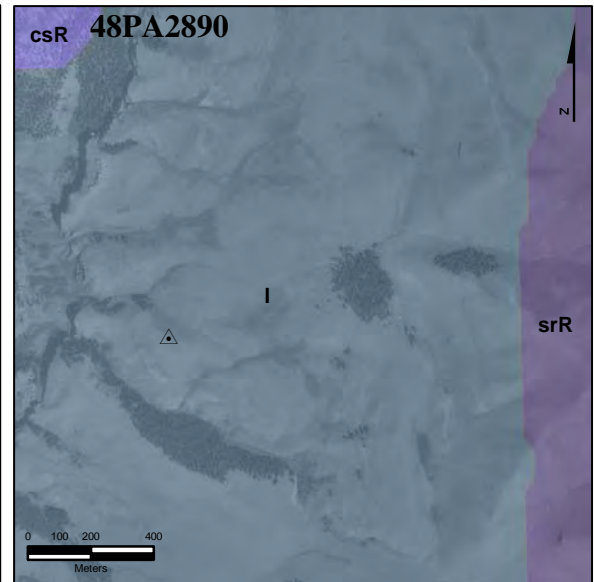
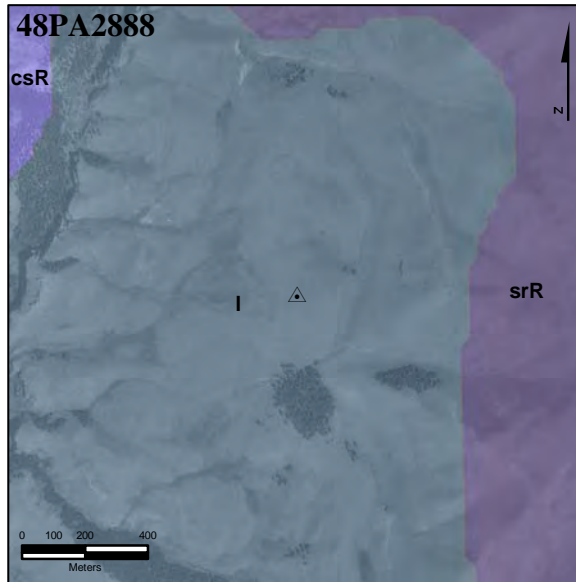


