INTEGRATING CLIMATE CHANGE WITH HUMAN LAND USE PATTERNS:

ARCHAEOLOGY OF BUTTE LAKE NORTHEAST

By

Michael L. Wendt

RECOMMENDED: ______________________________

Dr. Patrick Plattet

____

Dr. Joel Irish

____

Dr. Ben Potter, Advisory Committee Chair

____

Dr. David Koester, Chair, Department of Anthropology

APPROVED: ______________________________

Mr. Todd Sherman, Dean, College of Liberal Arts

____

Dr. John Eichelberger, Dean of the Graduate School

13 September 2013

Date

INTEGRATING CLIMATE CHANGE WITH HUMAN LAND USE PATTERNS:

ARCHAEOLOGY OF BUTTE LAKE NORTHEAST

A

THESIS

Presented to the Faculty

of the University of Alaska Fairbanks

in Partial Fulfillment of the Requirements

for the Degree of

MASTER OF ARTS

By

Michael L. Wendt, B.S.

Fairbanks, Alaska

August 2013

Abstract

This research explores the effects of climate change throughout the Holocene by investigating a multi-component site at Butte Lake, Alaska. This research combines expectations generated from ethnographic models to evaluate site use conditioned by environmental constraints within the theoretical framework of human behavioral ecology. Analysis of lithic materials, faunal remains, and site structure are evaluated to determine site type by occupational component. The results of this research show that a period of low effective moisture during the early Holocene (9000 to 5000 cal BP), as well as a period of both low temperature and increased effective moisture associated with the Neoglacial (3500 to 1500 cal BP) had considerable impacts on the habitability of the site. This research also shows that a period of relatively abundant productivity associated with the Medieval Optimum (1500 to 750 cal BP) may have resulted in extensive trade with, and/or local occupation by Eskimo (Ipiutak/Norton) inhabitants. Most importantly, analysis has shown a sharp distinction between site use associated with the early and middle Holocene occupations, and the specialized and discrete activity loci associated with caribou processing during the late Holocene occupations, likely affected by both climate and water levels at Butte Lake during these respective periods.

Table of Contents

Page

Page

List of Figures

Page

List of Tables

List of Appendices

Acknowledgements

There are many people that I would like to thank and who helped make this research possible. I would first like to thank the members of my advisory committee, Ben A. Potter, Joel D. Irish, and Patrick Plattet for their help and guidance throughout my studies at the University of Alaska Fairbanks. I would especially like to thank Ben Potter for his intensive instruction in regional archaeology and guidance on this research. I would also like to thank Patrick Plattet for all of his positive feedback and approachable nature during my time at UAF. Finally, Joel Irish's guidance on how to present my hypothesis and approach statistical analysis have been very helpful in this research.

I would also like to express my great appreciation to Robert M. Libby, the owner of the property who kindly provided permission to excavate and use his cabin to keep the crew warm on those very cold and wet days during the 2012 excavation.

I would like to thank all those who helped to fund this project as well, including the Otto Geist Fund and the selection committee, and Pete Bowers of Northern Land Use Research. I would also like to thank Jeff Rasic, and the personnel at the University of Alaska Museum of the North for providing me with the space to study, analyze, and photograph the collection for this project.

I would like to thank Josh Reuther for his time, counsel, and advice, Jamie Clark for her guidance on the faunal analysis, and Holly McKinney for being a great cheerleader and for giving me a fresh pair of eyes when I needed them.

Most of all, I would like to thank the people without whom this project never would have been undertaken in the first place including Bob Betts who originally excavated the site and whose work first stirred my interest. I would also like to thank Bob for driving from his home in Idaho to participate in the 2012 excavation. In addition to Bob, I want to thank Meagan Ellicott, Theresa Dutchuk, Paul Korchin, Brent Glays, Megan Hinzman, and Dustin Wagner, for not only helping me to excavate the site in all kinds of weather, but for being great friends and colleagues in our shared adventure.

Finally, I want to thank my wife, partner, and best friend Hayley Brown, for all of her love, patience, and support over the last year and a half.

