Chapter 1
Research Objectives and Background

1.1 Introduction

Yellowstone is America's first National Park and is considered the "crown jewel" of the National Park system. Comprising 2.2 million acres, it is situated in the extreme northwest corner of Wyoming with boundaries extending into southwest Montana to the north and eastern Idaho to the west. Perhaps best known for its spectacular thermal features such as the Old Faithful geyser, Yellowstone also has a rich cultural history, both before and after its dedication as a National Park. While the traces of their daily lives were often ephemeral, people have been visiting and inhabiting Yellowstone for the past 12, 000 years. The Greater Yellowstone Ecosystem (GYE) is a term that will be used in this thesis and refers to an area including Yellowstone and Grand Teton National Parks and surrounding areas. The concept of the GYE is useful as it takes into account the arbitrariness of these boundaries when it comes to floral, faunal, geological and human patterns, and follows the natural boundaries of the ecosystem.

Obsidian is a glassy volcanic material ranging in color from black to brown, red, green and even white (Davis et al. 1995:21). Its tendency for conchoidal fracture and extremely sharp edges make it a prized tool-making material which was heavily exploited in Yellowstone National Park (Davis et al. 1995). Many other types of stone (such as chert) display distinct chemical signatures that differ between sources, but are problematic for archaeological applications as they often display high variability of chemical "signatures" within a single source. Obsidian, however, is a unique stone in that it allows for analysts to consistently distinguish between different geochemical sources of the material in a way that is useful to archaeologists. It can be analyzed for its chemical composition accurately and non-destructively providing a unique "fingerprint" for each source because of low intra-source variability. Tools made of obsidian can be traced back to their source using this fingerprint.

Through time, each pre-contact group had access to different obsidian sources in the GYE. There are 15 known obsidian sources used by pre-contact peoples in the Yellowstone region (Davis et al. 1995) spread out to the south, southwest, west, and northwest, offering choice and opportunity. One of these sources, Obsidian Cliff, is a National Historic Landmark and a highly significant raw material source for the Plains and beyond. Artifacts made from obsidian from this source are found as far afield as Texas, Washington State, southern Alberta, and Hopewellian burial mounds in the Ohio Valley, indicating it was a prized material that was also extensively traded or exchanged by people for thousands of years (Davis et al. 1995). Obsidian may have been significant in different ways both for its utility and for symbolic purposes as well.

This research will examine the potential for cultural selection of obsidian sources by pre-contact peoples during different time periods based on archaeological evidence in the Park. A focused analysis of obsidian source selection across a specific time span has never been done in the Park. This study provides a unique opportunity to learn more about the extensive use of obsidian by prehistoric people in the GYE over thousands of years.

A large dataset of sourced obsidian artifacts currently exists, generated by survey and excavation work performed by contractors, volunteers, and the Park archaeologist. To date, no one has analyzed this large dataset by culture or time period. In addition, no one has ever examined the information to see if different cultures were favoring some sources over others when the quality of the material is comparable.

1.2 Research Problems and Objectives

This research is focused on analyzing the spatial and temporal trends of obsidian use in Yellowstone. A primary objective is to provide a comprehensive list of obsidian sources important to Yellowstone and to describe the relationship between obsidian and the pre-contact people who occupied the Park. An up-to-date compilation of source information does not currently exist. This information will then be used to analyze obsidian selection by two archaeological cultures in different sub-areas within the Yellowstone region. Finally, the question of cultural selection/preference of obsidian sources and the implications if this is determined to be the case will be considered.

This analysis will be restricted to tools produced by people during the Archaic period, focusing on the McKean complex (~5500-3000 BP, or years Before Present) and Pelican Lake phase (3000-1600 BP) in an effort to examine the cultural selection of obsidian sources in

Yellowstone. The tools included in this study will be limited to diagnostics (namely, projectile points with enough stylistic markers to be assigned to a specific time period/culture) to control for time in a sample that includes mostly surface collections. In a few cases, the tools included were found *in situ* with good provenience, but this was not the case for the majority of the sample.

A second objective is to compare these results with the earlier assemblage of tools found at the Osprey Beach site (on the western shore of Yellowstone Lake), culturally and stratigraphically associated with the Cody complex (9500-8500 BP), which is part of the Paleoindian period. This site provides an excellent dataset for comparison controlling for space and varying time. Obsidian sourcing results performed on artifacts from this site were analyzed to determine a proposed seasonal round for Cody Complex peoples (see Johnson et al. 2004). This proposed movement will then be compared with the results of the analysis of McKean and Pelican Lake annual rounds. Diagnostics included in the sample as representative of the Cody complex include Cody knives, with their distinctive morphology, as well as projectile point types associated with the time period.

1.2.1 Key Research Questions

Research questions include: Are there significant patterns of preference for certain obsidian sources among McKean, Pelican Lake and Cody people? If so, are these patterns similar or different? Can the frequency of obsidian tools at a given location be an indicator of seasonal travel routes based on where the obsidian came from?

If a clear pattern of procurement is discerned, the differences may represent where and in what general direction the groups traveled during the year, and/or cultural preference for sources indicated by the frequency of these obsidians as a tool stone used by each group. The current model of movement of pre-contact peoples is of one large seasonal round with groups moving southward through the Park in the summer, then west and northwest into Idaho for the winter, and back north and northeast into the Park. Frison’s (1992) diversified and ecosystem-specific subsistence strategy for the Intermountain area of Wyoming contributes to the currently held concept of a seasonal occupation of the Yellowstone Plateau during Cody Complex times. A model of the seasonal round traveled by Cody Complex groups in the GYE has been proposed based on the results of obsidian source analysis of tools from the Osprey Beach site excavation by Lifeways of Canada, Ltd. contractors in 2002 (Johnson et al. 2004). While this previous research is specifically tailored to Cody complex groups, it is generally assumed by most researchers that this seasonal round is applicable to later time periods as well. This assumption is made without any specific analysis relating obsidian source selection to time period, which is a gap that this research will hopefully fill.

The results of this research suggest that a second model, whereby people entered and exited the Park from different directions, is more applicable. In addition, spatial analysis and frequency studies appear to show that certain preferred sources might have carried significance as part of a meaningful landscape. Returning to the question of cultural preference, does the evidence indicate that we should move beyond only considering economics? Economics are certainly part of a cultural system. However, a distinction is made for the purposes of this thesis between decision making based on "economics" (in the sense of maximum gain for minimum effort) and decisions made for a social or "cultural" reason (which do not appear to conform to concepts of efficiency). "Cultural" or social aspects are elements embedded in the activities undertaken as part of the seasonal rounds of pre-contact peoples. These social aspects are never mentioned in the existing literature on Yellowstone archaeology, and are discussed in this thesis under the broader term of "cultural preference".

1.3 Thesis Organization

This thesis is divided into 8 chapters, addressing obsidian provenance within the context of the research questions posed above. Chapter 2 describes the archaeological history and environmental setting of the study area. Chapter 3 details the methods used in the research, analysis and interpretation of the data and introduces landscape theory and analogy. Chapter 4 introduces obsidian as a tool stone material, describes the history of obsidian use studies in the Park, and provides a comprehensive list of the geochemical sources important to Yellowstone archaeology. Chapter 5 analyzes the applicability of a landscape approach to obsidian procurement studies, and critically examines the use of analogy as an interpretive tool. Chapter 6 introduces comparative examples of the multi-functionality of obsidian in Yellowstone and Mesoamerica. Chapter 7 presents the results of this study in relation to the research objectives of this thesis. Chapter 8 is a discussion of concepts of efficiency and the idea of an annual round, and provides alternative models for the movement of people through the Park. Chapter 8 also provides direction for future research.

Chapter 2
The Environmental and Archaeological Setting

2.1 The Plains and Middle Rocky Mountains

Montana is typically considered part of the greater Plains region within North America for both ecological and archaeological purposes. The Plains is a massive region and can be further subdivided into the Northern Plains (which includes Montana and Wyoming) and the Central and Southern Plains, respectively. At this scale, Yellowstone sits in the border region between the Northwestern Plains cultural sub-area (which includes the Plains region west of the Missouri and north of Colorado Springs) and the Rocky Mountain/Intermountain sub-area (Figure 1). Often Yellowstone has been lumped together with either the Northwestern Plains or so-called Middle Rocky Mountains for archaeological purposes.

The Yellowstone area shares many environmental and archaeological/cultural patterns with both regions. At the same time, the environment and geology of Yellowstone is distinctly local- the thermal features and volcanic caldera which lies beneath Yellowstone are unique features in North America. As Wood (1998:9) explains, the Plains "is not environmentally homogenous…[the region is] a complex mosaic of seasonally and geographically induced patches, varying through time, that were both climatically manipulated by nature and culturally modified by humans". Thus, instead of an endless expanse of grass blowing in the prairie wind, we should expect to see environmental and cultural variety within this vast landscape. Although the heterogeneity of the Plains culture is understood, the concept of the Plains is still used as a way to organize data (Wood 1998:9). The anthropological distinctions within the Plains are based on the generalized definition of the typical Plains environment (short and long grass prairie) in relation to surrounding zones (i.e. the Great Basin, which is environmentally distinct and also culturally distinct from the Plains). These distinctions must not be held too rigidly, particularly in relation to culture. We must remain aware of the blending of cultural and environmental zones in border regions and even within the "heart" of an area.

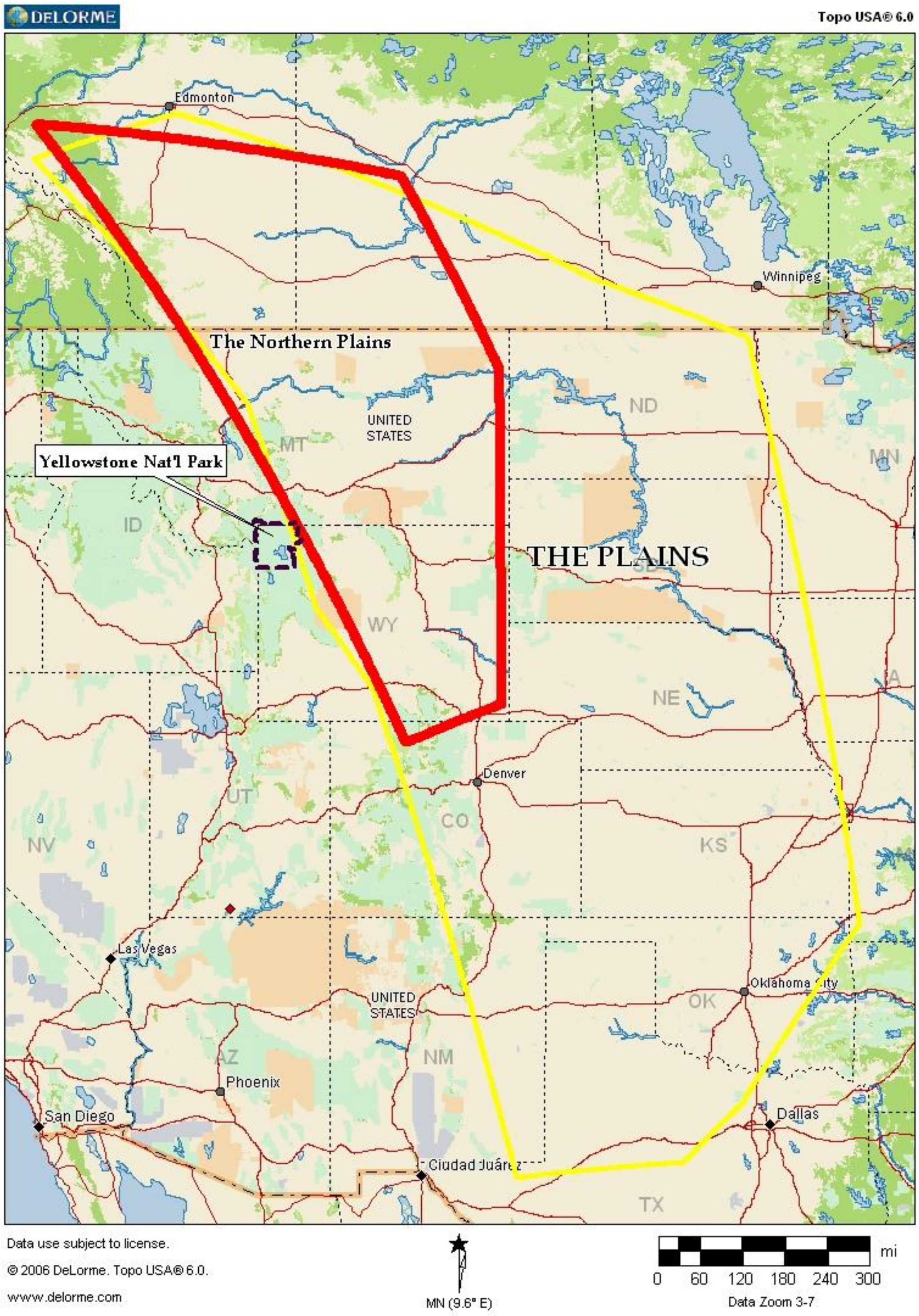


Figure 1: Yellowstone National Park within the Greater Plains Region (adapted from Wood 1998).

2.1.1 The Greater Study Area

The environmental setting of Yellowstone ranges from alpine, sub-alpine and coniferous forest, to meadows and grasslands, arid high-country desert as well as thermal areas with their own micro-environments. The majority of the Park is located on the Yellowstone Plateau which straddles the continental divide and is part of the Rocky Mountain range. The Plateau is actually comprised of several smaller plateaus within the Park's boundaries, namely the Blacktail, Buffalo, Central, Madison, Mirror, Pitchstone, and Two Ocean plateaus. Two major mountain ranges flank the Plateau-the southern end of the Gallatin Range in the northwestern quadrant of the Park and the Absaroka-Beartooth Range which forms the Park's eastern boundary. In addition, the Washburn Range and the Red Mountains are two isolated uplifts located in the central and southwestern regions of the Park respectively.

Three major rivers partially originate in the Park. The Yellowstone, which flows north from just beyond the southeast border through the Park and eventually joining the Missouri River in Central Montana; the Madison, which flows through a broad river valley west through the Park and past its western border, eventually joining the Missouri; and the Snake, which flows south from the Park creating a major river valley to the southwest in Wyoming and Idaho, before joining the Columbia River system. The Yellowstone River is the major drainage system in the Park, running generally north-south. From its headwaters just south of the Park boundary, it feeds into Yellowstone Lake (see Figure 2). Yellowstone Lake is the largest high altitude freshwater lake in the world, at an elevation of 2358 m, and approximately 30 km north/south by 20 km east/west (Vivian et al. 2007:1). The Yellowstone River flows north through the Lake and onwards creating the deep and imposing Grand Canyon of the Yellowstone. It then veers northwest creating the Black Canyon of the Yellowstone and past the northern Park boundary through the town of Gardiner, Montana. The Yellowstone River continues north carving a wide river valley between the Gallatin and Absaroka mountain ranges.

2.1.2 The North and South Study Areas

This thesis focuses on two areas within the Park: the Yellowstone River south of the town of Gardiner, Montana (which will be referred to as the North Study Area), and the southern and western shoreline areas of Yellowstone Lake (referred to as the South Study Area) (see Figure 2). The environmental setting of the North Study Area varies. The Yellowstone River

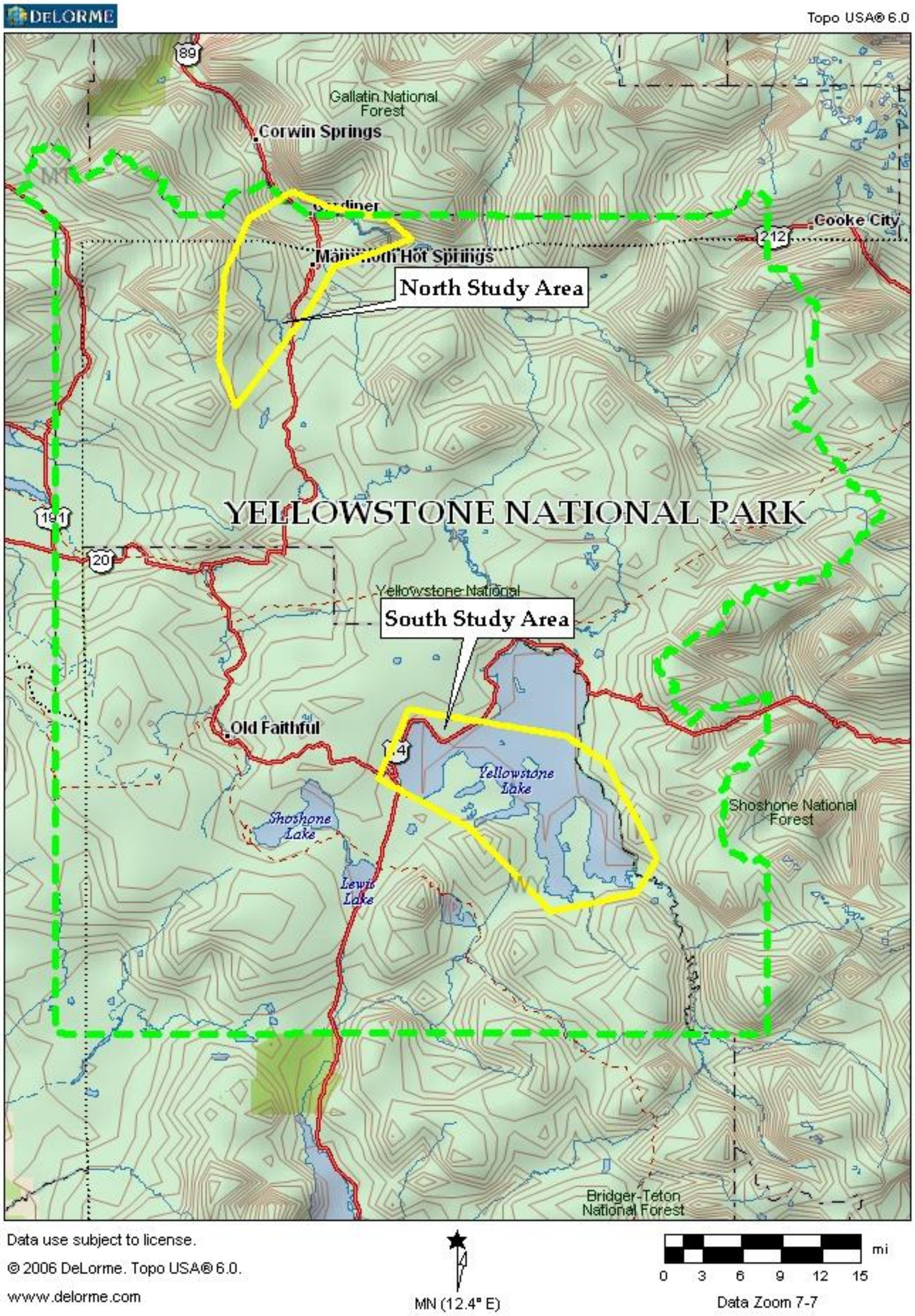


Figure 2: The Study Areas

runs through the Black Canyon of the Yellowstone before reaching the northern boundary of the Park. The canyon is one of the driest and hottest places in the Park, with an arid desert-like environment at an altitude of approximately 1675 m. The North Study Area along the eastern edge of the Gallatin mountain range (the eastern border of the study area-see Figure 2) is less arid, with meadows and conifer forest blending into sub-alpine environments as one gains elevation. The South Study Area (at approximately 2375 m) is higher in elevation relative to the North Study Area, and thus experiences colder winters. It is generally comprised of conifer forest and grassy meadows, with areas of thermal activity near the Osprey Beach site area and more rugged promontories and cliffs along sections of the shoreline.

2.2 Background of Yellowstone Archaeology: Major Surveys and Excavations Included for Study

Yellowstone National Park encompasses an area approximately three times the size of Rhode Island, yet only about 2-3 % of this area has been archaeologically surveyed (Ann Johnson [former Yellowstone National Park archaeologist], personal communication 2008). However, extensive survey and inventory has been performed by contractors along the south shore of Yellowstone Lake (see Vivian et al. 2007) and the Yellowstone River upstream from Gardiner, Montana near the northern boundary of the Park.

While several artifacts were sent for chemical analysis as part of each of these projects, a comparative analysis by time period and location of sites was suggested but never undertaken. Groups who produced the McKean and Pelican Lake cultures are the best represented in the Park's archaeological record in these areas. The extensive dataset of McKean and Pelican Lake obsidian projectile points from this work provides the opportunity to have all these diagnostic tools sourced. This information has been added (by this author) to the large existing source dataset and analyzed as a fuller representation of obsidian source selection by Archaic groups.

2.2.1 The Osprey Beach Site (48YE409)

The Osprey Beach site (48YE409) is a multi-component Cody Complex site on the West Thumb of Yellowstone Lake (see Figure 3). The site is located on a bank that is rapidly eroding due to wave action and the changing water levels as a result of the "breathing" of the caldera beneath the Lake. This site was first recorded by Jacob Hoffman in the late 1950s as a surface scatter (Johnson et al. 2004:9). Upon subsequent re-visits in the early 2000s the volume of artifacts observed eroding out of the banks and collected from the beach indicated the presence of buried materials. The site area is near the West Thumb developed area of the Park. Illegal collecting was also suspected to be impacting the site. Mitigative action was recommended and Osprey Beach was excavated during the 2000 and 2002 field seasons by Lifeways of Canada Ltd. (see Johnson et al. 2004).

The site is the most extensive Cody Complex site in the Park and one of the oldest documented sites to be excavated. It represents several thousand years of repeated occupation and has provided the most comprehensive insight into the Paleoindian period in the Park. The excavation locality dug during the 2002 excavation was a total area of 858 square meters (Johnson et al. 2004:157) and hundreds of Cody complex tools were recovered from both surface and *in situ* contexts. Extensive obsidian sourcing was performed for the final Osprey Beach site report and the results of that analysis will be considered for the Cody Complex as a comparison to the results of my sample group from the Archaic period. This research also includes seven Archaic period projectile points from the Osprey Beach site that had not previously been sourced and were not included in the sourcing analysis presented in the final report by Johnson et al. (2004).

2.2.2 The Donner Site (48YE252)

The Donner site (48YE252) is located on the southwest shore of the Southeast Arm of Yellowstone Lake (see Figure 3). Following reports and collections made by Tom Murphy, a local photographer and amateur archaeologist, the site was further investigated and recorded during the 2002 and 2006 field seasons of the Yellowstone Lake Shoreline Survey (see Vivian et al. 2007). The Donner Site is located on a terrace that is eroding into the Lake and thus the site was excavated in 2008. Two hearth features were discovered eroding from the bank and over 300 lithic artifacts were recovered. The site represents a campsite with most intensive use during the Middle and Late Archaic (McKean and Pelican Lake cultures). All of the obsidian projectile points from that excavation have been included in this research.