Surface Geology



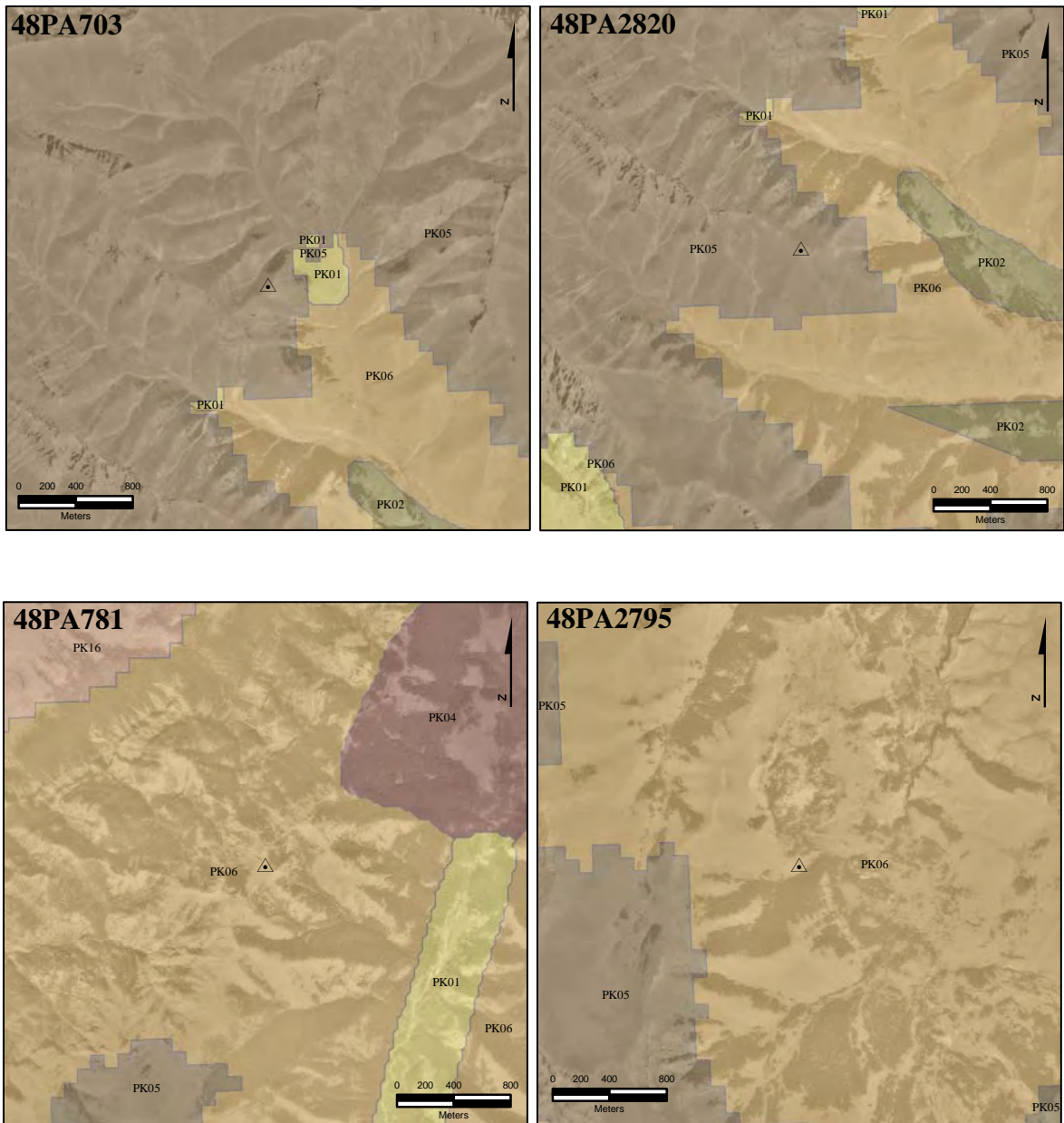
Surface Geology – scale 1:24000				
Entity Attribute	Single Unit (first letter)	Multi-element Classification (following letters)– elements ranked from most to least dominant (Case et. al. 2007)		
csgG	Colluvium	Slopewash	Glacial Deposits	Glaciated Bedrock
csR	Colluvium	Slopewash	Bedrock	-
scR	Slopewash	Colluvium	Bedrock	-
t	Terrace Deposits	-	-	-
l	Landslide Deposits	-	-	-
rsR	Residuum	Slopewash	Bedrock	-
srR	Slopewash	Residuum	Bedrock	-
RsQ	Bedrock	Slopewash	Periglacial Deposits	-
cgRG	Colluvium	Glacial Deposits	Bedrock	Glaciated Bedrock
rcsR	Residuum	Colluvium	Slopewash	Bedrock