Chapter One. Introduction

Archaeological sites in interior Alaska represent snapshots of time. This is not to say that they represent only moments along the greater temporal continuum, but that they represent limited portions of the annual cycle of economic procurement unique to a culture over time. Sites are seasonal in nature and only allow the researcher a glimpse into the temporary occupation of the site. Some sites are important in that they contain evidence of regular occupation over a great period of time, but the evidence is often limited to robust artifacts such as lithic technology. Ideally, evidence of a more organic nature such as bone or antler that can be used to date and/or determine a more precise function for the site can be uncovered, but this is not always the case. Each of these sites represents part of a puzzle that the archaeologist attempts to piece together. The resulting synthesis is meant to shed light on the intersite relationship underscoring the annual cycle of economic procurement within a limited region. This information could be further analyzed within an ecological framework for the purposes of understanding causal relationships between habitat productivity and seasonal use over time.

Purpose Statement

The purpose of this research is to examine the intrasite variability to determine site function over time as a product of environmental change. This thesis links environmental change to climate change. This thesis will use a model of ethnographic resource scheduling and procurement in concert with a climate model when addressing artifacts, faunal remains, and features within the archaeological context. The ethnographic model is expected to provide data on site types and procurement strategy within the parameters of current climate conditions. Differences in artifacts, faunal remains and features will then be explored using the climate model in a middle range approach that seeks to develop links between cause and effect over the course of the Holocene.

Lithic analysis uses traditional methods to explore raw material availability and procurement, reduction sequences, and behavior as a function of tool production and maintenance. Faunal remains will be analyzed to ascertain both subsistence foci and site type based on presence or absence of elements, and how those elements have been processed. Likewise, features recorded at the site will provide information of site type as well as limiting dates that can be compared to the climate model to assess impacts on local terrestrial biomes and resource scheduling .

Each site within this region represents part of a shift in procurement that is arguably unique to the season, the geographic location, altitude, and the resources being utilized (Potter 2008c). Research over the last several decades in Interior Alaska concentrating on the Gulkana Uplands, the Upper Susitna Drainage, Healy Lake, Paxson Lake, the Gulkana River, the Tangle Lakes, and Gerstle River (Arndt 1977; Betts 1987b; Cook 1969; Dixon 1985; Dixon et al. 1985; Hadleigh-West 1967, 1975, 1996; Hanson 2008; Holmes 2001; C. E. Holmes 2008; Ketz 1982; Mobley 1982; Potter 1997, 2005, 2008a, b, c, 2011; Potter et al. 2011; Skeete 2008; Workman 1976) have contributed to an understanding of a geographically unique seasonal relationship between the local indigenous populations and available upland, lowland, riverine, and lakeshore resources. For example, Cook (1969) has described the Healy Lake Village Site as a late spring and summer site due to the large numbers of small mammal and bird bones; while based on the absence of architectural features and the faunal evidence, the upper Susitna sites suggest that people were not confined to the lowland areas during the early spring and summer months but were taking advantage of both spring and fall caribou migrations in the uplands (Skeete 2008). The faunal and lithic assemblage at the Jay Creek Mineral Lick for example, is suggestive of a subsistence economy that emphasized the capture of caribou which was the largest contributor of meat in the diet, followed by moose, sheep, and squirrels (Skeete 2008).

Human behavioral ecology (HBE) provides the theoretical framework in a middle range theoretical approach that seeks to explore the links between climate and behavior. HBE generally assumes that humans will employ a strategy that maximizes the mean rate of return while minimizing the risk of variation in return rates. This is expected to be true of mobility for example, where a particular strategy, whether residentially or logistically oriented is affected by the availability and predictability of resources either seasonally or annually. Likewise, this expectation can also be extended to the use of a weapon strategy. Archaeological evidence indicates for example that microblade and burin technology associated with organic insets, are most often located in lowland settings and winter/spring encampments. While some argue that this weapon strategy is oriented toward specific hunting practices, other possible correlations suggesting that the technology may provide a conservative means of coping with seasonal climate oscillations should be given equal weight. Based on this expectation, differences in technological organization, subsistence economy, and site structure between and within occupation components can be viewed as a means of maximizing biological fitness while mitigating risk associated with the impacts of climate oscillation on a habitat.

Understanding human behavior in upland settings is difficult due to the paucity of clearly defined sites. In most cases, sites located in the upland regions centered around the central Alaska Range in interior Alaska are surface sites with little organic preservation useful for dating occupational components or recognizing subsistence foci. Butte Lake however, is a multi-component site with faunal remains and deep - clearly defined stratigraphy composed of soil and sediment development overlying glacial till. The site is defined by three prehistoric and one protohistoric occupation components with numerous features including a house-pit, cache-pits, and hearths, as well as technological organization with the potential to range the extent of the Holocene (10,000 years ago to present). This research utilizes data recorded during the 1984 and 2012 field excavations with the explicit expectation that technological organization, subsistence economy, and site structure resolve problems of risk associated with seasonal resource availability and long term climate change. Therefore, the purpose of this research is to explore how adaptive strategies in upland subsistence may reflect climate oscillations and regional ecological change during the Holocene.