2.2.3 The Malin Creek Site (24YE353)

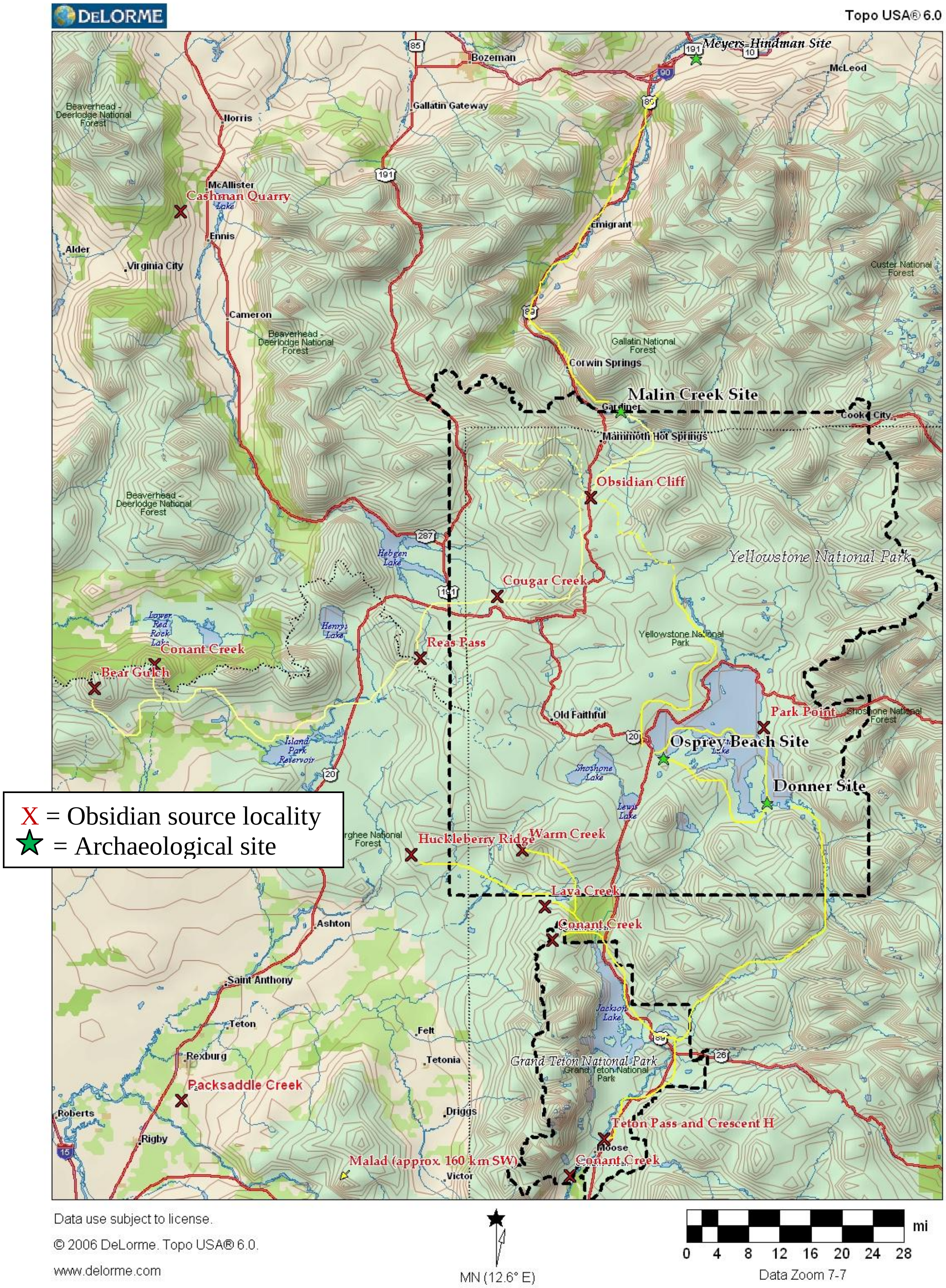


Figure 3: Major Sites and Obsidian Sources (proposed travel routes highlighted in yellow)

The Malin Creek site (24YE353) is located on the first terrace on the north side of the Yellowstone River in the Black Canyon of the Yellowstone (Vivian et al. 2008:2). This area is in the northern end of the Park, approximately 5 km downstream from the town of Gardiner, the north entrance to the Park (see Figure 3). Hearth features and various lithics were observed eroding out of the bank by archaeologist Tom Jerde in 1987 (Vivian et al. 2008:3). Jerde observed that the material appeared to be eroding from a significant depth and that there was evidence of illegal collecting from the exposed hearth features (Vivian et al. 2008:3). Data recovery including placement of test units and salvage of the hearth features was undertaken by a crew from the Midwest Archaeological Center in 1989. In addition to bone fragments and flora remains recovered from the excavations, nearly 500 lithic artifacts were collected from the surface of this site (Vivian 2008:3). Excavation was performed by Lifeways of Canada Ltd. in the summers of 2002 and 2004 (Vivian et al. 2008) revealing a deeply stratified site with cultural layers over 1.5 m below the surface.

This site is significant on a regional level. The two most deeply buried occupations (dating to ca. 9, 500- 8, 500 BP) make Malin Creek the only site along the Yellowstone River with occupations of this age and at this depth showing excellent stratigraphic integrity (Vivian et al. 2008: 94). Component Three, a mixed unit including both McKean and Pelican Lake diagnostics was used for analysis in this thesis. Despite a certain degree of mixing, two distinct occupations within this component were identified. One of these was associated with the "Hayden Valley Subphase" (a local expression of the Hanna phase of the McKean complex) (Vivian et al. 2008: 90). Six projectile points from this site are included for analysis.

2.3 Local Chronology and Typological Classification

The cultural chronology of the Yellowstone area has been established based on comparisons with Northern Plains and Bighorn Basin as well as Great Basin typologies. While the extent of exploratory archaeological work in the Park has been somewhat limited, there has been a significant amount of work performed in the surrounding areas of Wyoming and Montana.

Comprehensive local stone tool typologies and cultural sequences have been established for the Intermountain area of Montana and Wyoming by Frison's work at various sites in the Bighorn Mountains to the east of the Yellowstone Plateau (see Frison 1968 for an example). The spectacular sequence at the Mummy Cave site in the Absaroka Mountains just outside the eastern boundary of the Park (see Husted and Edgar 2002) has also provided a baseline chronology for the area. Thirty-eight "culture layers" were recorded, containing all manner of stone tools, beads, faunal and floral remains, hide fragments, cordage and basketry, tubular bone pipes, feathers, and a mummified adult male. These layers were found to be in good stratigraphic context despite previous digging by pot hunters. The sequence at Mummy Cave was thus established as the comparative dataset for creating a local chronology in many neighboring areas including Yellowstone.

Sites in neighbouring Grand Teton National Park have also influenced local chronology as this area is directly south of Yellowstone and part of the same ecosystem. The Lawrence site (48TE509) is located at the northern tip of Jackson Lake (see Figure 3) and represents "each major cultural period from the Cody Complex to historic times" (Wright 1984:50). Radiocarbon dates from a roasting pit indicate occupation of this "base camp" during McKean times. In the Jackson Lake area archaeological evidence has been interpreted to support year round occupation of sites during the Early Archaic. The author (Connor 1993:10) infers year round occupation at the Lawrence site from the presence of Early Archaic Bitterroot points. Projectile point types recovered from this site are similar to those in Yellowstone as are the materials exploited to fashion these tools. Local sources of obsidian for the Lawrence site are the same utilized at sites in the South Study Area.

To the north of the Park, the Meyers-Hindman site is located in the Upper Yellowstone Valley near Livingston, Montana on the floodplain of a tributary of the Yellowstone River (Lahren 1976:21) (see Figure 3). This site has provided a comparative sequence from the Paleoindian period to the Late Prehistoric with an assemblage that includes steatite beads, red ochre pigment, grooved mauls, and grinding stones (see Lahren 1976). The Anzick site is located in nearby Wilsall, Montana. This site remains the only Clovis burial recorded in North America, where the remains of two sub-adults were found associated with approximately 100 lithic and bone artifacts covered in red ochre (Lahren 2006:80).

The Eagle Creek site, located just north of the Park in the Upper Yellowstone Valley, contained Intermountain ware pottery in the upper level occupation (dated to 300 BP) (Arthur, personal communication 1969 in Lahren 1976:170). Intermountain ware is considered a Shoshonean cultural marker (Frison 1991:116) and gives insight as to the time depth of presence of these people in Yellowstone and surrounding areas. The earliest Intermountain ware was found at the Meyers-Hindman site and was dated to ca. 750 BP (Frison 1991:117). This ware was also found at the Mummy Cave site (see Husted and Edgar 2002) and is the only pre-contact pottery found in Yellowstone (at the Ryder site [24YE32/48YE765] on the Yellowstone River within the North Study Area).

As discussed previously in this chapter, the Yellowstone area is comprised of several microenvironments and is distinct from neighboring areas within the Northwestern Plains. While there is much overlap in cultural chronology, a local chronology has been proposed specific to the Yellowstone area (see Johnson et al. 2004:242; Vivian et al. 2008:133). This local chronology has been built on three decades of archaeological fieldwork in the Park and is a blending of Northwestern Plains and Bighorn Basin/Mountains chronologies in Wyoming. This model accommodates both the distinct nature of the environmental setting of the Park area and the applicable environmental and cultural overlap that is inevitable from areas only one mountain range away. However, the nomenclature is inconsistent with the rest of the Northwestern Plains typologies and can be unnecessarily confusing. In the interest of consistency, this local chronology has been adapted and used here in combination with the chronologies proposed by Frison (1991) and Skinner Hale (2003) (see Table 1). It is favoured over a more generalized "one size fits all" Plains model and lists point types that have been identified in Yellowstone assemblages.

Table 1: Culture Chronology of Yellowstone National Park

AGE	PERIOD	ASSOCIATED CULTURE/COMPLEX
Present-200 BP	Historic period	Modern-day American Indian Tribes, Euro-Americans
200-1600 BP	"Late Precontact" period-use of bow and arrow	Avonlea, Besant, Plains Notched. Presence of earliest Shoshonean cultural markers (?)
1600-3000 BP	"Late Archaic" period-transition from atlatl darts to bow and arrow use	Pelican Lake
3000-5500 BP	"Middle Archaic" period -use of atlatl	McKean, Duncan and Hanna
4500-7500 BP	"Early Archaic" period -use of atlatl	Oxbow, Salmon River, Elko Eared, Bitterroot
7500-8500 BP	"Early Precontact" period-use of atlatl/spears	Lovell Constricted, James Allen, Metzal
8500-11000 BP	"Paleoindian" period-use of atlatl/spears	
8500-9500 BP		Cody Complex (including Alberta, Eden and Scottsbluff)
9500-10000 BP		Hell Gap, Agate Basin and other lanceolates
10000-ca. 12000 BP		Folsom and Clovis

Chapter 3
Methodology

3.1 The Approach

The methodology used in this research is based on a deductive approach. By starting with the idea that there may be a cultural preference for certain obsidian sources over others, and then examining the evidence, this hypothesis will either be supported or refuted. The initial development of this working theory came from casual observations (by this author) that there seemed to be some correlation between the provenience of an artifact within the Park and the source from which it came. The relationship seemed to support the efficiency models frequently used by systems theory advocates.

The existing model of annual migration through the GYE is based on location of obsidian source localities exploited through time (see Figure 4). However, the total distance suggested by this model seemed unlikely and unnecessary considering the resources available within much closer proximity. In addition, the influence of culture on the daily lives of people throughout time is often ignored. The concept of a cultural preference for one source over another has never been addressed in the literature on Yellowstone. The approach of this thesis is an attempt to address what is certainly a large gap in the research. If critiques of models based on efficiency and pseudo environmental determinism are to be accepted, then results refuting these models would have to be in evidence.

There is indisputably a relationship between the distance from source to the location where an artifact is discarded or lost. This relationship can be explained in several ways, most notably in an economic, logistical/migrational, or culturally determined way. The distance from source could potentially indicate regular seasonal movement of a group, cultural preference (not based on quality of material or convenience of source), convenience, or simply more or less inclination towards curation of stone tools.

3.2 Landscape Theory and Analogy

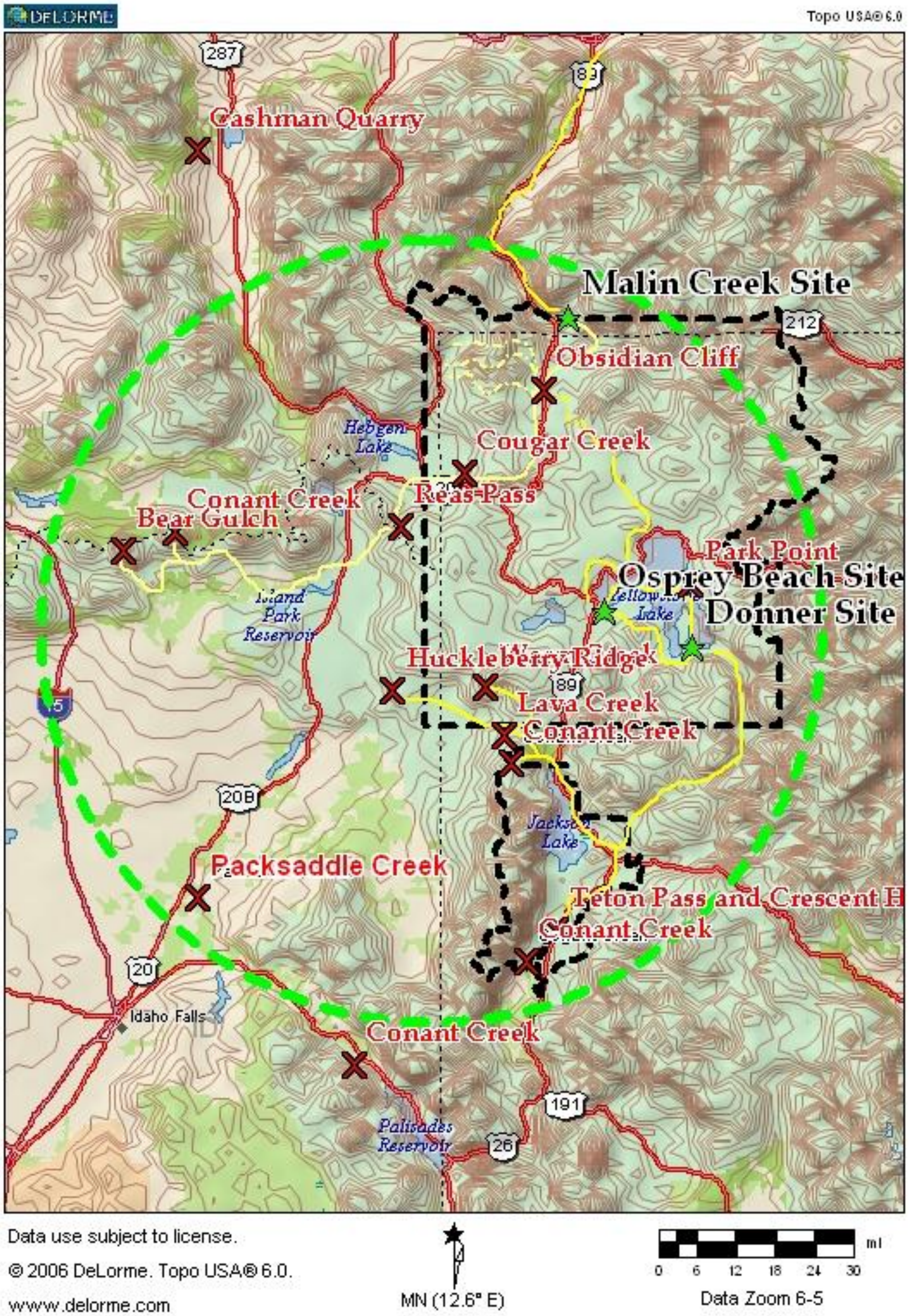


Figure 4: Previously Proposed Annual Round (in green- adapted from Johnson et al. 2004)

This thesis is not suggesting the complete abandonment of spatial models and analyses based on time-distance or efficiency principles. In fact, these are useful as a starting point to an understanding of the story of encultured landscapes. Rather, it is proposed that underlying assumptions of efficiency and environmental determinism be questioned. An alternative approach which takes into account the encultured and ideological landscape would fill in the gaps left by traditional approaches. This "landscape theory" is discussed in more detail in Chapter 5.

By critically examining the appropriateness of a landscape approach to pre-contact hunter-gatherer archaeology on the Plains, it may be argued that the idea of an "encultured" landscape provides a useful framework to interpret the representation of different obsidian sources at archaeological sites in Yellowstone.

In addition to pursuing a landscape approach, analogy is employed as a tool for interpretation in more detail in Chapter 5. Further insight into potential social aspects of obsidian procurement and selection may be gained by considering modern-day and historical uses of obsidian, and the attitudes and ideologies related to this material and its source localities.

In order to support an argument for obsidian source selection based on some form of cultural preference a few key points must be made. First, it must be shown that there is indeed a significant amount of obsidian coming from sources which are not the most convenient. Second, the quality (for tool making purposes) of the obsidian from the sources examined must be comparable. Third, direct procurement must be assumed. Once these points have been established, it seems appropriate to apply an approach that considers the landscape as more than a "blank slate" or (conversely) an ultimate determining force.

3.3 The Sample

Having determined an approach to the pertinent research problems, it was decided that only artifacts that were either diagnostic (based on typology) or found *in situ* in an identifiable and applicable culture level and in good context would be included. This controls for time and addresses that aspect of this research. There were a few instances where this author's opinion of the culture or complex assigned to an artifact based on morphology differed from that in a report. However, for the most part the culture assigned by the respective author/investigator was accepted, unless otherwise noted. In the interest of enlarging the sample size, some projectile points described as "Early Archaic" types were also included. Those types that have some temporal overlap with the early McKean complex were included.

In addition, some sites that were located in the area of study but not *specifically* on the Yellowstone River near Gardiner or on the South Lakeshore were also included. It was felt that these inclusions would create a fuller, more representative sample for research purposes while not adversely affecting sample controls. This geographical expansion would not significantly affect the spatial controls that have been placed on this study. The total sample for this research was therefore composed of diagnostic artifacts gleaned from the sites described in Chapter One (the Osprey Beach site, Malin Creek site, and the Donner site), from miscellaneous geochemical analysis reports which included artifacts from sites in my study areas, and the surveys and inventories described below.

Reports available in the Yellowstone Archaeology lab (the so-called "gray literature") prepared by contractors as well as the Park Archaeologist and other researchers were thoroughly reviewed. Primary sourcing data were taken directly from these reports, as well as from the geochemical sourcing reports on file in the Archeology Lab at the Yellowstone Heritage and Research Center in Gardiner, Montana. Access was granted to confidential Federal site files, correspondence, and databases, as well as unpublished restricted reports. Permission to use this information had been granted by the Park archaeologist and by the Park Ethnography office for certain non-confidential ethnographic materials.

Geochemical analysis of all artifacts included in this sample was performed by Dr. Richard Hughes over a period of twelve years (1997-2009). XRF and EDXRF techniques were used consistently throughout this time period (see Hughes 2009 for an example). All analysis was performed by Hughes at the Geochemical Research Laboratory in Portola Valley, California. This author submitted 20 obsidian artifacts for sourcing during 2008 as part of this study. The remaining 65 artifacts which make up the total sample had previously been sourced as part of survey, inventory or data recovery projects.

3.3.1 Inventories and Surveys-North Study Area

Samples for this research were limited to surveys and inventories from the two study areas. Representing the North Study Area are the following projects:

1. 1999-2001 Archaeological Inventory-Yellowstone River: Tower Falls-Gardiner and Hellroaring Creek, Wyoming and Montana (Reeves 2006). This project was performed by Lifeways of Canada, Ltd. This inventory covered approximately 21 km of linear distance on the east bank and 23 km of the west bank of the Yellowstone River as it flows towards the northern boundary of the Park from Quartz Creek to the town of Gardiner, Montana (the northern entrance to the Park) (Reeves 2006:5). Six projectile points were included from this inventory.

2. Yellowstone National Park Archaeological Site Inventory-The Black Canyon of the Yellowstone and its Tributary Streams: 1996 Field Season (Shortt 1998). This project was performed by Lifeways of Canada, Ltd. This inventory focused on the northern portion of the Yellowstone River as it parallels the Park boundary and flows through the Black Canyon of the Yellowstone immediately southeast of the town of Gardiner, Montana. This inventory is a more focused assessment of this area which was also part of the larger-scale Yellowstone River inventory listed above. The Malin Creek site is located within the boundaries of this inventory, which included 12 km in linear distance of the north bank of the Black Canyon, and selected portions of the south bank (Shortt 1998:i). Eight projectile points have been included in the sample from this inventory.

3. Yellowstone National Park FHWA Mammoth-Gardiner Road Archaeological Site Inventory: 1998 Field Season (Shortt 1999). This project was performed by Lifeways of Canada, Ltd. This inventory covered the area between the North Entrance to Yellowstone in the town of Gardiner, Montana, south approximately 8 km to Park Headquarters at Mammoth Hot Springs, Wyoming. The boundaries were the Gardiner River to the east, and the old Gardiner-Mammoth road (no longer in regular use) to the west (Shortt 1999:4). Two projectile points were included from this project.

4. The 1997 Archaeological Investigation of Nine Prehistoric Sites in the Northern Portion of Yellowstone National Park (Sanders 1998). This project was performed by the Office of the Wyoming State Archaeologist. Only one site from this project, 48YE137, was located within the North Study Area and could be included. A single projectile point was included in the sample from this site, collected during the 1997 investigation.

5. An Archaeological Inventory on the Eastern Edge of the Gallatin Range (Vivian and Mitchell 2005). This project was performed by Lifeways of Canada, Ltd., and includes the area of Swan Lake Flats and the edge of the Gallatin Mountain range to the west of the Flat.

This inventory represents the western and southern boundaries of the North Study Area and the only true alpine environment represented in the entire sample. Nine projectile points from this inventory were used in the sample.

6. 2007 Boundary Lands Archaeological Survey and National Register Evaluation (MacDonald 2008). This survey was part of the 2007 Montana-Yellowstone Archaeological Project (MYAP) performed by the University of Montana. It covered the area directly to the north of the Heritage and Research Center in the town of Gardiner, Montana, in the boundary lands adjacent to the northern boundary of the Park. Sites 24YE355 (the Yellowstone Bank Cache site) and 24YE356 (the Stephens Creek site) were test excavated/surveyed as part of this project and each site yielded a single projectile point for this sample.

3.3.2 Inventories and Surveys-South Study Area

There was only a single survey that could be examined for artifacts to use in the South Study Area sample:

1. The Archaeological Inventory of Yellowstone Lake Shoreline Survey, Solution Creek to Southeast Arm (Vivian et al. 2007). This survey covered approximately 95 km of shoreline along the southern portion of Yellowstone Lake, recording nearly 100 sites and collecting 372 formed tools from the surface (Vivian et al. 2007:1, 34). This is the largest scale survey to date in the SSA area, and was performed by Lifeways of Canada, Ltd. over a span of five years. Twenty-eight points were included in the sample from this survey.

Chapter 4
Obsidian: A Comprehensive Overview

4.1 Why Obsidian?

Obsidian and other rhyolites can be analyzed for their chemical composition, which provides a unique "fingerprint" for each source. Thus, tools made of obsidian can be traced back to their source using this fingerprint. It is important to note that the term "source" here refers to the geochemical group and not necessarily the primary geographical location of a lava flow. While the two concepts are sometimes one in the same, it is important that the term be understood to refer specifically to the geochemical makeup of a material and not a geographic location (see Hughes 1998 for a discussion).

The source affinity of cherts and other cryptocrystalline materials locally available and frequently exploited by prehistoric people in the Park can also be determined at the trace elemental level. However, cryptocrystalline materials have a high degree of intra-source variability and require the use of a nuclear reactor to analyze at the elemental level. The process is expensive and the results are not always of a nature useful to archaeological research questions.