Surface Geology



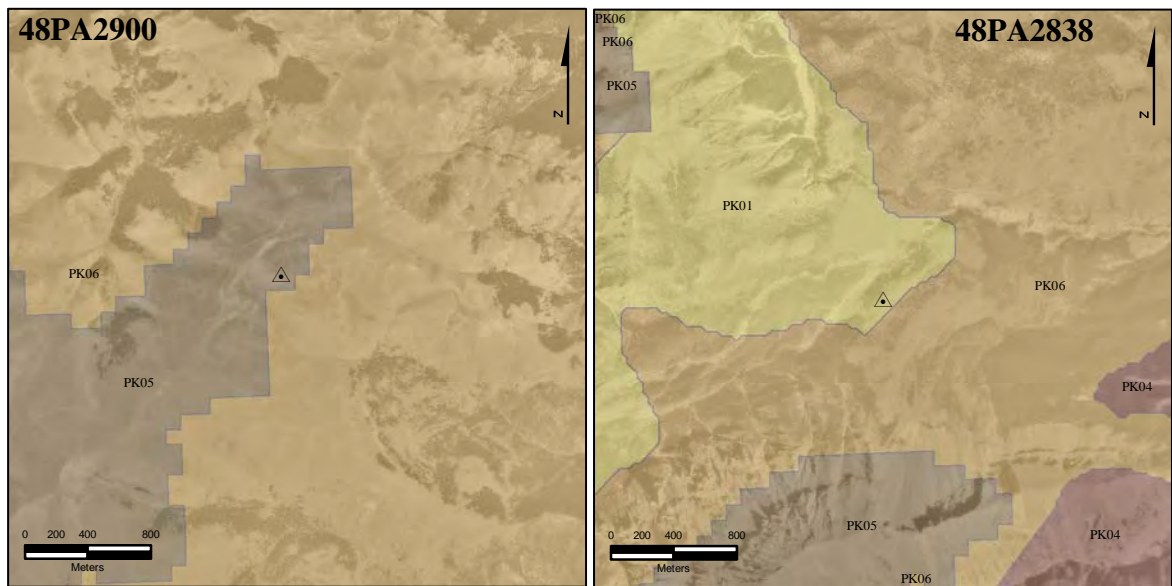
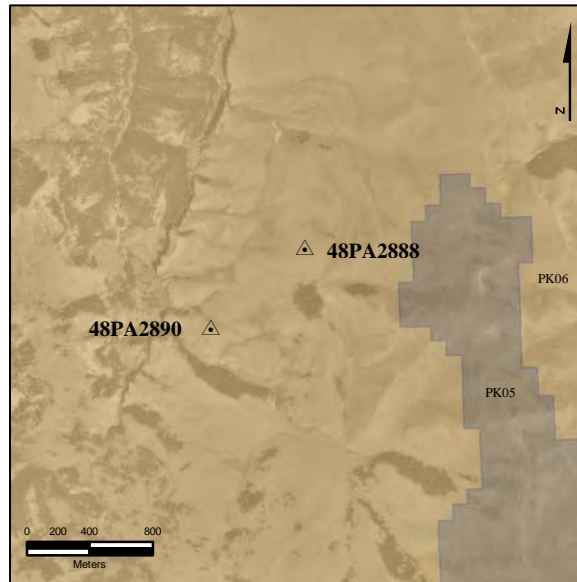
Surface Geology – scale 1:24000				
Entity Attribute	Single Unit (first letter)	Multi-element Classification (following letters)– elements ranked from most to least dominant (Case et. al. 2007)		
csgG	Colluvium	Slopewash	Glacial Deposits	Glaciated Bedrock
csR	Colluvium	Slopewash	Bedrock	-
scR	Slopewash	Colluvium	Bedrock	-
t	Terrace Deposits	-	-	-
l	Landslide Deposits	-	-	-
rsR	Residuum	Slopewash	Bedrock	-
srR	Slopewash	Residuum	Bedrock	-
RsQ	Bedrock	Slopewash	Periglacial Deposits	-
cgRG	Colluvium	Glacial Deposits	Bedrock	Glaciated Bedrock
rcsR	Residuum	Colluvium	Slopewash	Bedrock