Obsidian, on the other hand, is an ideal tool stone for determining source affinity to a degree that is archaeologically applicable. Instrumental trace element analysis of obsidian can be performed and results obtained through energy dispersive x-ray fluorescence (EDXRF), which is a relatively inexpensive, non-destructive, and highly accurate technique.   Intra-source variability in obsidian typically falls into a predictable range for those sources in the Yellowstone area. The Obsidian Cliff source in Yellowstone, for example, is quite homogenous in its chemical makeup and thus this major source shows high geochemical integrity (Davis et al. 1995:41). Thanks to intensive and extensive sampling of the Obsidian Cliff flow, the composition of this source is known to cluster within an expected range and the geochemical integrity of the source has been well established (see Hughes 1990:2).

4.2 A Brief Geological Explanation of Obsidian

It is important that archaeologists understand basic principals and qualities of obsidian at the geological level for several reasons. As Shackley points out,

> …it is simply not enough to use source provenance data to address issues of procurement, exchange, group interaction, or cultural identity…without a basic understanding of the physical processes that create the material [Shackely 2005:7].

He quite rightly argues that knowledge of the geological aspects of obsidian, such as the processes by which the material is formed, is essential to archaeologists. They form the "basis for understanding why we can separate sources of archaeological obsidian with such a high degree of confidence, and why as a very rare event in nature it is so valuable for dealing with current issues in …archaeology" (Shackley 2005:7).

"Obsidian" is a term that is used somewhat indiscriminately to refer to many types of glassy rhyolitic material (James et al. 1996:95). In general, obsidian "is formed primarily by the very rapid cooling of low silica basalts, and higher silica content andesites, dacites and rhyolites" (James et al. 1996:95). As a result, obsidian can be called a rhyolite, but it can also be used to refer to certain dacites. Rhyolite is a volcanic rock that is the lava form of granite, and is distinguished from other volcanic rocks partly by the presence of quartz phenocrysts composed of potassium feldspar in equal or more abundance as those of plagioclase, typically with biotite as the only mafic mineral (Compton 1962:254). Dacite, for example, also has phenocrysts composed of quartz. However, phenocrysts of plagioclase are the predominant or only feldspar present, "typically with a variety of mafic minerals" (Compton 1962:254). For the purposes of this research dacite and obsidian are distinguished from one another although both are included as "obsidian" samples eligible for study.

Magma, the hot "melt" of lava below the earth's surface, is affected by two factors which control whether or not it will become a glass: the rate at which it cools and its viscosity which is determined by the magma's chemical makeup (Shackley 2005: 11). While most lava can theoretically create a glass, "the presence of aluminum and silicon oxides in rhyolite greatly facilitates the process" (Shackley 2005:11). Thus, the chemical composition of the rhyolite in obsidian is largely responsible for its formation as a glass and it can be said that obsidian is "typically of rhyolitic composition" (Ambroz 1997:17).

The formation of obsidian lava is typically "at depths where the temperatures are on the order of 1000-1200 degrees Celsius (Ambroz 1997:17). The formation of the obsidian glass itself occurs as the "pressure increases [and] the magma begins to move upward" (Ambroz 1997:17). The "magma from below the earth's crust is [then] extruded and cooled so rapidly that little or no crystallisation occurs" (James et al. 1996:95).

The way that obsidian is extruded from pools just under the earth's crust is also dependent on the chemical composition of the magma. Rhyolite is high in viscosity (a result of its chemical makeup) and thus rhyolite melts "frequently form dome structures rather than flows" (Shackley 2005:14). Rhyolitic domes are "usually composed of glass on the outside but have crystalline interiors" (Ambroz 1997:18) and the contact areas between these two layers are where the highest quality glass for artifact making is formed.

Volcanic tuff, another form of obsidian glass that is used for tool stone in the Yellowstone area, is the result of an explosive eruption of magma due to the volatile mixture of water with liquids high in glass-forming elements (such as silica) before the magma was extruded (Ambroz 1997:17;Shackley 2005:14). This ash-flow tuff is often part of a more extensive "sheet" as a result of the explosive nature of eruption (Ambroz 1997:20). These tuffs are known to have considerable variation in their chemical composition (Ambroz 1997:20), providing unique problems for archaeological interpretation as examined later on in this chapter.

As a glass the atomic structure of obsidian is "disordered" which means that it has no "preferred direction of fracture" (Shackley 2005:10). This is the reason for obsidian's conchoidal fracture pattern and allows for easy flaking and sharp edges-qualities that make it an excellent tool stone.

4.2.1 Primary and Secondary Deposits

Definition and discussion of "primary" and "secondary" sources is appropriate at this juncture as they are terms used frequently in most obsidian source studies. It is essential to understand the potential impacts the source "type" has on the archaeological study of movement and procurement patterns. The distinction is straightforward: a primary source is the location where obsidian for tool making can be obtained that is in the immediate vicinity of the vent where the magma was extruded (Ambroz 1997:20). A secondary source is "spatially removed from the primary source" (Ambroz 1997:20) and thus refers to dispersed cobbles of sufficient size and quality to be useable as tool stone.

Natural forces such as mass wasting, glacial transport, or fluvial transportation are responsible for the creation of secondary sources (Ambroz 1997:20-21). The transport and redeposition of material by people from a primary source does not result in the designation of the area of redeposition as a "secondary source". This situation may appear to be hard to distinguish archaeologically, but it is logical to assume that cobbles transported by people will be found in an archaeological context (such as in a workshop or lithic reduction area), as opposed to the "natural" context of secondary sources (e.g. downstream from primary source localities).

4.3 Obsidian and Yellowstone: Past and Present

Obsidian has been an important and prized resource used for tool making in Yellowstone since the Clovis culture. Although no Clovis age points have been recovered from within Park boundaries, a Clovis point was discovered in Gardiner, Montana, just outside the Park's northern boundary. This point was made out of obsidian, however, it was never submitted for geochemical analysis and the current location of the artifact is unknown. Also just north of the Park's boundary, one Clovis (or possibly Folsom) base/midsection and one Folsom (or possibly Midland [Davis, personal communication 2009]) base, both made of obsidian, were recovered on private land and loaned to the Park Service for sourcing (Skinner Hale 2005:5). Following analysis, both points were sourced to Obsidian Cliff located in the northern end of the Park (Hughes 2004:3, Skinner Hale 2005:5).

Through time, each pre-contact group had access to different obsidian sources in the GYE. There are over 45 rhyolitic flows in Yellowstone containing obsidian, however, only about 15% have obsidian with the right qualities (such as absence of flaws in the material and usable cobble size) to be made into tools (Ann Johnson, personal communication 2009). Currently a large dataset exists composed of sourced obsidian artifacts found within Park boundaries. This dataset has been generated by survey and excavation work performed by contractors, volunteers, and Park staff.

Analysis of 473 obsidian artifacts performed by Cannon and Hughes in 1994 showed a general dominance of Obsidian Cliff source obsidian in assemblages throughout Yellowstone (Davis et al. 1995:51). This was followed in frequency by Bear Gulch source obsidian, located in northeastern Idaho, outside of the Park boundaries (Davis et al. 1995:51). This dominance of both Obsidian Cliff and Bear Gulch in archaeological assemblages is expected in the results of this study as well.

4.3.1 Techniques

Neutron Activation Analysis (NAA) was the first method used to chemically analyze obsidian samples from the Greater Yellowstone region. The first analysis obtained for Obsidian Cliff obsidian was published by Frison et al. in 1968 (Davis et al. 1995:45). This technique involved the destruction of a small part of the sample and use of a nuclear reactor in order to perform analysis of chemical composition. Although costly and destructive, at the time this was the only method available for analysis of the chemical composition of obsidian.

Obsidian artifacts from the Park have been analyzed by various methods since 1985. Initially, this was performed by Dr. Joseph W. Michels of the Mohlab laboratory in Pennsylvania, from 1985 to 1988 (see Michels 1985 for an example). Dr. Michels performed atomic absorption spectrometry (AAS) analysis of obsidian from Yellowstone and neighboring regions in the Middle Rocky Mountains. Mohlab ceased operations in 1988 (see Michels 1988) and with this came a change in both the laboratory performing the analysis as well as the method used.

Geochemical Research Laboratory located in Portola Valley, California (with Dr. Richard E. Hughes as director) has performed the majority of analysis of Yellowstone obsidian (submitted by National Park Service and associated staff) since 1988 using x-ray fluorescence (XRF). At the time XRF was replacing AAS as the preferred method of instrumental analysis of obsidian. It became the standard method of instrumental analysis as it was non-destructive, relatively inexpensive, and highly accurate. The technology has advanced even further into energy dispersive x-ray florescence (EDXRF), which allows analysis of specimens that were previously too small or thin for accurate XRF reading. Since 1991, Hughes has used EDXRF to analyze all obsidian from Yellowstone.

4.4 Obsidian in the Greater Yellowstone Area

In Yellowstone, there are two main geological units comprising the rhyolite plateau. The first is the Yellowstone Tuff covering approximately 1,560 square kilometers (Davis et al. 1995:19). The second unit consists of the younger flows on the Madison (in the Western part of the Park), Pitchstone (in the Southwest), and the Central plateaus. These younger flows cover approximately 2,600 square kilometers of the Park (Davis et al. 1995:19). The Yellowstone Plateau is the result of several cycles of caldera eruption and collapse with the most recent being the collapse approximatey 600,000 years ago, followed by the eruption of Lava Creek Tuff (Davis et al. 1995:19). The Yellowstone rhyolites are all of Quaternary age (Davis et al. 1995:20).

There are 15 known geological obsidian sources in the Yellowstone area (Davis et al. 1995:51). Not all of these sources appear in the sample used for this study. However, these are the sources that have been chemically identified in assemblages and artifacts found within the boundaries of Yellowstone.

4.4.1 Definitions of the Term "Source"

As mentioned above, obsidian sources are geochemically defined based on chemical composition and not on spatial distribution (Hughes 1998:140). Since we are using geochemical composition to designate and differentiate between "sources", this definition must be understood and adhered to.

There are instances where the flow outcrop is located in one place, but useable obsidian bearing the same chemical makeup may also be located hundreds of kilometers away. This is often seen in Quaternary age flows where over time useable cobbles are moved by natural forces away from the original geographical "source" or extrusion. Indeed, "the areal extent of redeposition must be taken into consideration… (as) 'older' glasses may be redeposited tens to hundreds of kilometers from the original source" (Hughes 1998:104).

Hughes sums up a second situation that illustrates the necessity of a well-defined concept of "source":

> If significant chemical contrasts are identified, obsidian outcrops located in the same mountain range or volcanic field can be segregated from one another; conversely, if chemical identity is present, obsidians occurring in mountain ranges many miles apart may be combined into a single geochemical unit [Hughes 1998:104].

4.4.2 Some Considerations for Utility

Methods for instrumentally determining the elemental composition of obsidian are important to archaeology when the results are applied to specific research problems. While it can be useful to know where major vitreous or obsidian outcroppings or cobbles are available in a given region, the quality of the material must also be considered. There may be several obsidian sources available to people in a particular area, however, only those with tool stone quality are considered when attempting to apply source affinity data to determine seasonal rounds, home territory or other research questions. Yellowstone provides excellent examples of both high quality tool stone obsidian sources (such as the Obsidian Cliff flow) and poor tool-making quality material that is considered strictly "geological" (such as the Otter Creek flow) (A. Johnson 1999:5). During formation, obsidian and other volcanic glasses "may acquire spherulites, lithphysae, or other crystalline minerals that make them unsuitable for knapping purposes" (Baugh and Nelson 1987:317).

The age of a flow may also affect the utility of the obsidian for pre-contact peoples. Obsidian contains tiny amounts of water. This makes it unstable as the water molecules attract other water molecules which causes a natural process known as hydration (Baugh and Nelson 1987:315). Hydration allows a method for dating obsidian artifacts by measuring the thickness of the hydration rind and comparing this with other measured rinds of artifacts that are from the same source (Baugh and Nelson 1987:315). While this is a convenient dating method in the early stages of hydration, as the process continues, "mechanical strains develop with the expansion of water…thereby transforming the obsidian to perlite" (Baugh and Nelson 1987:315-317). This process effectively destroys the utility of the material for tool making. Thus, giving consideration to inclusions and the process of hydration, the "best obsidians for the manufacture of implements are relatively young (commonly those formed during the Tertiary or later) and are generally free of crystalline inclusions" (Baugh and Nelson: 1987:317).

4.4.3 Considerations for Geochemical Analysis

Certain trace elements are assigned more analytical weight in analysis based on findings that the elements Rubidium (Rb), Strontium (Sr), Yttrium (Y), and Zirconium (Zr) show the most consistent inter-source variability for the region (Hughes, personal communication 2008). These elements are considered "diagnostic", signifying that these trace elements are well-measured by XRF and show high variability between sources, while maintaining low intra-source variability (Hughes 2007:1). These diagnostic elements are therefore most useful in distinguishing between different geochemical sources. The trace elements Zinc (Zn) and

Gallium (Ga) are also recorded but not considered diagnostic of distinct chemical groups because they "don't usually vary significantly across obsidian sources [in the Greater Yellowstone area]" (Hughes 2007:1).

A major consideration for analysis of obsidians in the Yellowstone area is the chemical variability in ash-flow tuffs. Due to the nature of their formation, their chemical composition shows an unusually high variability in trace element values. In the American Southwest region, for example, "as much as 40% variation in some elements may be present within the same source locality" (Baugh and Nelson 1987:317). In addition, "concentrations *between* source complexes may differ by as much as 1000% for certain elements" (Baugh and Nelson 1987:317, emphasis added). Therefore, while more pronounced in some formation types of obsidian than others, it is nonetheless important to know the intra and inter source variations for all potential sources when attempting to determine a geochemical source (Baugh and Nelson 1987:317; see Hughes 2008 for an example).

In Yellowstone, the Park Point, Lava Creek, Warm Creek and Cascade Creek obsidians are all ash-flow tuff. Much more sampling of the Warm Creek and Cascade Creek sources is needed before their acceptance as official new sources in Yellowstone because of this potential for variability. These sources, however, are slowly progressing towards "official" recognition (see Szamuhel 2008). While Park Point has been provisionally accepted as a distinct and "official" source (see A. Johnson 1999), there remains the need for further field sample collection and XRF analysis in order to more fully realize the variation to be expected within this geochemical group (Hughes, personal communication to Ann Johnson, 2008).

4.4.4 Previous Research Goals of Obsidian Sourcing in Yellowstone

The research goals of obsidian sourcing in the early phase of source affinity studies were focused on building a comprehensive database of sources in the Greater Yellowstone area. With the improvement of NAA technology, the accuracy of this method also improved to the point where earlier results were no longer considered comparable to the results that were currently being obtained. Therefore, a new database needed to be developed.

In addition, research in the late 1980s and early1990s focused on the detailed mapping and survey of the Obsidian Cliff source resulting in National Historic Landmark status for Obsidian Cliff (see Davis et al. 1995). While the Obsidian Cliff source was already known to be an important tool stone source in the area, the variation within this flow needed to be understood and more fully realized. With the large scale reconnaissance and survey of the Obsidian Cliff Plateau, the "baseline importance of empirically establishing the range of chemical variability within single geological sources" (Davis et al. 1995:41) had come to the forefront. The construction of such a chemical database moved the geochemical analysis of obsidian for archaeological purposes from a coarse to a more fine-grained analysis.

Since then, a comparative geochemical database has been built up for sources in the area, with steady accumulation of data. While the database of sourced obsidian artifacts in Yellowstone is robust, there have been no published attempts at a comprehensive examination of these data in relation to more specific archaeological problems (but see Cannon and Hughes 1993; Cannon and Hughes 1994).

4.5 Primary Sources

The following geochemical sources have localities that were directly quarried by pre-contact people. It should be noted that for several of these sources obsidian also occurs in a secondary context, and these cobbles were likely exploited as well.

4.5.1 Obsidian Cliff (Yellowstone National Park)

Perhaps the most well known obsidian source in the Greater Yellowstone area is Obsidian Cliff. The glassy cliff exposure of this source visible from the road rises 60 m from the ground; the flow itself covers an area of approximately 14.5 square kilometers (Davis et al. 1995:20). It is a highly significant source at both the regional, national, and international levels. Artifacts made from obsidian from this source are found as widespread as Texas, Washington State, southern Alberta (see Brink and Dawe 1989; Reeves 2003), and Hopewellian burial mounds in Ohio (see Griffin et al. 1969; Hatch et al. 1990; Hughes 1992), indicating it was a prized material that was extensively traded/exchanged (and directly accessed) by people for thousands of years (see Davis et al. 1995; Figure 5). Large-scale reconnaissance and reporting of this source in the late 1980s (see Davis et al. 1995) culminated in its nomination as a National Historic Landmark.

The Obsidian Cliff flow is approximately 183,000 years old (Davis et al. 1995:20). It is one of the four rhyolite flows that make up the Roaring Mountain Member of the Yellowstone

Plateau rhyolite which extends north of the caldera (Davis 1995:20). The Obsidian Cliff source locality is in the northwestern region of the Park, to the east of the Gallatin Range and adjacent to the modern-day Mammoth to Norris section of the Grand Loop Road (see Figure 3). This locality consists of an exposed cliff face (which is the feature popularly known as Obsidian Cliff or the Obsidian Cliff Plateau) and the flow area immediately east of the cliff face. There is evidence for both the utilization of cobbles as well as direct quarrying of the bedrock obsidian (Davis et al. 1995:6). Therefore, the Obsidian Cliff plateau is both a primary and secondary source.

When visually inspected, Obsidian Cliff obsidian is glassy and smooth with few inclusions and ranges in color from black to brown, mahogany, gray, and even green. It is typically semi-translucent in opacity, but infrequently can also be opaque. It is considered an excellent choice for flint knapping.

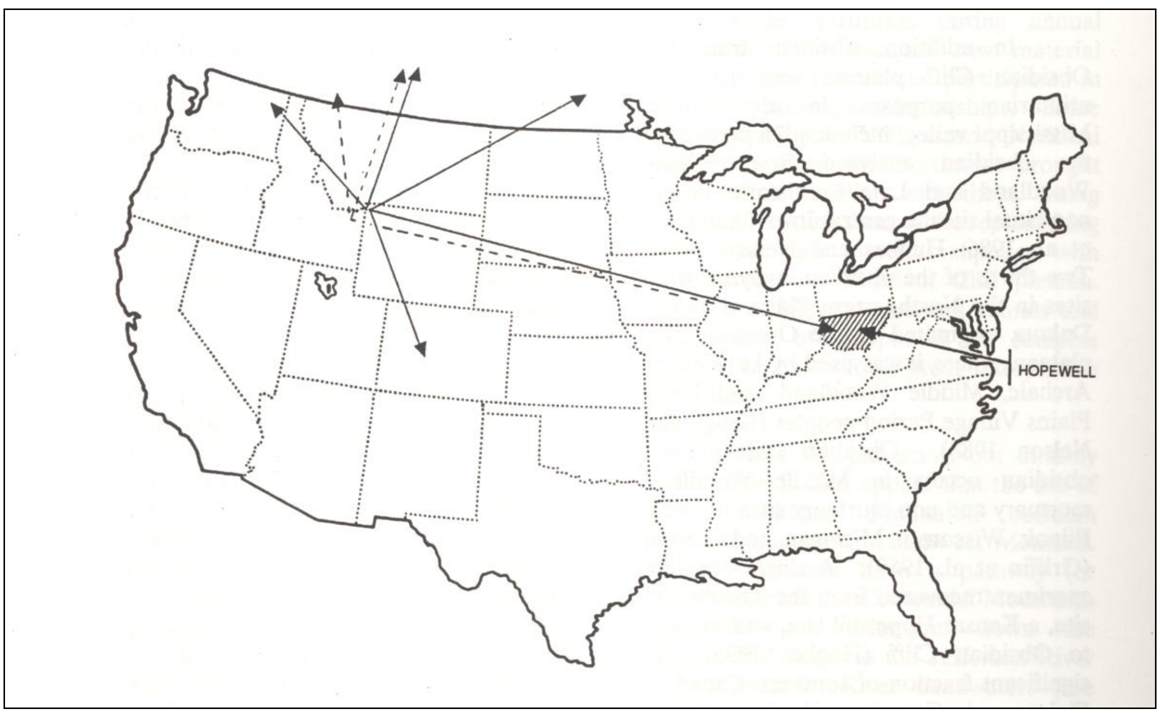


Figure 5: Range of archaeological occurrence: Obsidian Cliff (solid line) and Bear Gulch (dotted line) obsidians (from Davis et al. 1995:54).

4.5.2 Cashman Quarry Dacite (Montana)

Although not obsidian, dacite is a close relative and shares characteristics that allow for accurate source affinity testing. Dacite from the Cashman Quarry appears periodically in geochemical reports on artifacts from Yellowstone and thus it is included here as an important source. Perhaps most significantly, the Cashman locality is the furthest source to the north, located just north of Ennis, Montana (Rennie et al. 2008:3) (see Figure 3). Dacite from this source is always opaque with a fine texture and is easily knappable.

4.5.3 Bear Gulch (Idaho)

The Bear Gulch obsidian source has been the subject of some debate and confusion over the years since it first appeared in a report by Griffin et al. in 1969 (Willingham 1995:5). The source itself is a primary and secondary source consisting of major outcrops of obsidian and "numerous quarry pits with debitage backfill over one meter thick" (Willingham 1995:3). Outcrops and quarry areas are found on the southwestern and northeastern slopes of Big Table Mountain in the Centennial Mountains of eastern Idaho (Willingham 1995:3) (Figure 3). These outcrops "appear as boulder and cobble deposits rather than continuous shield flow beds" (Willingham 1995:3). The combined area of obsidian outcrops and quarry pits is approximately 28 square kilometers, although Willingham (1995:3) notes that the "source and quarry areas are not contiguous".

The source has been referred to in the literature by several different names, creating some confusion. The same geochemical source has been referred to as Field Museum Yellowstone 90 Group (F.M.Y. 90 Group) (see Griffin et al. 1969; Davis 1972); Camas Dry Creek (with Bear Gulch as the name of the locality) (see Wright et al. 1990); Bear Gulch (see Hughes and Nelson 1987); and Big Table Mountain (see Willingham 1995). Additional confusion is created by the fact that another place called Bear Gulch (which is not an obsidian source) has been incorrectly mentioned in the literature (Willingham 1995:5). This other "Bear Gulch" is also located in the Targhee National Forest in eastern Idaho, approximately 60 km to the southeast of the Bear Gulch obsidian source.

Despite the added confusion surrounding the name Bear Gulch, this thesis will refer to the source as Bear Gulch in keeping with the name used by Hughes (see Hughes 2009:3) in geochemical reports submitted to the Park. When visually examined, Bear Gulch obsidian is typically black in color, opaque and very glassy, indicating a highly siliceous material of excellent tool-making quality. Very few phenocrysts or other inclusions are found in tools made of this material.

4.6 Secondary Sources

These geochemical sources provided obsidian in a secondary context that was utilized by pre-contact people, typically in the form of large useable cobbles that could be collected in the locality area. There is no recorded evidence of any direct quarrying activity of the source locality of these geochemical sources (with the exception of the Teton Pass source and possibly the Parker Peak source- see below).

4.6.1 Park Point (Yellowstone National Park)

The Park Point source is a secondary source located in the area of Park Point on the northeastern shore of the Southeast Arm of Yellowstone Lake (Figure 3). It was tentatively designated as an "official" source in the late 1990s over the course of a few years. Efforts have been made to go back over old reports and extract those unknown source samples that match the Park Point chemical signature (Johnson, personal communication 2008). As the database grows, so does our inclusion of samples under the Park Point designation. Samples that would previously not fit the profile of the Park Point group now might be considered part of its extended range. As an ash-flow tuff, there are additional problems with characterization of the extent of range in the Park Point source geochemistry (as discussed previously in this chapter).

Geological samples of this source (in the form of useable cobbles) were first collected by Park archaeologist Ann Johnson in 1996 and sent for sourcing. It is significant that attempts to locate outcrops suitable for primary procurement in the Park Point area itself have been unsuccessful. Indeed, it has been difficult to locate further geological samples upon re-visits to the initial collection area (Ann Johnson, personal communication 2009). This indicates that we are still not clear as to the geographical range and availability of primary and secondary deposits of the Park Point chemical group.

Recent additions to the sourcing database for Yellowstone have shown that Park Point is a source that was exploited most frequently by people when camped on the shores of Yellowstone Lake. This local distribution makes sense economically, as it would have been a convenient source of tool stone. It could have been accessed by land or potentially by water using skin-covered boats (as suggested for fishing activities by Johnson et al. 2005:187) to cross Yellowstone Lake from more distant shores.

Park Point obsidian can be visually identified with some degree of confidence by its distinctive mahogany red color and high opacity although black colored obsidian is also associated with this source. The surface texture is generally coarser with a matte luster.

4.6.2 Cougar Creek (Yellowstone National Park)

The Cougar Creek source locality is along the creek of the same name near the western entrance to Yellowstone (Figure 3). This material has been observed approximately 2 km north of the "big bend" in the Madison River where it runs parallel with the West Entrance road (Johnson et al. 2006:87). The Cougar Creek source locality is in need of further inventory to fully identify the source area and quarrying locations. For example it is still necessary to determine if primary areas occur or if there are only secondary procurement areas were used for obtaining raw material (Ann Johnson, personal communication 2009).

Upon visual inspection, Cougar Creek obsidian appears to be a poor tool-making material. Many white phenocrysts and inclusions are characteristic of this type. It is typically opaque and black in color with a glassy luster. The presence of so many flaws makes this type difficult to work with and a poor tool stone choice. This may explain why this type is almost exclusively found in local archaeological contexts restricted to this mid-western pocket of the Park (Johnson et al. 2006:87-88). It appears to have been a tool stone that people used for expedient tool making while camped in the area (Johnson et al. 2006:87). For example, only certain tool types which do not require fine flaking (scrapers, bifaces and knives) are typically made out of Cougar Creek obsidian in the area (Johnson et al. 2006: 90; Ann Johnson, personal communication 2009).

4.6.3 Parker Peak (Yellowstone National Park)

This source was first recorded (as the "Parker Meadow Obsidian Source Site" 48YE483, later changed to 48YE507) by Kenneth Feyhl, Stuart Conner and Daniel Martin in 1977 (see Feyhl 1978). Located to the north-west of Parker Peak in the northeastern part of the Park, the obsidian source was described as "the top of an igneous body outcropping in a sinuous band approximately 20-30 feet wide by several hundred feet long [with the outcrop oriented] NW-

SE…parallel to the valley's edge" (Feyhl 1978:2). Feyhl (1978:2) also describes secondary obsidian availability observing that "obsidian occurs as nodules and irregularly shaped masses weathering from the exposed surface of the igneous body". No primary quarrying activities were mentioned in this report. An obsidian "workshop" area was recorded adjacent to the source area in a meadow (see Feyhl 1978).

This source was rerecorded as the "Parker Meadow Ignimbrite Source" (Eakin 2008) as it was determined that the material available was ignimbrite, a close relative to obsidian which typically has white crystalline inclusions. Although both recordings of the source area indicate that primary material is present, Eakin (2008:4) specifically states that "no quarry pits, features, or other ground disturbances related to the physical extraction of the material were observed". Parker Peak, therefore, appears to be a secondary ignimbrite source where material was procured from redeposited nodules and gravels (Eakin 2008:4). However, Eakin (2008:4) also states that a "probable primary ignimbrite source locality was defined in association with an exposed portion of a dike located north of the pack trail [Miller Creek Trail]". While it has been included here for the purposes of giving mention to all sources in Yellowstone, Parker Peak appears very rarely in geochemical analysis results and is therefore not considered a "key" source for this research. It is not represented on the map in Figure 3.

4.6.4 Cascade Creek (Yellowstone National Park)

As recently as 1999, it was suggested that Cascade Creek obsidian cobbles were "large enough and of sufficient quality to have been used for prehistoric tools although this source has not been identified in archaeological sites" (A. Johnson 1999:5). A study by this author of "unknown" geochemical types that appear in Yellowstone assemblages turned up one archaeological sample that seems to fit the Cascade Creek group at site 48TE356 in neighboring Grand Teton National Park (Szamuhel 2008:8). This is an important specimen, however, as it appears to be the first identified in an archaeological site.

Our understanding of the potential significance of Cascade Creek obsidian, and its designation as a distinct geochemical group used in prehistory is still in its infancy. As with the Park Point and Warm Creek groups, this ash-flow tuff would require much more field sampling and geochemical analysis to support its nomination as a distinctive source with a well understood range of variation. This source locality is still unknown, but though to be in the southwest corner of the Park. Due to the uncertainty surrounding the locality of this source, it has not been included on the map in Figure 3.

4.6.5 Warm Creek (Yellowstone National Park)

The Warm Creek source locality is still considered an "unknown" in that there has yet to be good geological sampling performed to understand the range in elemental values to be expected. Further samples are needed to build a satisfactory comparative set of values.

This potential source locality was discovered when Park Botanist Jennifer Whipple returned from the site of the "Unlucky Fire" in 2000. She had collected two brown and black tertiary obsidian flakes from the north side of the fire and brought them to the attention of Park Archaeologist Ann Johnson who sent them for sourcing. The report written by Hughes (2001:1) indicated that the samples "appear superficially similar (geochemically speaking) to obsidians erupted within the Conant Creek Tuff. However, these specimens are distinct chemically from Conant Creek Tuff glass…[to the degree that] it appears that Warm Creek may represent a 'new' geochemical type of obsidian." Subsequent sourcing of artifacts has returned results that are comparable to the Warm Creek samples. A small but significant database is being built towards making this an official source to the degree that Hughes has begun to indicate a sample as sourced to "Warm Creek?" (Hughes 2009:3) instead of "Unknown".

The Unlucky Fire burned in the southwestern corner of the Park on the plateau between Bechler Creek and Bechler Canyon to the northwest and Mountain Ash Creek to the southeast. This is also the suspected source locality of Warm Creek obsidian (Figure 3); however, no outcroppings have been reported in the area. There are known obsidian localities to the south of this area near the Grassy Lake Reservoir and Grand Teton National Park, where the Conant Creek, Lava Creek and Crescent H geochemical type has been recorded.

4.6.6 Malad (Idaho)

The Malad obsidian source area is located in southeastern Idaho, in the "Wright Creek and Dairy Creek areas of the central Bannock Range" (Thompson 2004:5) (Figure 3). The source area appears to be quite extensive. Material from this source has been found approximately 24 km (15 miles) north of Malad City (Thompson 2004:5) which is roughly 40 km (25 miles) south of the Bannock Range.

The obsidian from this source occurs in "relatively large nodules and is usually a transparent black, although occasionally, it may also be mixed with a red or mahogany color (Thompson 2004:5). Malad obsidian is found in archaeological contexts in Oklahoma, Colorado and Texas as well as closer to home on the Snake River Plain. This indicates an obsidian that was widely traded or exchanged (see Thompson 2004 for a discussion). Despite clearly being an important source in Idaho and for parts of the eastern Great Basin, Malad obsidian appears very infrequently in Yellowstone assemblages.

4.6.7 Teton Pass and Crescent H (Grand Teton National Park/Wyoming)

The Teton Pass obsidian source near Jackson Hole, Wyoming (Figure 3) is an excellent example of one geochemical source with different geographical source localities. The Teton Pass site (48TE960- dubbed the "Love Quarry" after the researcher who first recorded it) is a primary source locality of this obsidian where quarry pits were recorded (Cannon et al. 2001:xvii-2). However, this geochemical source has at least three localities in the form of two volcanic "vents" in the Teton Pass area, and an exposure in the neighbouring valley at the McNeely Ranch near Jackson Hole (the "Fish Creek" locality) (Cannon et al. 2001:xvii-3). It is also available as a secondary source south of the Jackson Hole area.

Initially, two "Teton Pass" sources were named: Teton Pass/Fish Creek and Teton Pass Variety 2/Fish Creek Second Variety (Schoen 1997:220-221). Researchers believed that the chemical makeup of the two was sufficiently dissimilar to make these different chemical groups (and thus different "sources"). The Teton Pass Variety 2 geochemical group is now called Crescent H (after the locality it was original found in) and these two highly similar types have been identified as mixed together in the same secondary deposits (Cannon et al. 2001:XVII-3). They are thus thought of as the same chemical "family" as well as being available in the same general location. Crescent H is exclusively a secondary source.

It has been suggested that these sources be lumped into a single Teton Pass source for archaeological research purposes (see A. Johnson 1999:5). The rationale behind this decision is that although our technology can now differentiate between these very chemically similar varieties, this ability "does not translate into human selection for one over the other" when both are present in mixed gravels (A. Johnson 1999:5). However, the Teton Pass and Crescent H types are differentiated in geochemical source results. Hughes differentiates between the two when reporting the results of source affinity (see Hughes 2009b:3 for an example). As this thesis is considering the geochemical definition of source, Teton Pass and Crescent H will be counted separately. In addition, all the “grey literature” consulted for artifact data report source affinity results in the same manner. It does remain important to acknowledge that at the selection level, people would not have differentiated between the two types and this will be considered when analyzing geographical distribution and distance from source models.

Teton Pass and Crescent H obsidian typically appears glassy and semi-translucent upon visual inspection. Both varieties are high quality obsidian for tool making. These varieties are usually black to gray in color, and banded.

4.6.8 Conant Creek Tuff (Wyoming/Idaho)

Exposures of the tuff are found on the north end as well as the eastern and western edges of the Teton Range just south of Yellowstone’s southern border. The tuff is “exposed sporadically along both sides of the Teton range…in the northern Tetons just northeast of Survey Peak…and small outcrops are present near the head of Glade Creek…and along Polecat Creek” as well as further south in the Jackson Hole area (Christiansen and Love 1978:C2-C4) (Figure 3). Conant Creek and other welded tuffs underlie the Huckleberry Ridge Tuff (which is part of the Yellowstone Formation) (Christiansen and Love 1978:C4) and thus exposed tuff in nearby areas may or may not be Conant Creek. For example, exposures (“at least some of which probably are the Conant Creek”) are present on the south side of the Snake River in the Swan Valley area of southeastern Idaho and in the Centennial Range in eastern Idaho (Christiansen and Love 1978: C4), which is the locality of Bear Gulch obsidian as well.

In addition it is important to note that there are exposures of Conant Creek tuff in the same area as the Teton Pass and Crescent H type obsidians. As mentioned in the discussion of the latter two types, although there are at least three geochemically distinct types in the same area, people would not have differentiated among those types and for the purpose of geographical analysis this might be considered one “source area”.

Conant Creek Tuff appears as a gray or purplish-gray rhyolite, and “generally only has sparse phenocrysts…[but has abundant] lithophysal cavities” (Christiansen and Love 1978:C5) which appear as spherical holes in the material. It superficially resembles both Huckleberry Ridge and Lava Creek Tuff (Christiansen and Love 1978:C5) which complicates the visual identification of this material in the field, as all these tuffs have been utilized as tool stone material in Yellowstone.

4.6.9 Lava Creek (Wyoming)

Lava Creek Tuff appears as exposures in the Jackson Lake area (near the Grassy Lake Reservoir) in Grand Teton National Park and just south of Yellowstone's border (Figure 3). The area around the Grassy Lake Reservoir also provides obsidian of the Conant Creek and Crescent H geochemical types. As mentioned above, Lava Creek obsidian superficially resembles both Conant Creek and Huckleberry Ridge Tuff (found generally to the west of this source locality- see Figure 3).

4.7 Other Sources

4.7.1 Packsaddle Creek (Idaho)

This source locality is in eastern Idaho north of Idaho Falls (Figure 3). It appears less frequently in geochemical reports than nearby sources (such as Conant Creek or Crescent H and Teton Pass) and this author was unable to find published information on this source. It is unknown to this author whether this is a primary or secondary source. It is included in this research because one of the samples was sourced to this geochemical type.

4.7.2 Reas Pass (Idaho/Montana)

This source locality is located near the border between Idaho and Montana (Figure 3). It appears very infrequently in Yellowstone assemblages, but is included on the map in Figure 3 because it was represented in the assemblage at the Osprey Beach site (48YE409) (see Figure 3). The assemblage at the Osprey Beach site is the basis for the annual round model proposed by Johnson et al. (2004) (see Figure 4) and this thesis presents a critical examination of this model.

4.7.3 American Falls/Mud Lake (Idaho), Timber Butte (Idaho)

These two geochemical sources in Idaho appear very infrequently in Yellowstone assemblages. They are not considered key sources for the purposes of this research and thus they will not be described in further detail at this time. They are mentioned here for the purpose of providing a comprehensive list of geochemical sources appearing in Yellowstone archaeological assemblages, but they are not included on the map in Figure 3.

4.8 Summary

The geochemical sources regularly represented in Yellowstone archaeological assemblages vary in terms of the number of localities and quality of material. Obsidian from these sources also appears in both primary and secondary contexts. The listing of sources important to Yellowstone archaeology is the first step in the process of moving from accumulation of data to analysis and interpretation of this information. Having established such a list, preliminary analysis will now be undertaken in the following chapters.

Chapter 5

Theoretical Perspectives: Landscape and the Use of Analogy

5.1 The Questions We Ask

As archaeologists, it is essential for us to not only record and analyze the physical remains of past societies, but also to try and interpret past lifeways based on the archaeological record. This includes attempting to re-construct what Heidegger called the "Being-in-the-world" (Tilley 1994) experience of past peoples, to flesh out everyday lives and ideology, and in turn to address our own biases in interpretation of the material record. Contextual interpretation, while perhaps more easily applied to certain time-periods and sites than others, should be a primary goal in the practice of archaeology (see Hodder 1986, for a discussion of the contextual approach).

In addition, it is important to think critically about why certain research questions are asked and to perhaps consider asking different kinds of questions. Studies analyzing the selection of raw material sources by pre-contact peoples, for example, show a consistent focus on trade and exchange or direct procurement patterns based on principles of efficiency (see Mitchell and Shackley 1995; Barge and Chataigner 2003; Low 1996; Church 1996). However, we risk overlooking the possibility that lithic sources may play additional, ideological roles in the lives of pre-contact peoples.

By asking questions only related to the economic functions of raw material sources, and looking for answers restricted to spatial analysis and concepts of efficiency, we may be overlooking alternative significance associated with the sources of lithic raw materials themselves. Indeed, it is crucial to consider that sites and artifacts often have multiple functions and may serve both economic and ideological purposes (see Gillespie 2007, for a Plains example). In addition, several studies have shown that a significant percentage of obsidian found in a site is often not from the most geographically convenient source (see Johnson et al. 2004; Mitchell and Shackley 1995; Barge and Chataigner 2003). Thus it is necessary to consider motivations other than convenience and efficiency for this occurrence.

5.2 The Cultural Selection of Obsidian Sources in Yellowstone

Plains prehistory is often examined within a cultural ecology or environmental determinism framework as a default response to studying hunter-gatherer subsistence and settlement strategies. Obsidian sources in this region can be viewed as places that are part of a greater landscape negotiated and expressed in the daily experience and consciousness of a group. This entails conceptualizing the physical landscape as a "human space" and places as having social and cultural meaning within the landscape. Extending the spatial limits of a "site" to encompass a larger, culturally meaningful landscape allows us to create a dialogue between the economic and the ideological and apply this to interpretation of pre-contact raw material source selection. This approach fuses methods of site catchement analysis with the concepts of an encultured landscape, interpreting distance between sources and sites as well as frequencies of artifacts and obsidian types.

5.2.1 Landscape Theory and Archaeology: Some Background

Prior to examining the applicability of the landscape approach it is wise to set out a definition for this paper. The term "landscape" can mean different things depending on the context. Indeed, within the context of archaeological literature, this term has seen a variety of uses, often as a synonym for "natural environment" and "settlement pattern" (Anschuetz et al. 2001:158). Archaeologists have been, in a sense, thinking about landscape as a framework before a "landscape approach" was delineated (Thomas 2001:165). For example, interest in spatial modeling and environmental functionalism were two popular themes in the archaeology of the 1960s and 1970s (Weimer 1995:92-93), both of which directly involved consideration of the physical landscape. Archaeologists were by and large taking an empirical approach to analysis of the natural world and not concerned with viewing landscape as "an object of theoretical reflection" (Thomas 2001: 165). However, rejection of the rigid spatial science of the 1960s resulted in a better understanding of the complexity of landscape (Thomas 2001:166).

Even within the discipline, archaeological definitions of landscape can differ in significant ways. Researchers working within a systems-oriented framework saw human culture and behavior as a means of "passively reacting to outside stimuli, such as the environment" (Duke and Wilson 1995:7). Environmental data are emphasized largely because they are easy to collect and analyze in contrast to the sparse material assemblages that characterize Plains archaeology

(Weimer 1995:96). Conceptualization of the landscape was therefore mainly to serve the purposes of spatial analysis and locational modeling gaining popularity with the "New Archaeology" of the 1960s. This approach was particularly appealing in that "[d]ata collected for such analyses [were] quantifiable and statistically manipulable and thus 'scientific'" (Weimer 1995:93).

The 1990s saw a movement within archaeology towards the integration of geographic space and encultured place and "landscape" began to be considered as a culturally constructed concept/entity. Enculturation of a landscape is an on-going transition or transformation occurring as a "space" takes on cultural meaning and becomes a "place" (Tilley 1994:161). Tilley further clarifies the difference between a landscape and locales. Landscapes, as both physical and symbolic space, are made up of locales, or places with cultural meaning, in a relationship of parts to a whole (Tilley 1996:161). Furthermore, landscapes can be "read" like the archaeological record because both are "records of human behaviour…[and] owe their realities to cultural priorities undergoing constant changes" (Wilson 1995:191).

5.3 Landscape and Hunter-Gatherers of the Plains

The landscape approach goes beyond conceptualization of hunter-gatherers as simply economic decision makers and passive participants in an ecosystem. Rather, hunter-gatherers of the Plains "lived in a cultural landscape of their making" (Gillespie 2007:172).

The highly mobile lifeway associated with Plains hunter-gatherer groups through time results in a general acceptance of seasonality as the primary determinant of regular movements made by such groups. In the open Plains to the north and the east, following the migrations of buffalo was a primary consideration of pre-contact hunter-gatherers. In the Yellowstone region a mountain-adapted lifeway has been proposed, whereby people moved into higher altitude regions of the plateau during the warmer months and down to the surrounding river valleys and foothills during the winter (see Johnson et al. 2004 for a variation of this idea).

This follows Frison's (1991:1992) mountain-oriented economy of the Bighorn Mountains and surrounding areas in northern Wyoming (such as the Absaroka Mountains forming the eastern boundary of Yellowstone). Frison (1991:1992) proposes that a highly diversified economy was in existence from Paleoindian times in this area. This was based on hunting Bighorn sheep and smaller animals, fishing, and gathering of plant foods,. This lifeway was distinct from that of the bison-hunting groups of the open Plains and it can be argued that the similarly high altitude Yellowstone Plateau had a diverse mountain-oriented economy as well. While bison were a part of the diet, faunal assemblages at sites in Yellowstone indicate a much more diversified hunting strategy emphasizing elk, deer, and small mammals. This makes the seasonality and annual rounds of people inhabiting Yellowstone quite different and perhaps more localized than groups inhabiting the Plains grassland, where bison were the primary source of food.

As with other mountainous regions (see Pitblado 2003:60-61), environmental zones in Yellowstone are relatively compressed. Therefore, people would not have to go very far in search of resources or with the changing of the seasons. This must be considered when examining the distance to some obsidian sources that appear with frequency in Yellowstone. It is typically suggested that obsidian from these far off sources was collected as part of the seasonal movement of a group (Johnson et al. 2004). Indeed, the archaeological interpretation of seasonal rounds of pre-contact people in Yellowstone is based largely on the frequency of appearance of different obsidian sources in assemblages. This information is then evaluated in relation to the source locations. If presumably all the resources a group needs are available within a day's walk in this "compact" mountain-foothill zone (Pitblado 2003:59-60), then why travel such great distances to obtain obsidian from sources in Idaho? This will be discussed subsequently in this thesis, but is worth asking before turning to Gillespie's (2007) example of interpreting the ideology of hunter-gatherers.

Gillespie (2007) presents an excellent example of the importance of an encultured landscape for Clovis peoples, the "colonizers" of North America. Clovis hunter-gatherers were constantly encountering unknown lands by virtue of their highly mobile lifeway and their role as "colonizers" of the New World. Thus, it was necessary to find a way to transfer a "*mobile* sense of landscape to a *fixed* sense of landscape" in order to instill the land with cultural significance (Gillespie 2007:172, author's emphasis). In the language of the landscape approach, Clovis people "moved rapidly from *space* to *place*…with presumably little time to create *places* (i.e., cultural landscapes)" (Gillespie 2007:172, author's emphasis). Caching of stone tools, a distinctive Clovis practice, symbolically performed this transference in a manner that made sense for a mobile lifeway.

Gillespie uses a phenomenological approach and describes how hunter-gatherers switch between two landscape ideologies depending on their mobility levels. The first, “chiefly” landscape, is “mobile and impermanent” and centers around the chief’s tent (or the groups’ collection of tents) as a miniature of the whole world, so that as the tents move the encultured landscape moves with it (Gillespie 2007:176). Wilson (1995:178) points out that the “mobility of a nomadic group favors a portable landscape, its internal organization encoding cognitive percepts and precepts.”

The second, “shamanistic” landscape, is “permanent and fixed” with named locations and places that store oral histories which often reference other named places (Gillespie 2007:176). The landscape ideology of early Clovis would, therefore, be consistent with a mobile (chiefly) sense of the landscape with subtle shifts in degree due to the relatively rapid enculturation of the landscape during successive stages of colonization. Gillespie (2007) provides a model of a shifting, ongoing landscape-learning process that adjusts to changes in mobility levels and stages of colonization.

Gillespie’s work is an excellent example of how a phenomenological landscape approach can illuminate ideological aspects of hunter-gatherer lifeways while complementing the economic. It also shows how, through analogy with living/historic hunter-gatherer groups, it is possible to argue for similarities in some aspects of ideology through time based on similarities in other aspects of their lifeways. It seems reasonable to conclude that pre-contact hunter-gatherer groups inhabiting Yellowstone would have varying degrees of a “chiefly” landscape ideology. However, the archaeological record indicates that there was some regularity to the movement of groups through Yellowstone. It would be necessary, therefore, to have more fixed aspects of landscape such as natural or constructed markers, guides or monuments. A middle ground between a completely portable landscape centered around the household and a permanent, fixed landscape seems suitable for the Yellowstone area and its inhabitants.

5.3.1 Ethnoarchaeology and Analogy

Place names in many American Indian languages have the fascinating ability to form pictures in the mind so that “truly what you see in your head is the place where you are located” (Schreyer 2006:229). An important point made by Basso (1996), in his groundbreaking work with the Western Apache, is that cultural constructions of the environment can only be understood by talking with people who inhabit the land. We must sit down and talk with informants to listen to them talk "not only about landscapes…but also about talking about landscapes as well" (Basso 1996:68).