Soils



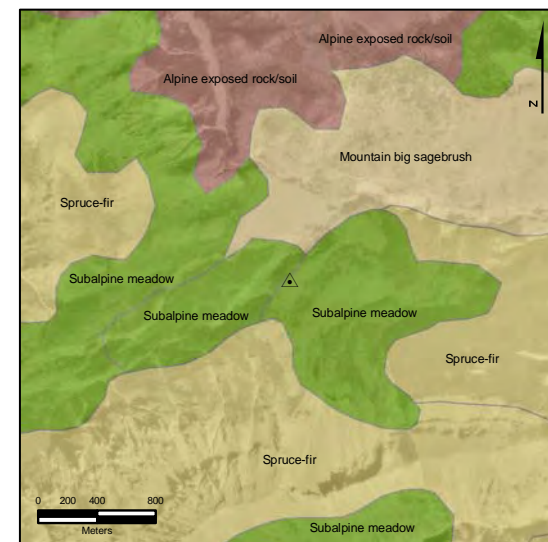
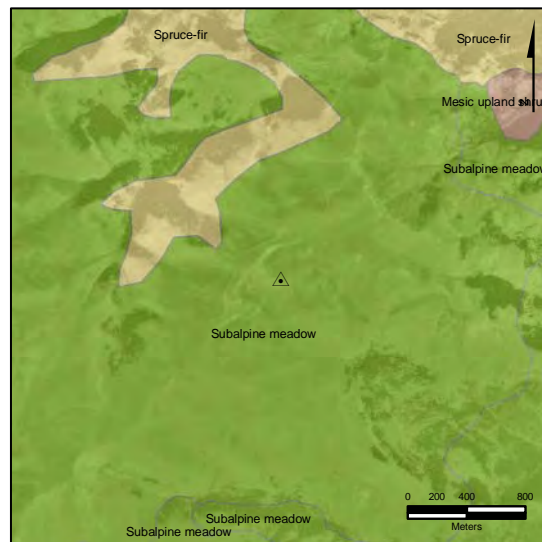
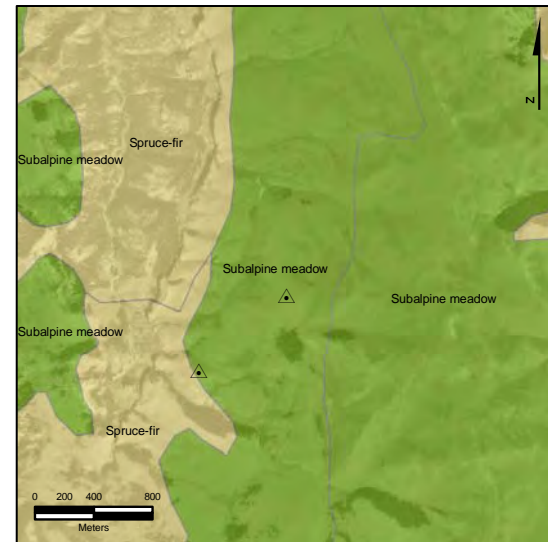
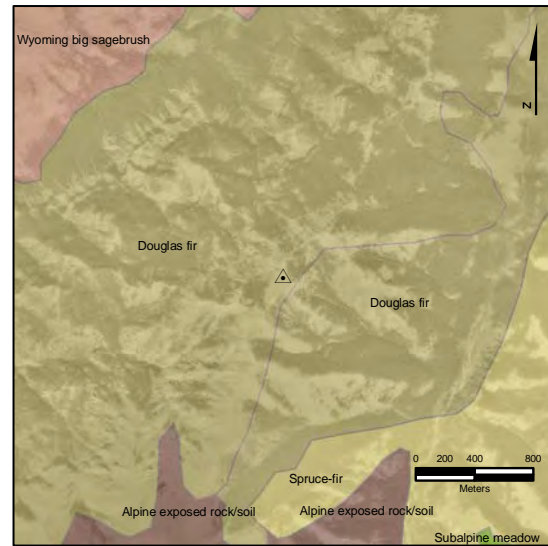
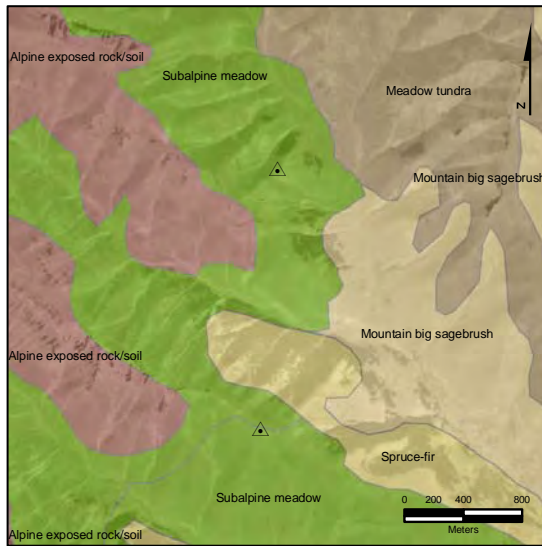
Soils - scale 1:100,000 (Digital Soils Map of Park County)	
PK01	Typic Dystricrypts-Typic Haplocryalfs, loamy-skeletal, mixed and Histic Cryaquepts, fine-loamy over sandy or sandy-skeletal, mixed.
PK02	Fluventic Haplocryolls, fine-loamy, mixed and Histic Cryaquepts, fine-loamy over sandy or sandy-skeletal, mixed.
PK04	Lithic Cryorthents, loamy-skeletal, mixed; Rock Outcrop; and Typic Cryaquepts, fine-loamy over sandy or sandy-skeletal, mixed.
PK05	Histic Cryaquepts fine-loamy over sandy or sandy-skeletal, mixed and Humic Dystricrypts, loamy-skeletal, mixed.
PK06	Typic Haplocryalfs, Typic Dystricrypts and Typic Haplocryolls, loamy-skeletal, mixed and Histic Cryaquepts, fine-loamy over sandy or sandy-skeletal, mixed.
PK16	Haplustolls and Haplustalfs, loamy-skeletal, mixed, frigid.