This lends support to the use of alternative approaches to the study of landscape, other than ecology or physical geography, because these standard approaches would overlook the *way* people think about space and place. The way people speak about landscape is thus an insight into the way they think about it presenting a highly cognitive approach. At first blush, this appears to make things problematic for a landscape approach to pre-contact cultures as it necessitates a living population. There is the implication, however, that because of shared underlying concepts between various indigenous groups, analogy should be appropriate to aid in the interpretation of past cultures.

Many indigenous groups in North America share conceptualization of the land as something that is imbued with moral regulations. This means that the stories associated with a place name, as a shared memory, often are cautionary tales ultimately implying how things *should* be done, and are brought up when someone in the community is in need of reminding (Basso 1994). At the same time, the stories (and encultured *places*) cannot be separated from the geographical *spaces* they are about. Evoking a contextual approach, "[p]laces are always 'read' or understood in relation to others…places themselves may be said to acquire a history, sedimented layers of meaning by virtue of the actions and events that take place in them" (Tilley 1994:27).

This obviously makes it more difficult to properly "read" the landscape of pre-contact people with no living members of a group to consult. However, this does not mean it is not important to try. With the judicious use of analogy and ethnohistory, cross-cultural comparisons can give insight to interpretation of past landscapes.

Schreyer's (2006) overview of ethnohistoric work on hunter-gatherers of the Plains further supports the usefulness of analogy for understanding the idea of a meaningful landscape among groups who share this subsistence pattern. Hunter-gatherer groups are typically mobile, and because of this they have a special relationship with the land. This relationship, the centrality of travel to the hunter-gatherer economy and the role of places as "guides" in regular movements through the landscape (Schreyer 2006) are ideas that can be applied to the analysis of pre-contact hunter-gatherers and obsidian sources in Yellowstone.

5.4 Natural Places as Monuments

"'Natural' places are not monuments, because they have not been constructed by human labour…[but they] have an archaeology because they acquired a significance in the *minds* of people in the past" (Bradley 2000:34-35). Thus, elements of the natural landscape such as mountains, rivers, and even lithic sources, are not "built" as such by humans, but these locations become encultured places because of the significance afforded them by humans. In this way, these encultured places are indeed "built" by humans and thus it is accurate to think of these places as monuments. Indeed, obsidian and other lithic sources are "natural" places that have been physically altered by humans. Thus, lithic sources are even more firmly in the category of monuments as places which are culturally modified both physically and cognitively.

5.4.1 Obsidian Cliff as Monument

Situated in the northern part of the Park, Obsidian Cliff is a large and striking natural landmark and a vital lithic resource "that served the utilitarian imperatives and ceremonial requirements of early native peoples over a large area of North America for more than 11,000 years" (Davis et al. 1995:59). Currently, a steep exposed face of the source is visible directly next to the main loop road running through the Park (see Figures 6). The cliff faces and flow are also accessible, located next to a creek bed and in terrain that is not particularly adverse (except for the extensive deadfall covering the ground on top of the cliff area which is the result of wildfire in the late 1980s). Allowing for changes in ground coverage, the obsidian would have been just as accessible to pre-contact people.

Obsidian Cliff was clearly an impressive natural monument to Euro-American visitors to Yellowstone (see Figure 7). In 1879, Philetus W. Norris, Yellowstone's first superintendent, described a feature extending "for two miles in distance and many hundred feet in height, literally towering vertical pillars of glistening black, yellow, and mottled or banded obsidian" (Norris 1879, in Davis et al. 1995:4). The first published description of Obsidian Cliff is by W. H. Holmes in 1879, who describes the approach to the feature:

> For half a mile [the road] is paved with glassy fragments and lined by huge angular masses of black and banded obsidian rock. From the upper border of the debris slope the vertical cliffs rise to the height of nearly two hundred feet. The lower half is composed

> of a heavy bed of black obsidian which exhibits some very fine pentagonal columns…with perfectly cut faces that glisten in the sunlight [Davis et al. 1995:1].

In pre-contact times it would have been just as impressive. The obsidian is of excellent tool-making quality with few inclusions or flaws (Davis et al. 1995:22). All in all, Obsidian Cliff meets the criteria to be a preferred source for pre-contact people and is either the most or second-most frequently represented source in assemblages throughout the Park (Davis et al. 1995; Johnson et al. 2004).

In the GYE there are multiple sources known to have been exploited by pre-contact people. Obsidian Cliff is obviously not always the closest or most convenient source for all locations in the Park. Some of other sources (such as Cougar Creek, which contains many phenocrysts) are not of comparable quality to Obsidian Cliff obsidian (Johnson et al. 2004:viii). However, it is essential to examine additional reasons why Obsidian Cliff is often the source preferred by pre-contact people beyond its quality and location.

Nabokov and Loendorf (2004) examined the ethnohistoric evidence for Obsidian Cliff as a special location that was shared territory for different tribes in the area. They discussed the idea that "obsidian was so important that its major quarry in the park [Obsidian Cliff] constituted a sort of sacrosanct zone", or neutral place where temporary peace would be abided by enemy tribes in the interest of procuring this valuable material (Nabokov and Loendorf 2004:162). The authors remained unconvinced of the "neutral ground" argument because of "too little [sic] hard data" (Nabokov and Loendorf 2004:163). They claimed that the great availability of good obsidian from different sources weakens the idea that Obsidian Cliff would have been in such high demand as to necessitate it being a neutral ground (Nabokov and Loendorf 2004:164). The authors' doubts, however, do not take into account the idea that Obsidian Cliff could have simply been a meaningful place to many different groups. Ethnographic information indicates that because tribes came to Obsidian Cliff for purposes other than warfare, "any hostility was forgotten, and left outside the area" (Weixelman 1992, in Nabokov and Loendorf 2004:164). The "reason" for setting aside differences at this location may be due to practical considerations. However, if in fact Obsidian Cliff had the power to invoke temporary peace (as Weixelman claims), this is indicative that it was considered a meaningful place. This is particularly significant considering that alternative good-quality sources were available within a few days distance.

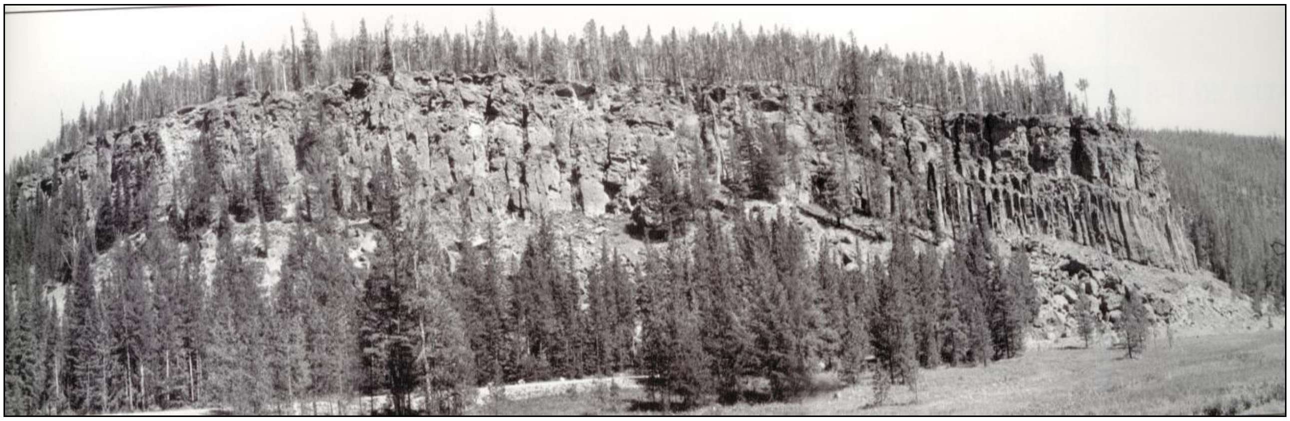


Figure 6: Photograph (taken by M. Meagher in 1990) of Obsidian Cliff Plateau- the locality of Obsidian Cliff obsidian. Note columnar structure of cliffs (from Meagher and Houston 1998: 62).

Figure 7: Photograph of Obsidian Cliff Plateau in 1884 (by F. J. Haynes 1884, courtesy of Yellowstone Heritage and Research Center).

In spite of Nabokov and Loendorf's (2004) need for "hard evidence", it is still worth exploring the ethnographic and ethnohistoric evidence for Obsidian Cliff as a meaningful place. Many of the modern-day American Indian tribes with ancestral or cultural associations with Yellowstone have indicated to Park ethnographers that Obsidian Cliff is a spiritually and ideologically significant place. There are oral histories on file with the Park's ethnography department that indicate specific reference to use of Obsidian Cliff obsidian, and etiquette and rules that were associated with quarrying at this place. In addition, there are references to an attitude of reverence shown when in the area. In an interview with Grant Bulltail, he indicates that the Crow "revered the Obsidian Cliff area, and prayed before collecting there" to the "Holders of the Earth…[who] inhabited (and still inhabit) the area" (Loendorf and Stroupe 2003:19). These Holders of the Earth are part of Crow mythology and are beings who were responsible for the replenishing of obsidian at Obsidian Cliff after the Crow collected there, and offerings were left after obsidian was removed (Loendorf and Stroupe 2003:19).

There is also reference to the timeframe of occupation during collection sessions. Information gathered from the same interview with Grant Bulltail indicates that the Crow would only remain at Obsidian Cliff for a few days, "because they did not want to 'taint the area'" (Loendorf and Stroupe 2003:19). This statement conveys two key pieces of information. First, quarrying/procurement activities were targeted events that occurred when the group was passing through the area. Perhaps the larger group would camp nearby while a smaller procurement group would go to quarry/collect obsidian and camp at the Obsidian Cliff only while completing their task.

Members of the Shoshone-Bannock of Fort Hall, Idaho have stated that historically, the Obsidian Cliff area was a regular stop over for hunting parties during the fall and summer bison hunts (Katharine L. White [of the Yellowstone National Park Ethnography office] personal communication 2009). This information presents a more specific aspect of seasonality for use of the area as well as specifying who would be camped there. This suggests that the hunters were also the ones who would procure raw material, in a multi-tasking outing involving both lithic procurement and hunting of bison further a field.

Secondly, the combined mention of reverence for the area, the presence of beings that are integral to Crow mythology (the Holders of the Earth) and concern over "tainting" the area gives support to the idea of Obsidian Cliff as a meaningful place. While Grant Bulltail's account of the Crow's relationship to the area talks of an attitude of reverence, an interview with a *Tukudika* (a tribe also known as "Sheep Eaters" or Mountain Shoshone-see Loendorf and Stone 2006:xi-xii) descendant takes this characterization one step further. "Because their [the *Tukudika*] prayers were left [at Obsidian Cliff] with whatever they left there…it also would be considered a sacred site" (Nabokov and Loendorf 2002:125). When collecting obsidian from Obsidian Cliff "it's like a sacrifice, you leave something there, an offering when you get it…we leave something there for the spirits to give a blessing for taking it", just as the Crow would pray after collecting to give thanks to the beings who replenish the obsidian (Nabokov and Loendorf 2002:125).

Loendorf and Stroupe's research (2003:17-19) found that all the tribes with whom they consulted said they collected obsidian from Yellowstone. Informants from the Oglala Sioux and Crow gave accounts of quarrying and Shoshone-Bannock gave accounts of collecting obsidian from Obsidian Cliff (Loendorf and Stroupe 2003:18-19; Katharine L. White, personal communication 2009).

There seems to be plenty of evidence in oral histories of the importance of Obsidian Cliff through time. Historical use of Obsidian Cliff and other obsidian sources in Yellowstone and the corresponding attitude of reverence have been documented. In addition, during interviews conducted by ethnographers informants reference the utility and quality of Obsidian Cliff obsidian (see Nabokov and Loendorf 2002 and 2004; Loendorf and Stroupe 2003).

The combination of utility, quality, and mythology surrounding the Obsidian Cliff and its materials makes a strong case for nomination of the location as a place of meaning on a cultural landscape. The ethnographic evidence suggests a strong connection to Obsidian Cliff as a place and also to the use of obsidian in general for several of the American Indian cultures who have historically visited or inhabited the Yellowstone area and have documented "traditional use" of the area's resources. Perhaps the most compelling evidence for Obsidian Cliff as a "place" instead of just a "space" is that the Crow, Shoshone and Bannock all have names for the site in their own languages (*Sh<lptachawaxaawe, Duupi*, and *Tupeshakabna'*, respectively) (Katharine L. White, personal communication 2009). As explained by Basso (1996) in his work with the Western Apache, the naming of a location is a key point of transition of the location from a "space" to a "place" (i.e. a location that has cultural meaning). Indeed, the naming is one of the defining features of a location becoming a meaningful place on a culture landscape.

The status of Obsidian Cliff as a place of meaning may also be extended to pre-contact times if we accept the usefulness of analogy as a tool for archaeological interpretation. Given the shortcomings of models based on efficiency and time-distance analyses that will be illustrated later in this paper, it seems appropriate to consider a landscape approach and ethnohistoric/ethnographic analogy as possible lines of inquiry.

5.4.2 Visual Impact and Analogy

The use of analogy as an interpretive tool rests on the premise that there is some cultural continuity between a living culture (which can be studied to understand "rules" of behavior and meaning) and a past culture (represented by the archaeological record) (M. Johnson:1999:60). If there is good support for some level of cultural continuity, then applying a modern culture's meanings and use of objects to the archaeological record can be fruitful. North American archaeology has justified the use of analogy this way more than once, most successfully in the Southwest. For example, some Hopi cultural aspects have been linked to the interpretation of Anasazi sites based on the idea that the Anasazi are the direct ancestors of the modern day Hopi (M. Johnson 1999:60-61).

Following this example, acceptance of Obsidian Cliff as a culturally meaningful and visually striking natural monument in pre-contact times is based on the following ideas: Obsidian Cliff is currently considered a natural monument that "stands out" on the modern landscape and historically it was also a meaningful place on the cultural landscape of the Crow and Shoshone-Bannock.

However, what about sources that are not as "stand-out" as Obsidian Cliff? Additionally, is it fair to apply our own perceptions of what is "striking" or particularly eye-catching in the natural environment? How can we avoid the pitfall of applying 21st century perceptions to cultures that existed thousands of years ago?

In this chapter, the use of analogy is supported as an appropriate method to understand the ideology of pre-contact hunter-gatherer groups on the Plains. Analogy may also be appropriate when evaluating the aesthetic or visual impact qualities of natural landscape features through time. There is criticism of using analogy when dealing with experiential events like the visual "impact" of natural features as this is a subjective impression that would be culturally mediated. For example, Bradley (2000:87), in discussing the locations selected for stone axe quarries in Great Britain, states that "[the locations] often stand out from the surrounding country because of their unusual physical characteristics." He went on to say that "[t]his is a difficult question to discuss because there is such a danger of imposing modern aesthetics on the past…[but several of these sites]dominate the surrounding landscape…[and] can be seen from an enormous distance away" (Bradley 2000:87). Tilley's (1996:163) discussion of Tors (naturally occurring rocky columns) of Bodmin Moor in Great Britain also described how some of these natural monuments "form distinctive silhouettes on the skyline visible from far away." He suggested that "[t]oday these Tors are a constant source of fascination…[and] a sense of awe and wonder for these places, notwithstanding a modern rational geological explanation for their formation, continues" (Tilley 1996:163). Therefore, if environmental and geologic conditions are comparable, it may be useful to assume a similarity of experience.

Although we should critically evaluate aesthetic value judgements before applying them to past societies, it seems reasonable to assume similar visual/experiential impact for some natural features. In Yellowstone, for example, erupting geysers are viewed by millions of tourists every year who think of them as special, fascinating natural wonders. Ethnohistoric records indicate that active geysers were seen as special places of power and treated with awe and respect by American Indian groups familiar with the area during the early historic period (Janetski 1987:81-82). While culturally derived aesthetic values may be different, the impact that these natural features make on those that experience them remains meaningful. This would apply to features such as mountains, rivers, clearing, or outcroppings of glassy material, to name a few. Ultimately, the type of feature that has an impact would depend on cultural values, but tentative analogies of experience may be made to facilitate an understanding of the landscape from the point of view of pre-contact peoples.

5.4.3 Problems with Analogy and Middle-Range Theory

There are several critiques of the use of analogy in archaeological interpretation. A major contention is over the concept of cultural continuity. Archaeologists are in the unique position to study culture and culture change through a much greater time-depth than cultural anthropologists or ethnographers. However, this poses the questions: to what degree can cultural continuity be assumed/observed across the incredible time-depth that we deal with? The use of analogy is essentially middle-range theory based on a uniformitarian assumption that conditions in the past were the same as conditions we see in the present (M. Johnson 1999:54-55). Of course, uniformitarian assumptions about human behavior are open to critique. Culture is dynamic, and trying to apply our so-called present day "statics" (the archaeological record) to past "dynamics" (human behavior/culture) has its problems. Clearly, a localized, culture-by-culture basis must be employed.

A significant problem for this thesis, in its attempt to apply both middle-range theory and landscape theory, is that middle-range theory does not technically allow for the effect of cultural ideas on behavior (M. Johnson 1999:61-62). Conversely, landscape theory and a phenomenological approach are largely based on the concept of cultural influence over behaviors. Johnson (M. Johnson 1999:61-62) points out that "these [culturally influenced ideas] don't just affect obviously 'cultural' things…[t]hey also affect apparently mundane activities such as the organization of household space and attitudes towards rubbish." Having argued that the choices people make are not solely based on environmental or economic factors it now seems contradictory to also want to use principles of analogy which rely on consistent behavior through time.

Analogy can be strengthened, however, if the archaeologist can positively answer some questions regarding applicability. If enough breadth and depth in parallels may be drawn between a living culture and a past culture, an assumption of some level of continuity may be considered. For example, Johnson proposes the following useful "sample questions" to ask:

> [A]re the pits of the same size and shape? Do we consider past and present societies to be at the 'same level of social development'? Do the ethnographic examples come from the same kind of environment, settlement type, economy?" [M. Johnson 1999:61].

The example given above of the link made between some Hopi practices and the Anasazi gains strength if "continuity in cultural ideas and practices is *probable*" (M. Johnson 1999:61, emphasis added). An analogy can not be proven scientifically, it cannot be tested, and we cannot know for sure if an assumption of cultural continuity is true or not (M. Johnson 1999:60). However, historically we have seen that cultures have elements of continuity and change. Thus, it is difficult for this author to support either extreme: the concept of uniformity and continuity or the belief that "all cultures are historically unique, and cannot be compared one with another" (M. Johnson 1999:60).

Chapter 6
The Multi-Functionality of Obsidian

6.1 Ideological, Ritual and Utilitarian Examples from Yellowstone and Beyond

Obsidian was used to make symbolic or decorative objects in regions surrounding the Plains as well as Mesoamerica. For example, obsidian from Yellowstone was used to make "magnificent ritual bifaces in Ohio, California, and elsewhere" (Nabokov and Loendorf 2004:63). The Shoshone associate obsidian with a powerful female spirit (Nabokov and Loendorf 2002). In Shoshone mythology, there existed a group of spirits known as *pan dzoavits*, one of whom was a "very dangerous, solitary spirit known as 'water ghost woman' (*pa:waaip*)…[and the Shoshone] always know she is around by obsidian flakes found on the ground which represent broken fragments of her body" (Shimkin 1947, in Nabokov and Loendorf 2002:125).

The fashioning of religious or ritual objects out of obsidian by groups who lived in the Yellowstone region was not the norm (Nabokov and Loendorf 2004:163). However, there are two examples of obsidian found in burial contexts in Yellowstone. The "Condon Burial" (48YE1) included the remains of an adult male and two dogs, believed to be of Late Prehistoric age (Willey and Key 1992:14-15). This grave site was discovered on the north shore of Yellowstone Lake near the Yellowstone River outlet in 1941 (Willey and Key 1992:14).

The only records of this site have very poor quality photocopies of photos and inconsistent information (see Willey and Key 1992). A report on this site indicates three "Late Prehistoric" projectile points (which appear to be Avonlea), one "Middle to Late Archaic" projectile point, and one "Early Prehistoric" point (which appears to actually be a knife) associated with the burial (Hoffman 1961: 63, 65, 72) . Unfortunately, the author does not indicate which of these are obsidian and it is impossible to tell from the photocopied images. Hoffman (1961:35) does mention that the materials the tools were made out of were "the same as those in the chips [obsidian and chalcedony] scattered throughout the site". Wright et al. (1982:14) observed four obsidian artifacts as part of the burial collection when it was housed in the museum, but their provenience could not be verified. There are catalog records (dating to 1960 and 1990) of one obsidian “Late Prehistoric” projectile point, an obsidian flake, and an obsidian “biface fragment” from this burial.

A second burial in the same area (48YE1) was discovered in 1956 and contained the remains of an adult female, fragments of an infant’s rib, and two dogs (Willey and Key 1992:22). Unfortunately there are no good records of this second burial site, and no mention of any associated lithics are made in the report on the skeletal remains (see Willey and Key 1992). The skeletal remains and associated artifacts from both burial sites have been reburied in accordance with the Native American Graves Protection and Repatriation Act (NAGPRA), and are unavailable for further analysis or sourcing. However, the inclusion of obsidian in at least one burial context provides preliminary archaeological evidence that obsidian had some cultural significance for pre-contact people in Yellowstone.

The practical uses of obsidian for hunting and cutting tools should not be of secondary importance to this discussion. In addition to use as a tool-stone, medicinal use of obsidian by the Wind River and Fort Hall Shoshone has been documented. Obsidian was used to make cuts for bleeding to release pressure from headaches and also to treat loss of eyesight from trachoma (Nabokov and Loendorf 2002:125). The Oglala Sioux have accounts of using heated obsidian to close wounds. They have indicated that they still do this today, but that the obsidian they presently use is not of the same high quality as that obtained from Yellowstone in the past (Loendorf and Stroupe 2003:19).

Obsidian clearly possesses excellent functional qualities as well as ideological importance for a variety of cultures in North America. Yet obsidian’s dark, glassy luster and variable translucency have also made it aesthetically intriguing, and cross-culturally appealing in Mesoamerica for thousands of years. Indeed, there are some interesting parallels with Mesoamerica in regards to the links between obsidian and the spiritual world, and the multiple functions of obsidian in the lives of different cultural groups. The role of obsidian in Mesoamerican cultures provides an interesting example of the multi-functionality of this material in other parts of the world. In an examination of obsidian in Mesoamerica from ca. 1500 BC through the Spanish conquest, Saunders (2001) argued for the shared symbolic and functional importance of obsidian among Mesoamerican peoples. A shared indigenous aesthetic based on the importance of obsidian shaped the relationships between people and objects/materials, and “bestowed distinctive kinds of agency on the ubiquitous obsidian blade” (Saunders 2001:221). In his quest for the full “biography” of obsidian, Saunders (2001:221) drew attention to “its unique ideological positioning as a bridge between symbolic and physical realities.”

Saunders’ (2001) discussion is a welcome contrast to the more economic/environmental focus that is usually encountered in articles on obsidian sourcing (see Mitchell and Shackley 1995, for an example). Obsidian in Mesoamerica has the rather infamous reputation as being the tool stone of choice for sacrificial knives, but Saunders (2001) offered insight to the symbolic nature of obsidian outside of a “ritual” setting. Symbolic importance of a geo-material also suggests importance of the source of that material in the cultural landscape. Although not dealing specifically with analysis of source locations and their relationship to a meaningful landscape, Saunders (2001:229) described how indigenous peoples conceptualized the land as the body of the female creator deity and mother of the god/esses. As a result, in Mesoamerica “obsidian mines appear to have been an important physical and metaphysical component of a landscape where individual features were given cosmological significance” (Saunders 2001:229).

Obsidian is functional as tool-stone, healing implement and symbolic material. Saunders’ (2001) examples from Mesoamerica illustrate how its *sources* might also be considered “multifunctional”. Within a phenomenological landscape approach, the definition of “function” should not be thought of in the narrow sense of serving a subsistence-related purpose. The term “function” is therefore used in the context of providing a “use” and serving a purpose appropriate to the needs of a culture.

Chapter 7

Results and Conclusions

7.1 Results

A total of 85 projectile points were selected for analysis, with 40 (or 47%) from the North Study Area and 45 (or 53%) from the South Study Area (see Table 2 and Figure 8). Forty-seven samples were projectile points of the McKean complex or related Middle Archaic types, and 38 projectile points were form the Pelican Lake phase (or Late Archaic period) (see Table 3 and Figure 9). Overall, 62 points were from the Obsidian Cliff source, eight were from the Teton Pass source, six from Bear Gulch, two from Cashman Quarry, two from Crescent H, one from Conant Creek, one from Cougar Creek, one from Huckleberry Ridge, one from Packsaddle Creek, and one from an unknown source (see Table 4).

Curiously, there were no samples from the Park Point, Warm Creek, Cascade Creek, or Lava Creek sources. These have appeared consistently in recent sourcing reports, particularly in the Yellowstone Lake area (see Hughes 2009), and it was expected that at least one of these would be represented in this analysis. Despite this, they have been included on the maps and in the discussion of key sources in Yellowstone, because they remain important sources to consider when examining obsidian use patterns in the Park.

This research has aimed to preliminarily analyze spatial and temporal patterns in exploitation of obsidian resources by pre-contact peoples in Yellowstone. These results must first be examined in relation to the question of a preference for certain sources that can be explained by cultural constructs as opposed to economic reasons. In order for a cultural preference to be indicated by the archaeological record, there would have to be a significant percentage of obsidian being utilized from a source that is a) not as convenient in terms of distance or accessibility or b) not as high quality as a source of comparable or less distance. Through the process of eliminating obvious “practical” reasons, a cultural/social influence may be considered. The findings of this study indicate that contrary to the hypothesis proposed in this thesis, the selection of sources seems to be based on the quality and location of the source relative to the site. There was no indication in the archaeological record that significant consideration was given to reasons beyond the practical to utilize an obsidian source. The archaeological record did not show any indication for a purely cultural selection or preference for one source over another.

The Obsidian Cliff source may be the exception to this conclusion. Representing 87% of the sample in the North Study Area, and 61% in the South Study Area, Obsidian Cliff was certainly an important source as evidenced by its u se through time and space (see Figure 8 and 9). It is the dominant source in both study areas, and as represented in the sample from both cultures examined. This is likely due in large part to its superior quality as a tool stone. However, the ethnographic evidence suggests that the role of Obsidian Cliff as a monument on a cultural landscape also contributes to the source's popularity.

The archaeological evidence in the study sample clearly shows preference for this source and this preference can be interpreted in both economic and cultural terms. That is, the quality of Obsidian Cliff obsidian makes tool stone from this source a good "investment" of time and energy (economic selection), and the location can be considered accessible and conducive to either easy direct procurement from either study area *or* to local trade between the two study areas. The Obsidian Cliff source therefore stands out among the other sources as a potential testament to the concept of a cultural landscape at work in pre-contact times, and demands further investigation in this regard.

The seasonal or annual round model that has previously been proposed for Yellowstone (see Johnson et al. 2004) (see Figure 4) is based on lithic procurement patterns because other indicators of seasonality (such as faunal and plant remains) are not well represented at sites. Bone does not keep well in the acidic thermally-influenced soils of the area and plant remains in hearth contexts are relatively rare (but see Vivian et al. 2008:93; Puseman 2002). There is secondary evidence for processing of plants such as the presence of grinding stones at the Malin Creek site (see Vivian et al. 2008).

The proposed seasonal round in use for Cody complex occupations in the Park is based on the assemblage at the Osprey Beach site. Based on the results of sourcing obsidian artifacts associated with the Cody complex at this site, an early summer to early fall occupation is suggested for Lakeshore sites. While there, people would utilize the closest source (Park Point) potentially accessing it through use of watercraft. Groups then moved south in the fall to the

Table 2: Results Sorted by Study Area

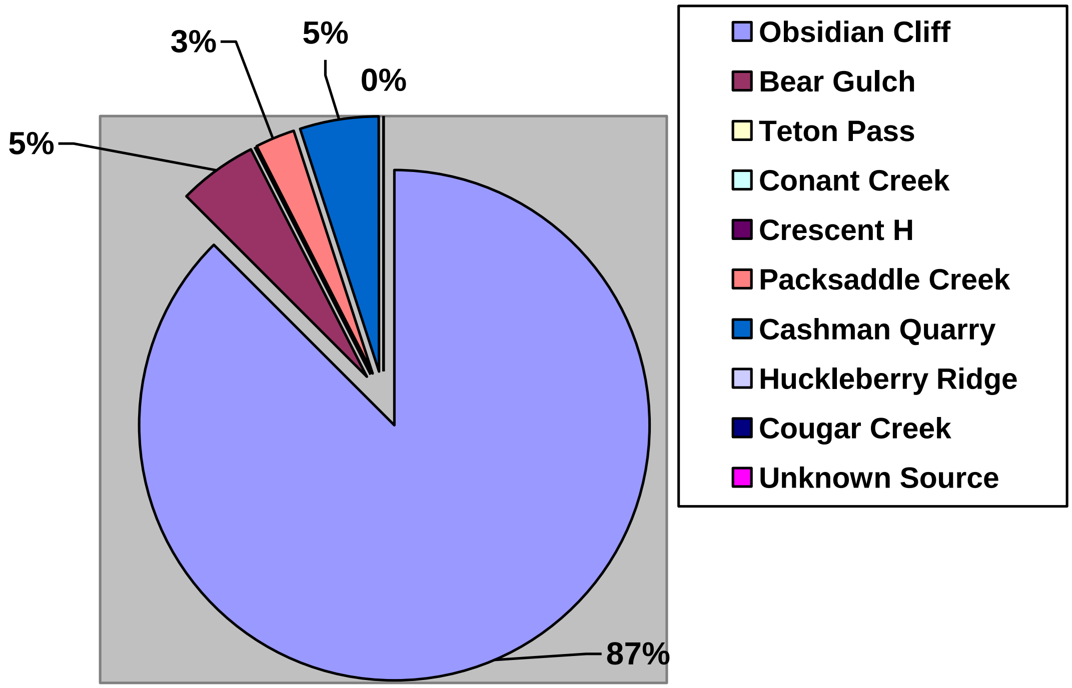
Study Area	Site #	Cat. #	Culture/Complex, Tool Type	Source	Project
N. End	24YE138	62312	Pelican Lake-PP	Bear Gulch	Yellowstone River Survey
N. End	48YE1533	68613	Pelican Lake-PP	Bear Gulch	E. Edge of the Gallatin Range Inventory
N. End	24YE353	68818	McKean-PP-Base	Cashman	Malin Creek Excavation
N. End	24YE356	FS19	McKean-PP	Cashman	Boundary Lands, N. Yellowstone
N. End	24YE353	65868	Duncan-PP-Base	Obsidian Cliff	Malin Creek Excavation
N. End	24YE353	68854	Mallory-PP	Obsidian Cliff	Malin Creek Excavation
N. End	24YE353	65937	McKean-PP-"Nubbin"	Obsidian Cliff	Malin Creek Excavation
N. End	24YE353	65905	Pelican Lake-PP	Obsidian Cliff	Malin Creek Excavation
N. End	24YE352	62348	Late Archaic-Corner Notched-PP	Obsidian Cliff	Yellowstone River Survey
N. End	48YE1024	146507	Middle Archaic-PP	Obsidian Cliff	Yellowstone River Survey
N. End	48YE985	143093	Pelican Lake-PP	Obsidian Cliff	Yellowstone River Survey
N. End	24YE134	62305	Pelican Lake-PP	Obsidian Cliff	Yellowstone River Survey
N. End	24YE137	62307	Late Archaic-Corner Notched-PP	Obsidian Cliff	Yellowstone River Survey
N. End	24YE9	109494	Elko Eared-PP-Base	Obsidian Cliff	Black Canyon Inventory
N. End	48YE762	109542	Duncan/Hanna-PP	Obsidian Cliff	Black Canyon Inventory
N. End	48YE762	109543	Duncan-PP	Obsidian Cliff	Black Canyon Inventory
N. End	48YE877	109565	Duncan-PP	Obsidian Cliff	Black Canyon Inventory
N. End	24YE2	109481	Pelican Lake-PP	Obsidian Cliff	Black Canyon Inventory
N. End	24YE7	109486	Pelican Lake-PP	Obsidian Cliff	Black Canyon Inventory
N. End	24YE26	109525	Middle Archaic-PP	Obsidian Cliff	Black Canyon Inventory
N. End	24YE29	109537	Middle Archaic-PP	Obsidian Cliff	Black Canyon Inventory
N. End	48YE50	68600	Pelican Lake-PP	Obsidian Cliff	E. Edge of the Gallatin Range Inventory
N. End	48YE50	68602	Pelican Lake-PP	Obsidian Cliff	E. Edge of the Gallatin Range Inventory
N. End	48YE1525	68605	Pelican Lake-PP	Obsidian Cliff	E. Edge of the Gallatin Range Inventory
N. End	48YE1529	68611	Pelican Lake-PP	Obsidian Cliff	E. Edge of the Gallatin Range Inventory
N. End	48YE1532	68616	Duncan-PP	Obsidian Cliff	E. Edge of the Gallatin Range Inventory
N. End	48YE1537	68625	Pelican Lake-PP	Obsidian Cliff	E. Edge of the Gallatin Range Inventory
N. End	48YE1540	68627	Pelican Lake-PP	Obsidian Cliff	E. Edge of the Gallatin Range Inventory
N. End	04YP113	68622	Duncan-PP	Obsidian Cliff	E. Edge of the Gallatin Range Inventory
N. End	24YE350	134194	Duncan-PP	Obsidian Cliff	FHWA Mammoth-Gardiner Inventory
N. End	48YE83	134223	Middle Archaic-Side Notched-PP	Obsidian Cliff	FHWA Mammoth-Gardiner Inventory
N. End	24YE14	117777	Middle Archaic-PP	Obsidian Cliff	Test Excavation of 24YE14
N. End	24YE14	117841	Late Archaic-PP	Obsidian Cliff	Test Excavation of 24YE14
N. End	48YE137	116382	Pelican Lake-PP-Base	Obsidian Cliff	Nine Prehistoric Sites in N. Yellowstone
N. End	24YE355	FS4	Middle Archaic-Side Notched-PP	Obsidian Cliff	Boundary Lands, N. Yellowstone
N. End	24YE26	109525	Salmon River?-PP	Obsidian Cliff	Misc. Geochemical Report #2008-103
N. End	24YE2	109481	Pelican Lake-PP	Obsidian Cliff	Misc. Geochemical Report #2008-103
N. End	24YE134	131550	Salmon River?-PP	Obsidian Cliff	Misc. Geochemical Report #2008-103
N. End	24YE322	181364	Pelican Lake-PP	Obsidian Cliff	Misc. Geochemical Report #2008-103
N. End	24YE353	65902	Pelican Lake-PP	Packsaddle Creek	Malin Creek Excavation
S. End	48YE1576	130799	Pelican Lake-PP	Bear Gulch	Yellowstone Lake Shoreline Survey
S. End	48YE409	146425	Pelican Lake-PP	Bear Gulch	Osprey Beach Excavation
S. End	48YE409	146429	Duncan-PP	Bear Gulch	Osprey Beach Excavation
S. End	48YE252	183575	Duncan-PP	Bear Gulch	Donner Site Excavation
S. End	48YE736	130768	Hanna-PP	Conant Creek	Yellowstone Lake Shoreline Survey
S. End	48YE1500	67262	Mallory-PP	Cougar Creek	Misc. Geochemical Report #2008-76
S. End	48YE1388	63707	Late Archaic-Corner Notched-PP	Crescent H	Yellowstone Lake Shoreline Survey
S. End	48YE252	67214	Middle Archaic-PP	Crescent H	Misc. Geochemical Report #2008-103
S. End	48YE231	63722	Duncan-PP	Huckleberry Ridge	Yellowstone Lake Shoreline Survey
S. End	48YE1388	63712	McKean-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE439	63714	Duncan-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE1388	130761	Duncan-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE1631	165280	Duncan-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE1703	165375	Duncan-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE736	130767	Hanna-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE1394	63717	Hanna-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE1637	130841	Hanna-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE1703	165384	Hanna-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	05YP383	130885	Pelican Lake-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE1381	63685	Pelican Lake-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE1384	63696	Pelican Lake-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE1388	63702	Pelican Lake-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE1623	165270	Pelican Lake-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE1631	165281	Pelican Lake-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE409	146432	Pelican Lake-PP	Obsidian Cliff	Osprey Beach Excavation
S. End	48YE409	63664	Duncan-PP	Obsidian Cliff	Osprey Beach Excavation
S. End	48YE409	146419	Middle Archaic-PP	Obsidian Cliff	Osprey Beach Excavation
S. End	48YE409	146727	Hanna-PP	Obsidian Cliff	Osprey Beach Excavation
S. End	48YE252	183583	Duncan-PP	Obsidian Cliff	Donner Site Excavation
S. End	48YE252	183574	Hanna-PP	Obsidian Cliff	Donner Site Excavation
S. End	48YE252	183568	Middle Archaic-PP	Obsidian Cliff	Donner Site Excavation
S. End	48YE252	67226	McKean-PP	Obsidian Cliff	Misc. Geochemical Report #2008-103
S. End	48YE252	67231	Pelican Lake-PP	Obsidian Cliff	Misc. Geochemical Report #2008-103
S. End	48YE409	165319	Pelican Lake-PP	Obsidian Cliff	Misc. Geochemical Report #2008-103
S. End	48YE390	170975	Hanna-PP	Obsidian Cliff	Misc. Geochemical Report #2008-103
S. End	48YE409	121743	Duncan/Hanna-PP	Obsidian Cliff	Misc. Geochemical Report #2008-76
S. End	48YE252	165308	Duncan-PP	Teton Pass	Yellowstone Lake Shoreline Survey
S. End	48YE1327	63669	Pelican Lake-PP	Teton Pass	Yellowstone Lake Shoreline Survey
S. End	48YE1703	165385	Pelican Lake-PP	Teton Pass	Yellowstone Lake Shoreline Survey
S. End	48YE409	63656	Pelican Lake-PP	Teton Pass	Osprey Beach Excavation
S. End	48YE252	183576	Duncan/Hanna-PP	Teton Pass	Donner Site Excavation
S. End	48YE252	183569	McKean-PP	Teton Pass	Donner Site Excavation
S. End	48YE252	183567	Pelican Lake-PP	Teton Pass	Donner Site Excavation
S. End	48YE1496	67254	Pelican Lake-PP	Teton Pass	Misc. Geochemical Report #2008-76
S. End	48YE1645	130852	Pelican Lake-PP	Unknown Source	Yellowstone Lake Shoreline Survey

Table 3: Results Sorted by Culture/Complex

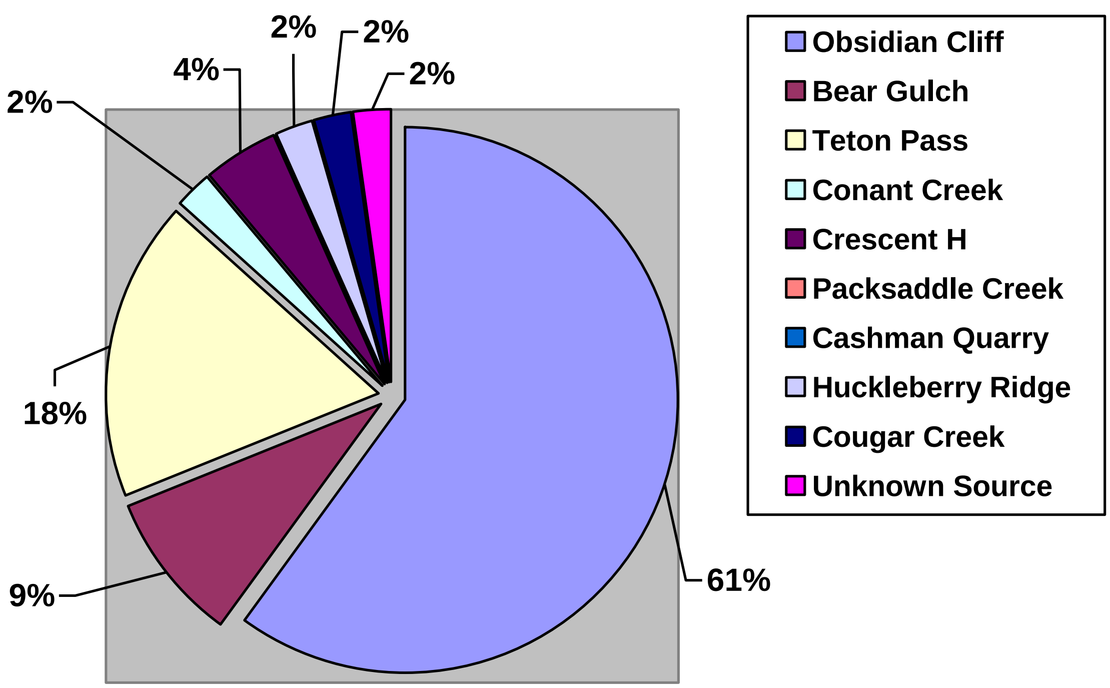
Study Area	Site #	Cat. #	Culture/Complex, Tool Type	Source	Project
N. End	48YE762	109542	Duncan/Hanna-PP	Obsidian Cliff	Black Canyon Inventory
S. End	48YE409	121743	Duncan/Hanna-PP	Obsidian Cliff	Misc. Geochemical Report #2008-76
S. End	48YE252	183576	Duncan/Hanna-PP	Teton Pass	Donner Site Excavation
S. End	48YE409	146429	Duncan-PP	Bear Gulch	Osprey Beach Excavation
S. End	48YE252	183575	Duncan-PP	Bear Gulch	Donner Site Excavation
S. End	48YE231	63722	Duncan-PP	Huckleberry Ridge	Yellowstone Lake Shoreline Survey
N. End	48YE762	109543	Duncan-PP	Obsidian Cliff	Black Canyon Inventory
N. End	48YE877	109565	Duncan-PP	Obsidian Cliff	Black Canyon Inventory
N. End	48YE1532	68616	Duncan-PP	Obsidian Cliff	E. Edge of the Gallatin Range Inventory
N. End	04YP113	68622	Duncan-PP	Obsidian Cliff	E. Edge of the Gallatin Range Inventory
N. End	24YE350	134194	Duncan-PP	Obsidian Cliff	FHWA Mammoth-Gardiner Inventory
S. End	48YE439	63714	Duncan-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE1388	130761	Duncan-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE1631	165280	Duncan-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE1703	165375	Duncan-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE409	63664	Duncan-PP	Obsidian Cliff	Osprey Beach Excavation
S. End	48YE252	183583	Duncan-PP	Obsidian Cliff	Donner Site Excavation
S. End	48YE252	165308	Duncan-PP	Teton Pass	Yellowstone Lake Shoreline Survey
N. End	24YE353	65868	Duncan-PP-Base	Obsidian Cliff	Malin Creek Excavation
N. End	24YE9	109494	Elko Eared-PP-Base	Obsidian Cliff	Black Canyon Inventory
S. End	48YE736	130768	Hanna-PP	Conant Creek	Yellowstone Lake Shoreline Survey
S. End	48YE736	130767	Hanna-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE1394	63717	Hanna-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE1637	130841	Hanna-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE1703	165384	Hanna-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE409	146727	Hanna-PP	Obsidian Cliff	Osprey Beach Excavation
S. End	48YE252	183574	Hanna-PP	Obsidian Cliff	Donner Site Excavation
S. End	48YE390	170975	Hanna-PP	Obsidian Cliff	Misc. Geochemical Report #2008-103
S. End	48YE1500	67262	Mallory-PP	Cougar Creek	Misc. Geochemical Report #2008-76
N. End	24YE353	68854	Mallory-PP	Obsidian Cliff	Malin Creek Excavation
N. End	24YE356	FS19	McKean-PP	Cashman	Boundary Lands, N. Yellowstone
S. End	48YE1388	63712	McKean-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE252	67226	McKean-PP	Obsidian Cliff	Misc. Geochemical Report #2008-103
S. End	48YE252	183569	McKean-PP	Teton Pass	Donner Site Excavation
N. End	24YE353	65937	McKean-PP-"Nubbin"	Obsidian Cliff	Malin Creek Excavation
N. End	24YE353	68818	McKean-PP-Base	Cashman	Malin Creek Excavation
N. End	24YE26	109525	Salmon River?-PP	Obsidian Cliff	Misc. Geochemical Report #2008-103
N. End	24YE134	131550	Salmon River?-PP	Obsidian Cliff	Misc. Geochemical Report #2008-103
S. End	48YE252	67214	Middle Archaic-PP	Crescent H	Misc. Geochemical Report #2008-103
N. End	48YE1024	146507	Middle Archaic-PP	Obsidian Cliff	Yellowstone River Survey
N. End	24YE26	109525	Middle Archaic-PP	Obsidian Cliff	Black Canyon Inventory
N. End	24YE29	109537	Middle Archaic-PP	Obsidian Cliff	Black Canyon Inventory
N. End	24YE14	117777	Middle Archaic-PP	Obsidian Cliff	Test Excavation of 24YE14
S. End	48YE409	146419	Middle Archaic-PP	Obsidian Cliff	Osprey Beach Excavation
S. End	48YE252	183568	Middle Archaic-PP	Obsidian Cliff	Donner Site Excavation
N. End	48YE83	134223	Middle Archaic-Side Notched-PP	Obsidian Cliff	FHWA Mammoth-Gardiner Inventory
N. End	24YE355	FS4	Middle Archaic-Side Notched-PP	Obsidian Cliff	Boundary Lands, N. Yellowstone
N. End	24YE138	62312	Pelican Lake-PP	Bear Gulch	Yellowstone River Survey
N. End	48YE1533	68613	Pelican Lake-PP	Bear Gulch	E. Edge of the Gallatin Range Inventory
S. End	48YE1576	130799	Pelican Lake-PP	Bear Gulch	Yellowstone Lake Shoreline Survey
S. End	48YE409	146425	Pelican Lake-PP	Bear Gulch	Osprey Beach Excavation
N. End	24YE353	65905	Pelican Lake-PP	Obsidian Cliff	Malin Creek Excavation
N. End	48YE985	143093	Pelican Lake-PP	Obsidian Cliff	Yellowstone River Survey
N. End	24YE134	62305	Pelican Lake-PP	Obsidian Cliff	Yellowstone River Survey
N. End	24YE2	109481	Pelican Lake-PP	Obsidian Cliff	Black Canyon Inventory
N. End	24YE7	109486	Pelican Lake-PP	Obsidian Cliff	Black Canyon Inventory
N. End	48YE50	68600	Pelican Lake-PP	Obsidian Cliff	E. Edge of the Gallatin Range Inventory
N. End	48YE50	68602	Pelican Lake-PP	Obsidian Cliff	E. Edge of the Gallatin Range Inventory
N. End	48YE1525	68605	Pelican Lake-PP	Obsidian Cliff	E. Edge of the Gallatin Range Inventory
N. End	48YE1529	68611	Pelican Lake-PP	Obsidian Cliff	E. Edge of the Gallatin Range Inventory
N. End	48YE1537	68625	Pelican Lake-PP	Obsidian Cliff	E. Edge of the Gallatin Range Inventory
N. End	48YE1540	68627	Pelican Lake-PP	Obsidian Cliff	E. Edge of the Gallatin Range Inventory
N. End	24YE2	109481	Pelican Lake-PP	Obsidian Cliff	Misc. Geochemical Report #2008-103
N. End	24YE322	181364	Pelican Lake-PP	Obsidian Cliff	Misc. Geochemical Report #2008-103
S. End	05YP383	130885	Pelican Lake-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE1381	63685	Pelican Lake-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE1384	63696	Pelican Lake-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE1388	63702	Pelican Lake-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE1623	165270	Pelican Lake-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE1631	165281	Pelican Lake-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE409	146432	Pelican Lake-PP	Obsidian Cliff	Osprey Beach Excavation
S. End	48YE252	67231	Pelican Lake-PP	Obsidian Cliff	Misc. Geochemical Report #2008-103
S. End	48YE409	165319	Pelican Lake-PP	Obsidian Cliff	Misc. Geochemical Report #2008-103
N. End	24YE353	65902	Pelican Lake-PP	Packsaddle Creek	Malin Creek Excavation
S. End	48YE1327	63669	Pelican Lake-PP	Teton Pass	Yellowstone Lake Shoreline Survey
S. End	48YE1703	165385	Pelican Lake-PP	Teton Pass	Yellowstone Lake Shoreline Survey
S. End	48YE409	63656	Pelican Lake-PP	Teton Pass	Osprey Beach Excavation
S. End	48YE252	183567	Pelican Lake-PP	Teton Pass	Donner Site Excavation
S. End	48YE1496	67254	Pelican Lake-PP	Teton Pass	Misc. Geochemical Report #2008-76
S. End	48YE1645	130852	Pelican Lake-PP	Unknown Source	Yellowstone Lake Shoreline Survey
N. End	48YE137	116382	Pelican Lake-PP-Base	Obsidian Cliff	Nine Prehistoric Sites in N. Yellowstone
S. End	48YE1388	63707	Late Archaic-Corner Notched-PP	Crescent H	Yellowstone Lake Shoreline Survey
N. End	24YE352	62348	Late Archaic-Corner Notched-PP	Obsidian Cliff	Yellowstone River Survey
N. End	24YE137	62307	Late Archaic-Corner Notched-PP	Obsidian Cliff	Yellowstone River Survey
N. End	24YE14	117841	Late Archaic-PP	Obsidian Cliff	Test Excavation of 24YE14