Soils

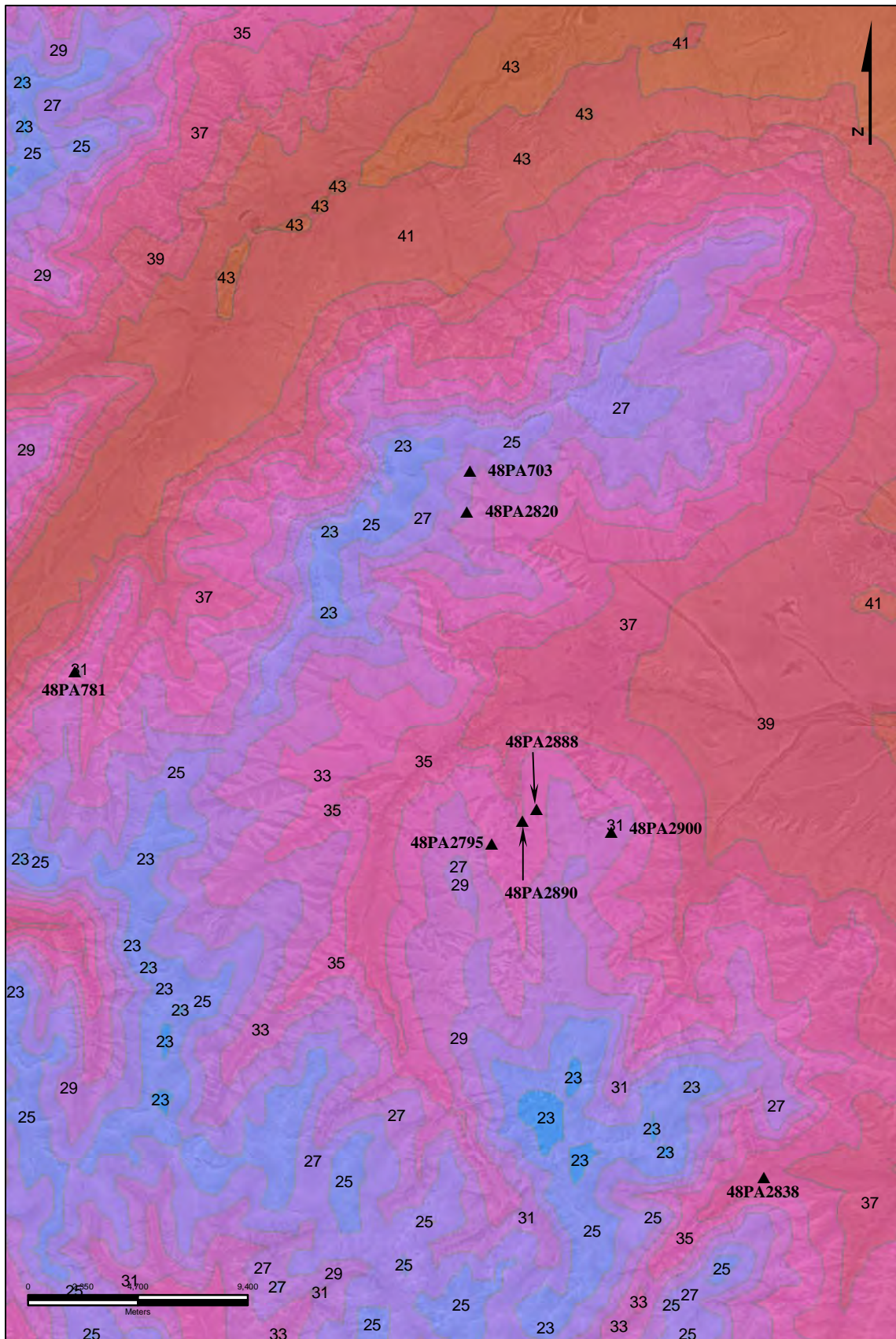


Soils - scale 1:100,000 (Digital Soils Map of Park County)	
PK01	Typic Dystricrypts-Typic Haplocryalfs, loamy-skeletal, mixed and Histic Cryaquepts, fine-loamy over sandy or sandy-skeletal, mixed.
PK02	Fluventic Haplocryolls, fine-loamy, mixed and Histic Cryaquepts, fine-loamy over sandy or sandy-skeletal, mixed.
PK04	Lithic Cryorthents, loamy-skeletal, mixed; Rock Outcrop; and Typic Cryaquepts, fine-loamy over sandy or sandy-skeletal, mixed.
PK05	Histic Cryaquepts fine-loamy over sandy or sandy-skeletal, mixed and Humic Dystricrypts, loamy-skeletal, mixed.
PK06	Typic Haplocryalfs, Typic Dystricrypts and Typic Haplocryolls, loamy-skeletal, mixed and Histic Cryaquepts, fine-loamy over sandy or sandy-skeletal, mixed.
PK16	Haplustolls and Haplustalfs, loamy-skeletal, mixed, frigid.

Landcover/Predominant Vegetation Community



Average Temperature 1961-1990 (PRISM data) – Degrees Fahrenheit



Average Precipitation 1961-1990 (PRISM data) – Inches per year