Table 4: Results Sorted by Obsidian Source

Study Area	Site #	Cat. #	Culture/Complex, Tool Type	Source	Project
N. End	24YE138	62312	Pelican Lake-PP	Bear Gulch	Yellowstone River Survey
N. End	48YE1533	68613	Pelican Lake-PP	Bear Gulch	E. Edge of the Gallatin Range Inventory
S. End	48YE1576	130799	Pelican Lake-PP	Bear Gulch	Yellowstone Lake Shoreline Survey
S. End	48YE409	146425	Pelican Lake-PP	Bear Gulch	Osprey Beach Excavation
S. End	48YE409	146429	Duncan-PP	Bear Gulch	Osprey Beach Excavation
S. End	48YE252	183575	Duncan-PP	Bear Gulch	Donner Site Excavation
N. End	24YE353	68818	McKean-PP-Base	Cashman	Malin Creek Excavation
N. End	24YE356	FS19	McKean-PP	Cashman	Boundary Lands, N. Yellowstone
S. End	48YE736	130768	Hanna-PP	Conant Creek	Yellowstone Lake Shoreline Survey
S. End	48YE1500	67262	Mallory-PP	Cougar Creek	Misc. Geochemical Report #2008-76
S. End	48YE1388	63707	Late Archaic-Corner Notched-PP	Crescent H	Yellowstone Lake Shoreline Survey
S. End	48YE252	67214	Middle Archaic-PP	Crescent H	Misc. Geochemical Report #2008-103
S. End	48YE231	63722	Duncan-PP	Huckleberry Ridge	Yellowstone Lake Shoreline Survey
N. End	24YE353	65868	Duncan-PP-Base	Obsidian Cliff	Malin Creek Excavation
N. End	24YE353	68854	Mallory-PP	Obsidian Cliff	Malin Creek Excavation
N. End	24YE353	65937	McKean-PP-"Nubbin"	Obsidian Cliff	Malin Creek Excavation
N. End	24YE353	65905	Pelican Lake-PP	Obsidian Cliff	Malin Creek Excavation
N. End	24YE352	62348	Late Archaic-Corner Notched-PP	Obsidian Cliff	Yellowstone River Survey
N. End	48YE1024	146507	Middle Archaic-PP	Obsidian Cliff	Yellowstone River Survey
N. End	48YE985	143093	Pelican Lake-PP	Obsidian Cliff	Yellowstone River Survey
N. End	24YE134	62305	Pelican Lake-PP	Obsidian Cliff	Yellowstone River Survey
N. End	24YE137	62307	Late Archaic-Corner Notched-PP	Obsidian Cliff	Yellowstone River Survey
N. End	24YE9	109494	Elko Eared-PP-Base	Obsidian Cliff	Black Canyon Inventory
N. End	48YE762	109542	Duncan/Hanna-PP	Obsidian Cliff	Black Canyon Inventory
N. End	48YE762	109543	Duncan-PP	Obsidian Cliff	Black Canyon Inventory
N. End	48YE877	109565	Duncan-PP	Obsidian Cliff	Black Canyon Inventory
N. End	24YE2	109481	Pelican Lake-PP	Obsidian Cliff	Black Canyon Inventory
N. End	24YE7	109486	Pelican Lake-PP	Obsidian Cliff	Black Canyon Inventory
N. End	24YE26	109525	Middle Archaic-PP	Obsidian Cliff	Black Canyon Inventory
N. End	24YE29	109537	Middle Archaic-PP	Obsidian Cliff	Black Canyon Inventory
N. End	48YE50	68600	Pelican Lake-PP	Obsidian Cliff	E. Edge of the Gallatin Range Inventory
N. End	48YE50	68602	Pelican Lake-PP	Obsidian Cliff	E. Edge of the Gallatin Range Inventory
N. End	48YE1525	68605	Pelican Lake-PP	Obsidian Cliff	E. Edge of the Gallatin Range Inventory
N. End	48YE1529	68611	Pelican Lake-PP	Obsidian Cliff	E. Edge of the Gallatin Range Inventory
N. End	48YE1532	68616	Duncan-PP	Obsidian Cliff	E. Edge of the Gallatin Range Inventory
N. End	48YE1537	68625	Pelican Lake-PP	Obsidian Cliff	E. Edge of the Gallatin Range Inventory
N. End	48YE1540	68627	Pelican Lake-PP	Obsidian Cliff	E. Edge of the Gallatin Range Inventory
N. End	04YP113	68622	Duncan-PP	Obsidian Cliff	E. Edge of the Gallatin Range Inventory
N. End	24YE350	134194	Duncan-PP	Obsidian Cliff	FHWA Mammoth-Gardiner Inventory
N. End	48YE83	134223	Middle Archaic-Side Notched-PP	Obsidian Cliff	FHWA Mammoth-Gardiner Inventory
N. End	24YE14	117777	Middle Archaic-PP	Obsidian Cliff	Test Excavation of 24YE14
N. End	24YE14	117841	Late Archaic-PP	Obsidian Cliff	Test Excavation of 24YE14
N. End	48YE137	116382	Pelican Lake-PP-Base	Obsidian Cliff	Nine Prehistoric Sites in N. Yellowstone
N. End	24YE355	FS4	Middle Archaic-Side Notched-PP	Obsidian Cliff	Boundary Lands, N. Yellowstone
N. End	24YE26	109525	Salmon River?-PP	Obsidian Cliff	Misc. Geochemical Report #2008-103
N. End	24YE2	109481	Pelican Lake-PP	Obsidian Cliff	Misc. Geochemical Report #2008-103
N. End	24YE134	131550	Salmon River?-PP	Obsidian Cliff	Misc. Geochemical Report #2008-103
N. End	24YE322	181364	Pelican Lake-PP	Obsidian Cliff	Misc. Geochemical Report #2008-103
S. End	48YE1388	63712	McKean-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE439	63714	Duncan-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE1388	130761	Duncan-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE1631	165280	Duncan-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE1703	165375	Duncan-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE736	130767	Hanna-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE1394	63717	Hanna-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE1637	130841	Hanna-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE1703	165384	Hanna-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	05YP383	130885	Pelican Lake-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE1381	63685	Pelican Lake-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE1384	63696	Pelican Lake-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE1388	63702	Pelican Lake-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE1623	165270	Pelican Lake-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE1631	165281	Pelican Lake-PP	Obsidian Cliff	Yellowstone Lake Shoreline Survey
S. End	48YE409	146432	Pelican Lake-PP	Obsidian Cliff	Osprey Beach Excavation
S. End	48YE409	63664	Duncan-PP	Obsidian Cliff	Osprey Beach Excavation
S. End	48YE409	146419	Middle Archaic-PP	Obsidian Cliff	Osprey Beach Excavation
S. End	48YE409	146727	Hanna-PP	Obsidian Cliff	Osprey Beach Excavation
S. End	48YE252	183583	Duncan-PP	Obsidian Cliff	Donner Site Excavation
S. End	48YE252	183574	Hanna-PP	Obsidian Cliff	Donner Site Excavation
S. End	48YE252	183568	Middle Archaic-PP	Obsidian Cliff	Donner Site Excavation
S. End	48YE252	67226	McKean-PP	Obsidian Cliff	Misc. Geochemical Report #2008-103
S. End	48YE252	67231	Pelican Lake-PP	Obsidian Cliff	Misc. Geochemical Report #2008-103
S. End	48YE409	165319	Pelican Lake-PP	Obsidian Cliff	Misc. Geochemical Report #2008-103
S. End	48YE390	170975	Hanna-PP	Obsidian Cliff	Misc. Geochemical Report #2008-103
S. End	48YE409	121743	Duncan/Hanna-PP	Obsidian Cliff	Misc. Geochemical Report #2008-76
N. End	24YE353	65902	Pelican Lake-PP	Packsaddle Creek	Malin Creek Excavation
S. End	48YE252	165308	Duncan-PP	Teton Pass	Yellowstone Lake Shoreline Survey
S. End	48YE1327	63669	Pelican Lake-PP	Teton Pass	Yellowstone Lake Shoreline Survey
S. End	48YE1703	165385	Pelican Lake-PP	Teton Pass	Yellowstone Lake Shoreline Survey
S. End	48YE409	63656	Pelican Lake-PP	Teton Pass	Osprey Beach Excavation
S. End	48YE252	183576	Duncan/Hanna-PP	Teton Pass	Donner Site Excavation
S. End	48YE252	183569	McKean-PP	Teton Pass	Donner Site Excavation
S. End	48YE252	183567	Pelican Lake-PP	Teton Pass	Donner Site Excavation
S. End	48YE1496	67254	Pelican Lake-PP	Teton Pass	Misc. Geochemical Report #2008-76
S. End	48YE1645	130852	Pelican Lake-PP	Unknown Source	Yellowstone Lake Shoreline Survey

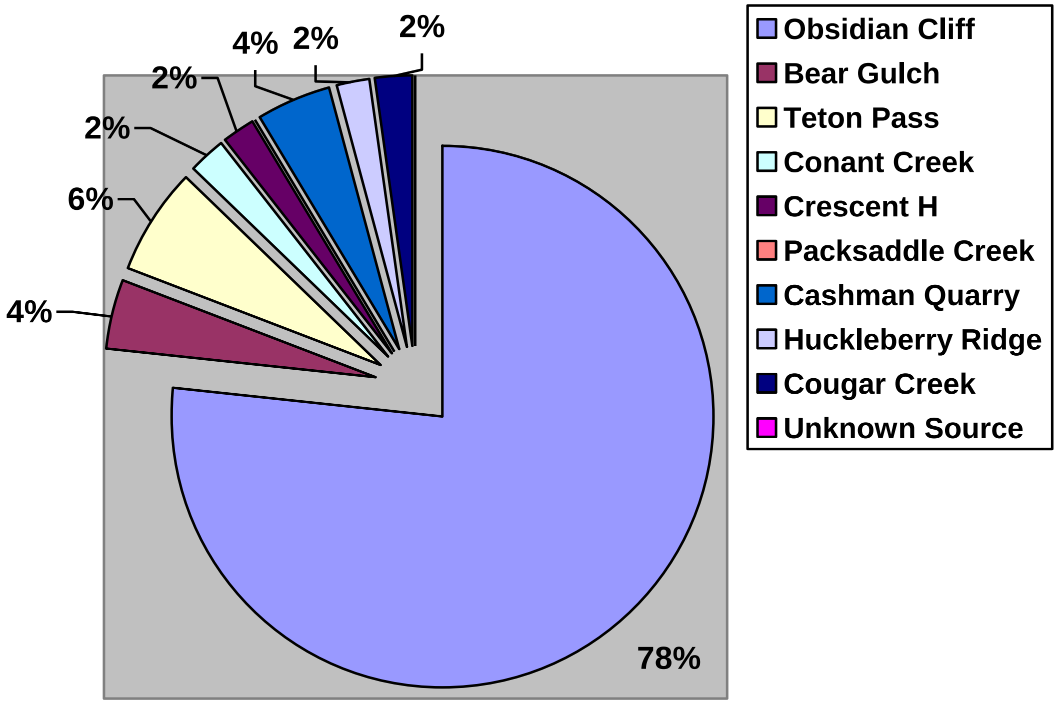


North Study Area

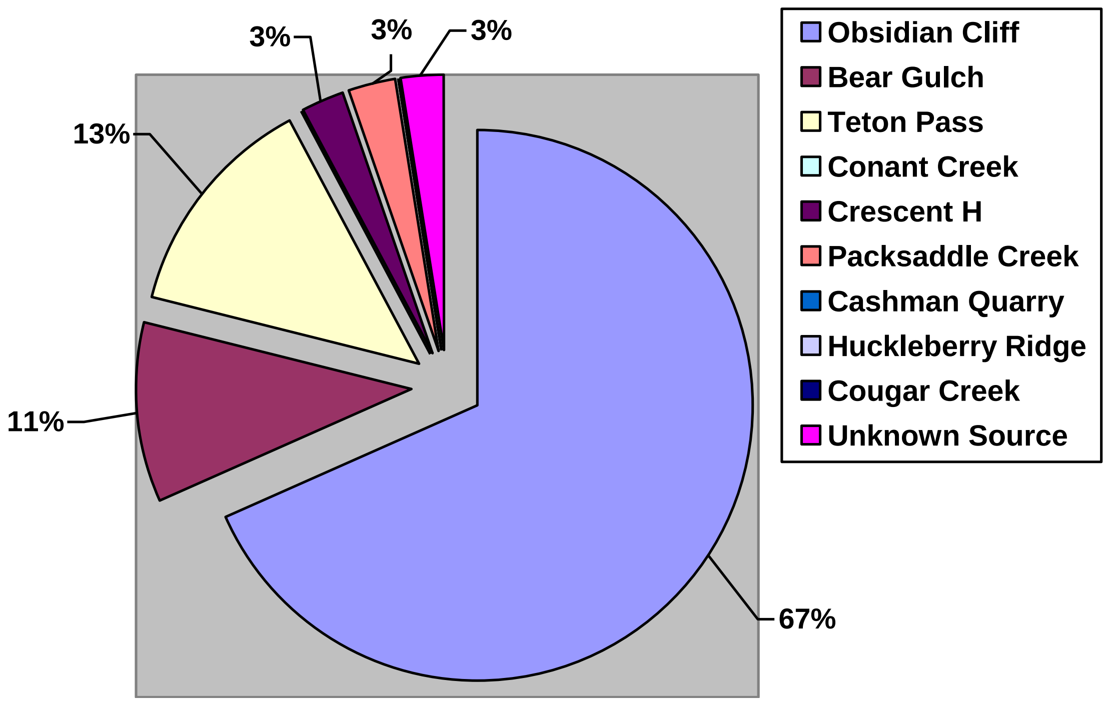


South Study Area

Figure 8: Percentage of Obsidian from each Source, by Study Area



McKean/Duncan/Hanna/Middle Archaic Cultures (~5500-3000 BP)



Pelican Lake/Late Archaic Cultures (3000-1600 BP)

Figure 9: Percentage of Obsidian from each Source, by Culture/Complex

Jackson Hole area (exploiting Teton Pass, Crescent H, Conant Creek and other nearby obsidians) and northwest into the foothills of Idaho during the winter. In early spring, groups would move further north and east back into the Park (passing the Bear Gulch source), stopping to collect obsidian at Obsidian Cliff before heading back down to the Lake in the summer (see Johnson et al. 2004 for a discussion). This model is based on an assumption of direct procurement of lithic materials as an activity undertaken during regular migration.

The analysis performed for this thesis has also rested on the assumption of direct procurement of obsidian by those who used it for tools. This assumption of direct procurement is based on the idea that all sources represented are within the parameters of a feasible annual travel distance for a mobile hunter-gatherer group. This assumption is typically the easiest for preliminary stage research on lithic procurement patterns. Taking trade or exchange out of the equation simplifies the line of inquiry by limiting variables.

However, subsequent examination of the existing model of annual round proposed by Johnson et al. (2004) resulted in rejection of this model for two reasons. First, the total distance that such a route would entail is extremely great, even though it is acknowledged that hunter-gatherers sometimes travel great distances for resources. The total "home range" area would be approximately 28,500 square kilometers, with a distance of close to 600 kilometers traveled in a single round based on the location of obsidian sources (see Figure 4). Second and perhaps most importantly, it is *unnecessary* for people to travel such great distances in the GYE. A plausible scenario for "unnecessary" travel presented in this thesis is cultural preference. However, the results of this thesis have not indicated that this influence played a significant role in the samples examined (with the exception of Obsidian Cliff). Rejection of the large annual round will be discussed further in Chapter 8.

7.2 Proposed "Local" Rounds

Instead of the large annual round proposed for the Cody complex (Figure 4), more localized "southern oriented" and "northern oriented" rounds should be considered (see Figure 3, 10 and 11). An alternative model to the large annual round was proposed in the same report on the Osprey Beach site:

> Alternatively, of course, we could have Cody Complex groups moving seasonally up from the south to the Yellowstone Plateau in the summer and returning to sites such as

> Lawrence in the fall. Then, they would move on to winter camps in the foothills to the west of the Tetons [Johnson et al. 2004:145].

This alternative model was rejected with the statement that if this were the case, we should see more "formed tools and flakes from southern obsidian sources at Osprey Beach" (Johnson et al. 2004:145). The materials from the southern and western sources represent what was collected during the fall and winter, and the dominance of Obsidian Cliff and Bear Gulch obsidians indicate that these were the last visited sources on a group's travels back south to the Lake (Johnson et al. 2004:144). However, the alternative model that was dismissed so readily seems to have gained credence based on the results presented in this thesis.

These results demonstrate that there is a definite trend towards exploitation of more local obsidian resources. This can be taken further to suggest that by following naturally created and historically documented travel corridors, all the sources represented in each study area could be accessed within a more localized travel sphere. When examined by study area, sites on the Lake represent more variety in source selection; yet the variety is among the "southern-oriented" sources, which are almost completely absent from the specimens analyzed in the North Study Area.

Historically documented travel corridors facilitating this interpretation include the Thorofare, which is a modern-day hiking route and historically used route which exits the park following the Yellowstone River to its headwaters south of Yellowstone Lake (see Figure 10). The Thorofare route remains one of the easiest ways to access the Lake from the Jackson Hole/Snake River valley area. It was described by William Jones during his expedition in 1873 to explore Northwestern Wyoming, as part of an "Indian Trail" which follows the Snake River from Jackson Hole where one fork bends "sharp around to the northeast, follows up Pacific and down Atlantic Creeks to the Yellowstone River, down which it follows…to the east of Yellowstone Lake" (Jones 1875:54). Clearly this route was known and used by the Shoshone (his guide on this trip was a "Sheep Eater", possibly Togwotee, a famous medicine man and guide) (Nabokov and Loendorf 1999:289), and Jones and his party followed this same route on their expedition. As he wrote in his report:

> One important object of the expedition was to discover, if possible, a practicable approach to Yellowstone Lake from the south or southeast…which would not only furnish the shortest route to the Yellowstone National Park, now practically inaccessible, but would open a new route to Montana by a wagon-road [Jones 1875:55].

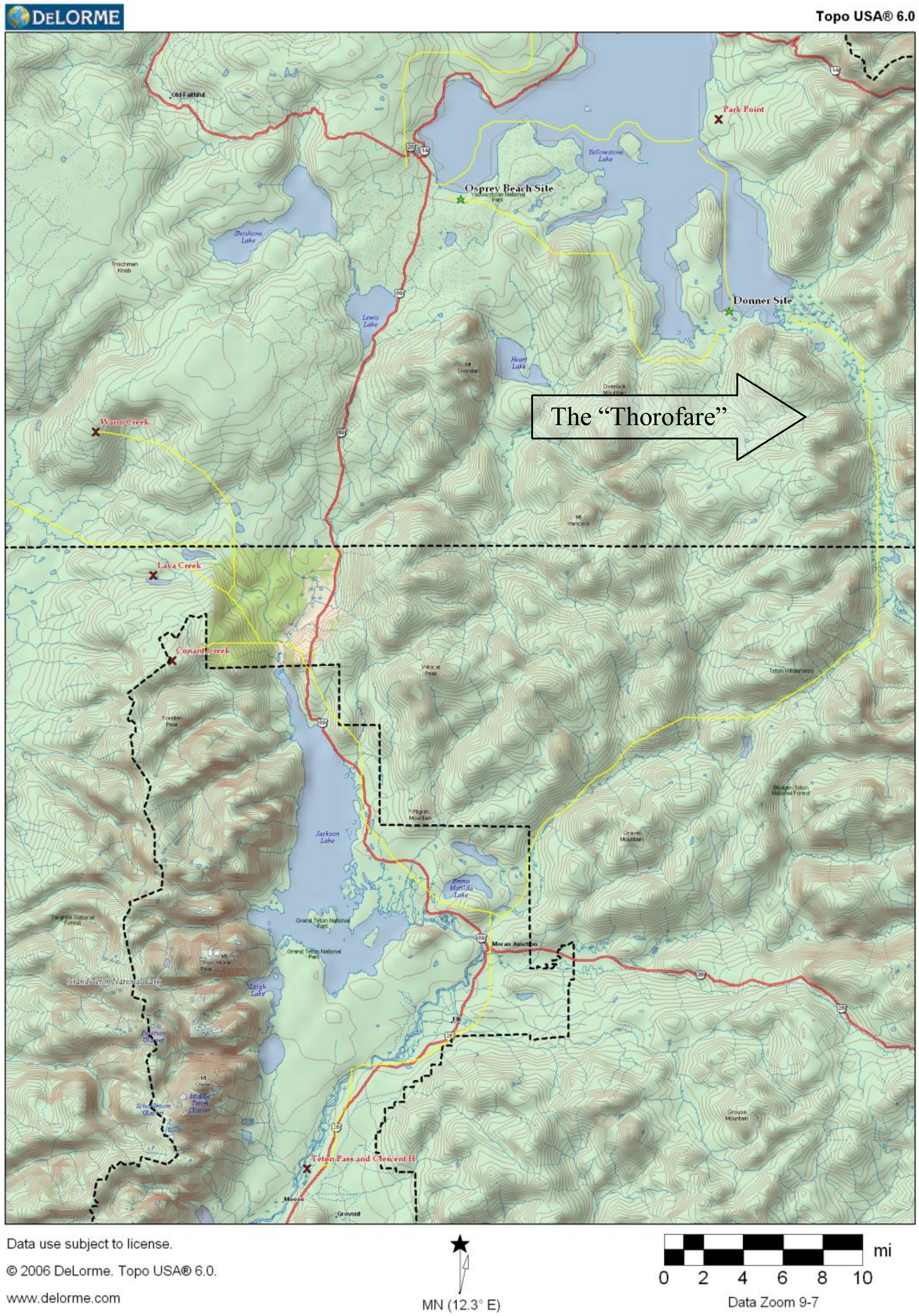


Figure 10: South Study Area: Yellowstone Lake and the Thorofare Travel Corridor

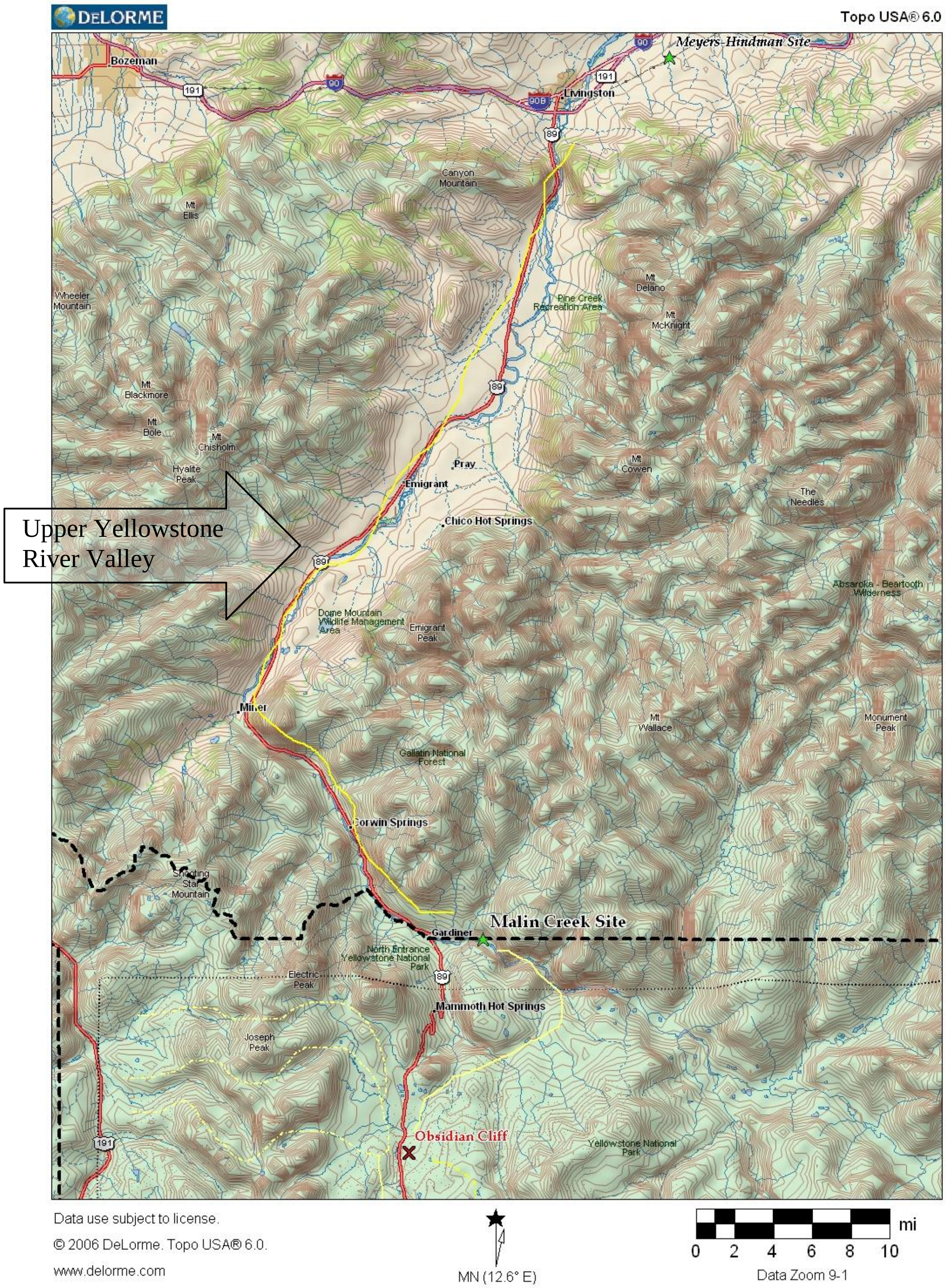


Figure 11: North Study Area: The Yellowstone River Valley

After traveling the route with his expedition, Jones declared that this objective was met with much success, as the passage was deemed suitable for potential wagon roads or even a railroad line (Jones 1875:55-56). Movement along major waterways was practical for navigation and for providing relatively easy-going routes. The Thorofare was very likely used through pre-contact times as well, and archaeological evidence along this route is limited only due to the lack of inventory and survey work performed in this most remote corner of the Park. This travel corridor would provide a practical route between Yellowstone Lake and the Jackson Hole area (and camps such as the Lawrence site in Grand Teton National Park) and access to the obsidian sources nearby (see Figure 10).

In the North Study Area the only artifact that was from a "southern source" is a point from the Malin Creek site sourced to Packsaddle Creek (approximately 160 km away as the crow flies). Besides this single sample, the remainder of artifacts in the North Study Area were sourced to "northern-oriented" sources. In the North Study Area one route giving access to sources to the west (such as Bear Gulch) is over Fawn Pass in the Gallatin Mountain range. The pass area shows archaeological evidence for the presence of people in this alpine environment during the Archaic (and earlier) (Vivian and Mitchell 2005). Preliminary analysis of the Fawn Pass area indicates that this may have been a well used pre-contact period travel corridor, providing access between the North Study Area (and occupants of the Malin Creek site, for example) and obsidian sources to the west (see Figure 11).

It may be that there is less of a "round" and more of a regular movement of groups through the landscape back and forth within a known landscape. Hunted animals such as elk, deer, antelope and smaller mammals would have been available much more locally in both study areas. There seems to be little practical reason for groups to make such an arduous and lengthy round every year when food, shelter at lower elevations, and good tool stone were available within a much smaller area. The significant percentage of Obsidian Cliff obsidian in the South Study Area could be explained as the result of focused, task specific trips made by a group to obtain this material. These trips would have been made due to the quality and potentially the cultural significance associated with the source.

The occurrence of trade must now be acknowledged as a possibility when considering the proposal of separate northern and southern oriented annual movement. There is evidence during specific time periods for extensive trade (and perhaps the maintenance of elaborate trade networks) of obsidian from Yellowstone's Obsidian Cliff to places as far away as the Ohio River valley. The appearance of Obsidian Cliff obsidian in Hopewellian burial mounds and other archaeological contexts begins approximately 2950 BP, and lasts until ca. 1550 BP (during the Pelican Lake phase in Yellowstone) (Davis et al. 1995:45).

When examined by time period, the results show a fairly even exploitation of the Obsidian Cliff source during both the Middle and Late Archaic (see Figure 9). Mirroring the analysis by study area, the Obsidian Cliff source is well represented, which is a testament to its high quality. It is known that during the Pelican Lake phase Obsidian Cliff obsidian was extensively traded to the east, and this would fit the new localized model if there was a significant presence of this material during this phase. Specifically, it would be most indicative if this presence was detected during this time period in the South Study Area, as this could support the hypothesis of local trade between people in the North Study Area and those to the south.

However, this research has not provided any strong arguments for this case. Of all the Pelican Lake projectile points in this study, approximately 35% of those made from Obsidian Cliff obsidian were from sites in the South Study Area. In contrast, of all the McKean complex and associated projectile points, approximately 50% of those made from Obsidian Cliff obsidian were from the South Study Area. Thus, there is in fact a stronger presence of Obsidian Cliff obsidian in the South Study Area during the Middle Archaic, and not during the Late Archaic when trade (at least from the Park to other areas) becomes more extensive. This slightly stronger presence is not statistically significant, and thus no conclusions may be drawn from this result. A larger and more representative sample will be necessary for discussion of this interpretation in more depth, and is beyond the scope of this thesis.

Chapter 8

Discussion

8.1 A Matter of Convenience? Obsidian Sources and the "Law of Monotonic Decrement"

The analytical techniques typically applied to the study of lithic sources involve spatial modeling. The questions asked by researchers are aimed at understanding if a material was obtained directly or through trade based on the distance from the site to the source. This information is then calculated in terms of cost-efficiency; if a source is within a certain distance, direct procurement is assumed. Examination of two examples of these types of studies related to obsidian sourcing illustrates how expectations associated with this type of approach are not always met. Indeed, the outcomes beg that new questions be asked and different approaches taken.

The comparative database of obsidian sources examined by Mitchell and Shackley (1995:295) is the result of a long-term sampling project in Arizona, New Mexico, and Northern Mexico. The petrology and geology of these sources is well known and thoroughly researched. In addition, these sources are considered to be "equal media for tool production" (Mitchell and Shackley 1995:295).

The quality of the tool stone is crucial when applying a landscape approach. Consideration must be given to flaws in the material (and size of available cobbles if the primary geological source location is not being exploited). As previously discussed, obsidian (when compared to other materials) is by nature a "good" tool stone. However, if the quality between obsidian sources is different, this must be taken into account when attempting to understand cultural preference. Mitchell and Shackley's (1995) study therefore provides an excellent opportunity to read preference based on qualities other than value as a tool stone.

The authors come to the conclusion that the pattern of procurement is based on proximity of site to source. For most of the sites there is a clear dominance of one or two sources in the assemblage. These sources are almost always the closest geographically to the site location (Mitchell and Shackley 1995). The authors introduce Renfrew's "law of monotonic decrement" (in Mitchell and Shackley 1995:297), whereby there is a "theoretically predictable rate of decrease with distance from a source" (Mitchell and Shackley 1995:297). This simple model is based on the pattern of a greater abundance of material from the sources that are closest to the site with a "rapid fall-off rate" (Mitchell and Shackley 1995:297), a pattern expected by the authors.

There are, however, two exceptions to the expected pattern, "that do not conform to a simple distance-decay model" (Mitchell and Shackley 1995:297). Although they dismissed one of these examples as sampling bias, the authors allowed that one of these sources (Government Mountain) might have been "important for social or cultural reasons, and acquisition was probably tied directly into the exchange systems operative between the Hohokam and the Sinagua and Anasazi" (Mitchell and Shackley 1995:299). The authors, however, appeared satisfied with the general patterning results that conformed to the expected model and did not pursue this idea further.

Barge and Chataigner's (2003:173) study of obsidian sources in Armenia also mention the "law of monotonic decrement", as well as the modifications proposed to address those instances where situations do not fit the rule. However, they find that such modifications, which include central place theory, "concern the means of distribution, but not those of acquisition" (Barge and Chataigner 2003:173). In effect, procurement of material "from the nearest source appears to be a fact" (Barge and Chataigner 2003:173). They proceed with analyzing time-distance models as well as consideration of factors such as source quality. They conclude that the closest or most accessible source is not always the preferred source (Barge and Chataigner 2003:173) with results showing that "only 40% of the sites [analyzed] are mainly supplied by the nearest source; 42% exploit the nearest source less than other ones, and 18% do not exploit it at all" (Barge and Chataigner 2003:176).

In addition to these examples from areas other than the Rocky Mountains, it is interesting to note that the results from a site closer to our study area found similar results. At the Lookingbill site in the Absaroka Mountains to the southeast of Yellowstone, "the largest number of obsidian pieces come from the Bear Gulch (or Targhee) source, which is the furthest away in linear distance", despite the expectation of "an inverse relationship between the quantity of obsidian at the site and distance from the source" (Kornfeld et al. 2001:316). In addition to obsidian from Bear Gulch, obsidian from Obsidian Cliff and Teton Pass were represented- all sources “between 115 and 215 km distant” (Kornfeld et al. 2001:316). These non-local materials make up less than one percent of the raw materials represented at the Lookingbill site and the authors infer that choice of these exotics “indicate areas known to the inhabitants” (Kornfeld et al. 2001:316). It may also be noted that time-decay models seem not to apply to the obsidian artifacts found at the Lookingbill site.

8.2 Concepts of “Efficiency”

These examples illustrate why the types of questions we ask, and the types of patterns we look for, might have to be reconsidered. The previous examples were studies based on the hypothetico-deductive model of processualist archaeology (see M. Johnson 1999:39). The expectation was to see clear associations between the distance/convenience of obsidian sources and the frequency in the archaeological record of a given site. They also illustrate how applying modern, Western/Euro-American concepts of logic to the past can be problematic (see Bradley 2000:91).

Bradley (2000:86) describes the tendency to focus on questions related to efficiency when examining lithic quarry sites, such as “the practicalities of reaching the stone source and the best ways of removing artefacts from the site.” He points out an underlying “principle of least effort” (Bradley 2000:86). “Prehistoric people were supposed to have calculated how they might maximise output while minimising labour” (Bradley 2000: 86). This assumes an economic system based on capitalist ideals of maximizing profits with minimal expense. However, much like the results seen by Barge and Chataigner (2003), Bradley’s (2000:87) study of stone axes in Great Britain found that people chose to quarry stone from sites on the steepest grade, at locations that were furthest from the ground. Even more intriguing, Bradley (2000: 86) observed that some of the best tool stone readily available in the area was not exploited, while stone with the same physical qualities but in highly inaccessible exposures was chosen instead. This led him to suggest that the “character of the place seemed at least as important as the qualities of the material that was found there” (Bradley 2000:86-87).

8.3 Results from the North and South Study Areas

Applying these efficiency principles and models to the results of this thesis indicate that a simple time-decay model is not applicable for both study areas. The North Study Area does show this type of relationship between source and find location to a certain degree. Obsidian Cliff is the closest source to the North Study Area with an approximate distance of 27 km one way (from the Malin Creek site) (see Figure 11). It is also the best represented source in the North Study Area, dominating the assemblage with 87% of the total amount of obsidian artifacts.

The Bear Gulch and Cashman Quarry source locations are both represented by five percent of the total and should be the next closest source localities following this model. The Bear Gulch source is approximately 182 km distant from the Malin Creek site and the Cashman Quarry is approximately 100 km away as the crow flies (Figure 3). However, it is important to consider that the distance to Cashman Quarry is not representative of actual travel on foot, as the Gallatin and Madison mountain ranges would have to be crossed, making direct access to this source from the Malin Creek site extremely difficult and inefficient. The Bear Gulch source also requires travel across the Gallatin mountain range, and into the Centennial Mountains to access the source locality. Travel from either of these source localities to the Malin Creek site would not be considered convenient by any standards. This is part of the reason why the previously proposed model of annual travel through the Park is rejected by this author.

The Cougar Creek source would be the next closest source after Obsidian Cliff to the Malin Creek site (at approximately 59 km from the Malin Creek site), yet it is not represented in the North Study Area sample. This may be due to the inferior quality of Cougar Creek obsidian.

For the South Study Area, a similar pattern is discerned. Obsidian Cliff represents the highest percentage of obsidian (at 62%- see Figure 8) in the sample. This source locality is approximately 77 km from the Osprey Beach site (following the proposed travel route-see Figure 3). Obsidian Cliff is not the closest source represented in this sample.

The Conant Creek source locality is approximately 45 km distant as the crow flies yet represents only two percent of the total sample. Although not represented in Figure 3 as a proposed route, travel as the crow flies from Osprey Beach to the Conant Creek source is possible without much topographical impediment. This source should therefore be considered the closest and most efficiently accessed source from Osprey Beach. Yet it is not represented in the sample to the degree expected by time-decay models.

The Teton Pass/Crescent H source locality is 129 km from the Osprey Beach site (see Figures 3 and 10) and is the second most popular source represented in this sample. Interestingly, the Bear Gulch source follows with nine percent of the total despite being the furthest away of all sources represented. The Bear Gulch source locality is approximately 120 km as the crow flies, and 307 km (or over 600 km round trip) following proposed travel routes from the Osprey Beach site (see Figure 3). Again, access to this source area as the crow flies requires crossing difficult terrain and mountain ranges, and is rejected by this author. Having also rejected the idea of a large annual round which would take people out to this source during the course of regular annual travel, direct procurement of Bear Gulch obsidian from the South study area is eliminated as a possibility. To account for its apparent popularity, trade must be considered in future studies.

8.4 Economies of the Archaic and the Rejection of a Large Annual Round

A brief discussion of subsistence strategies must be brought into the discussion at this point, to better understand arguments for alternative seasonal or annual movement patterns. Frison's proposal of a distinct mountain-foothills oriented economy for the Bighorn Mountains area of Wyoming is particularly relevant to my research, as it suggests a diversified subsistence strategy and ecosystem-specific movement pattern that is focused on exploiting resources in the mountains and surrounding foothills (Frison 1992). The Yellowstone Plateau is a similarly high-altitude area, and the currently held model of seasonal movement of groups is of occupation of the higher-altitude areas during the warm months, with movement into surrounding foothill areas with the changing seasons.

However, there are certain differences between a typical "high altitude" or "mountain adapted" strategy and what was likely happening in the Yellowstone region. Frison's model is relatively localized and based largely on the occurrence of Pryor Stemmed points (which have not been recorded in the Yellowstone area), and is specific to the Bighorn Mountains/Basin, the neighboring Pryor Mountains and the Wind River Mountain range, all in north or northwestern Wyoming (see Frison 1973). While his general theories of a diversified economy due to the unique environmental and geographical situations faced by people in mountainous areas are applicable, the Bighorn Basin and Mountains are isolated ranges, somewhat culturally sheltered and separate from the Plains to the north and the Rocky Mountains to the west. In addition, other notable hypotheses of distinct high-altitude adaptations are also not quite applicable to the Yellowstone Plateau. Black's (1991:21) description of the distinctive characteristics of his "Mountain Tradition" include "microtools, [pithouse] architecture…and rock art", none of which are part of the Yellowstone archaeological record (but notably, are elements of the archaeology of the Bighorn Mountains/Basin area to the west-see Frison 1991 for an example).

Johnson et al. (2004:187) suggested that from Cody times onwards, a pattern of "seasonal subsistence variation, not a 'subsistence dichotomy' [between the mountain/foothills and the Plains]" is in evidence. This articulates the subtle differences between hypotheses for neighbouring areas which are similar, but show significant differences in the archaeological record and in the local environment. This comment also reflects the *diversity* of game and other resources on the Yellowstone Plateau rather than a *dichotomy* between the Plains and the mountain/foothill subsistence strategies (Johnson et al. 2005:187).

At the Malin Creek site, "[p]ollen and macrofloral analyses indicate that [recovered hearth features] were used for processing prickly pear cactus" (Cummings 1993:235, in Puseman 2002:6). Analysis of pollen and macrofloral remains from additional hearth features at this site indicate that a diverse menu of local plants and animals were being processed in addition to prickly pear, including "grass seeds, bison, elk, bighorn sheep, and fish" (Vivian et al. 2008:3). People at the Malin Creek site were clearly exploiting a range of plants and animals, including fish and smaller mammals in addition to the typical large game animals. The recovery of a net sinker at this site (in Component Three associated with the Archaic and Late Prehistoric periods-see Vivian et al. 2008:167) further supports fishing as a subsistence strategy along the Yellowstone River, and the fish bones recovered here are the first to be recorded in an archaeological context in Yellowstone (Vivian et al. 2008:3).

Winter occupation and year round use has not been established archaeologically in Yellowstone. This is the primary reason why annual rounds proposed for the area include an exiting of the high altitude plateaus and mountain areas of the Park and movement to the lower elevation valleys to the south and west. The area around Jackson Hole in Grand Teton National Park shows evidence of year round use as early as the Early Archaic (Connor 1993:10). The Lawrence site, at the northern end of Jackson Lake, has a radiocarbon date of 5850 +/- 90 indicating occupation during the Early Archaic, a period which is interpreted as representing year round use of the mountains and the Jackson Hole area (Connor 1993:10). The Meyers-Hindman site, up the Yellowstone River valley from the North Study Area, is interpreted as representing a fall/winter occupation (Lahren 1976). These two sites are examples of how the movement of people with the seasons could be more localized than once thought, without challenging the lack of evidence for winter occupation in Yellowstone proper, and maintaining a "mountain-foothills" diversified economy model.

Current observations by wildlife management in the Park confirm that the movement of game animals (such as elk, deer and bison) in the Northern Range is relatively "local" as well. In fact, the winter ranges for these animals in the north end of the Park correspond with the proposed travel route in Figure 4 north along the Yellowstone River. The Meyers-Hindman site (with evidence of winter occupation) is only approximately 90 km away from the Malin Creek site following the excellent travel and game corridor provided by the Yellowstone River valley (see Figure 11).

Other confirmed winter ranges for bison are within the central plateau of Yellowstone and near the northern boundary of the Park along the Yellowstone and Lamar rivers directly in the North Study Area (Gates et al. 2005:84). Assuming that people followed game in the colder months, forays out to the Bear Gulch source would not be part of the annual round as game was available much closer.

Previously in this chapter it was mentioned that historically-used travel ways through the Gallatin mountain range also have evidence of pre-contact use, and might have been routes followed to access Bear Gulch obsidian. However, it appears more and more unlikely that people living in the North Study Area would have traveled across the Gallatin mountain range more than 180 km to collect Bear Gulch obsidian as part of their annual round. When considering terrain, distance, and local availability of resources, trade with a group that had Bear Gulch as part of their "home range" emerges as a likely scenario for both the North and South Study Areas.

8.5 Future Directions of Study

Although a purely cultural preference factor has not been seen in my results, consideration of the landscape approach to obsidian use in Yellowstone is still useful when interpreting the movement of people through time and space. Ultimately, future research should examine different types of obsidian artifacts when considering the question of annual rounds. Specifically, by examining flake debris and the entire assemblage of tools at specific sites, a more useful range of information is available to interpret. People only discard projectile points (especially those valued say, for the material they are made out of) when they are broken or at the end of their useful life. It is impossible to say at what stage of travel in an annual round a projectile point will be broken or lost accidentally. Rather, the flakes left over from working stone to make tools is much more indicative of when that activity took place relative to when the material was acquired. For example, if larger, secondary flakes of Teton Pass obsidian are recovered from a site near Jackson Lake, it tells us that Teton Pass was a source more recently visited. Not only because it is close by, but also because the size of the flakes indicates rough fashioning of blanks or the first stages of tool making. The raw material is being shaped to a manageable size for travel and would be made into a more formal tool at a later date.

Further inquiry into the proposed travel routes is essential. Patterns of wildlife migration, historically used travel corridors, and archaeological evidence along proposed travel routes must be examined in more depth in conjunction with obsidian source locations. These considerations emerged as key elements of interpretation during the development of this research and they demand further attention, but were beyond the scope of this thesis.

While this thesis limited analysis to projectile points in order to control for time period, by focusing on excavated sites with good stratigraphic integrity this control can still be maintained and all obsidian artifacts can be considered. This type of "whole assemblage" analysis should be the next step in the study of Obsidian use patterns in Yellowstone.

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