Butte Lake

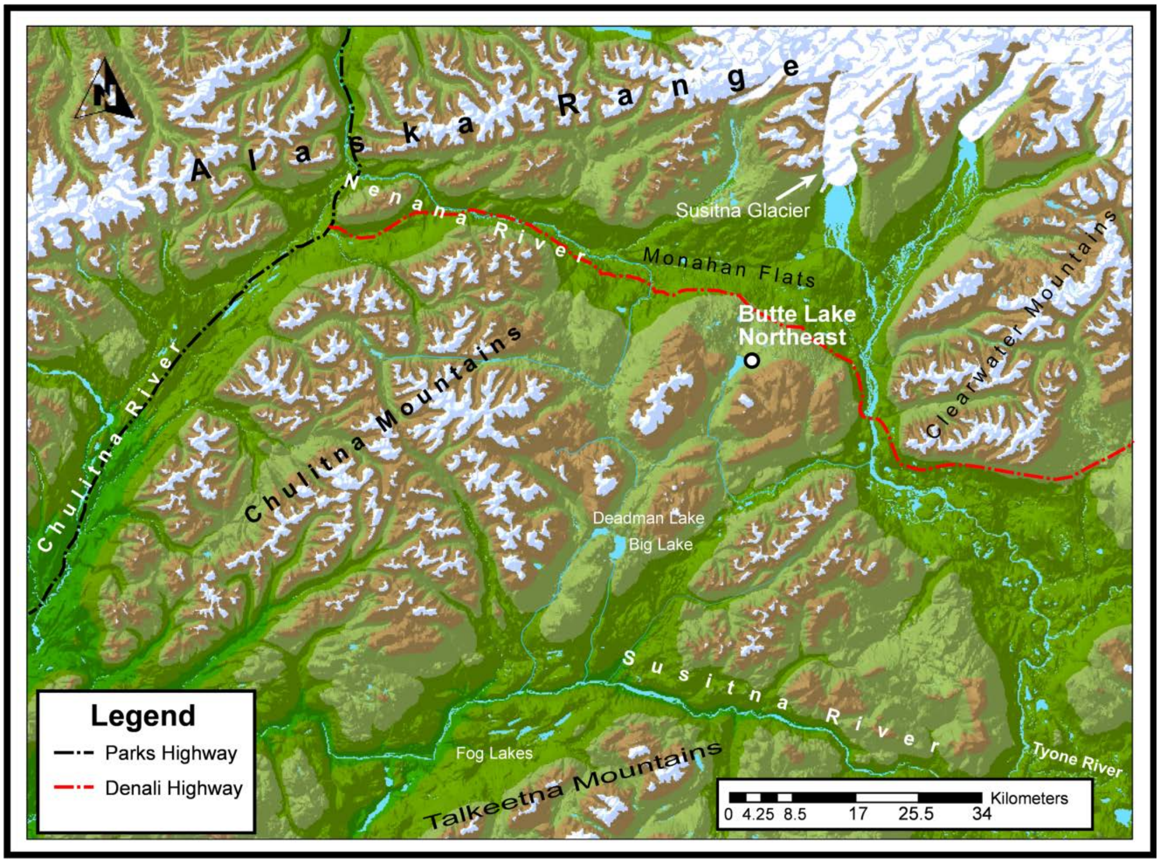

Figure 1-1. Map of study area.

The primary locus of this research is at the northeast corner of Butte Lake, a property owned by Robert M. Libbey. Butte Lake is located in a low broad pass in the Chulitna Mountains that naturally links the Monahan Flat to the north with the Susitna River drainage to the south and forms the head waters of Butte Creek, a tributary of the Susitna River that flows roughly south (Figure 1-1). The Chulitna Mountains are a group of mountain blocks isolated from the Talkeetna Mountains to the south by the Fog Lakes Upland (Wahrhaftig 1960:56). The Monahan Flats are a poorly drained lowland beneath the Alaska Range. They drain southeasterly into the Susitna River, and into the Nenana River to the northwest. Butte Lake is approximately 3.5 kilometers long and 1km wide, and is situated in a U-shaped valley at an elevation of 1022 meters above sea level (m asl) and is flanked on either side by summits ranging from 1220 m asl to 1581 m asl (Figure 1-2).

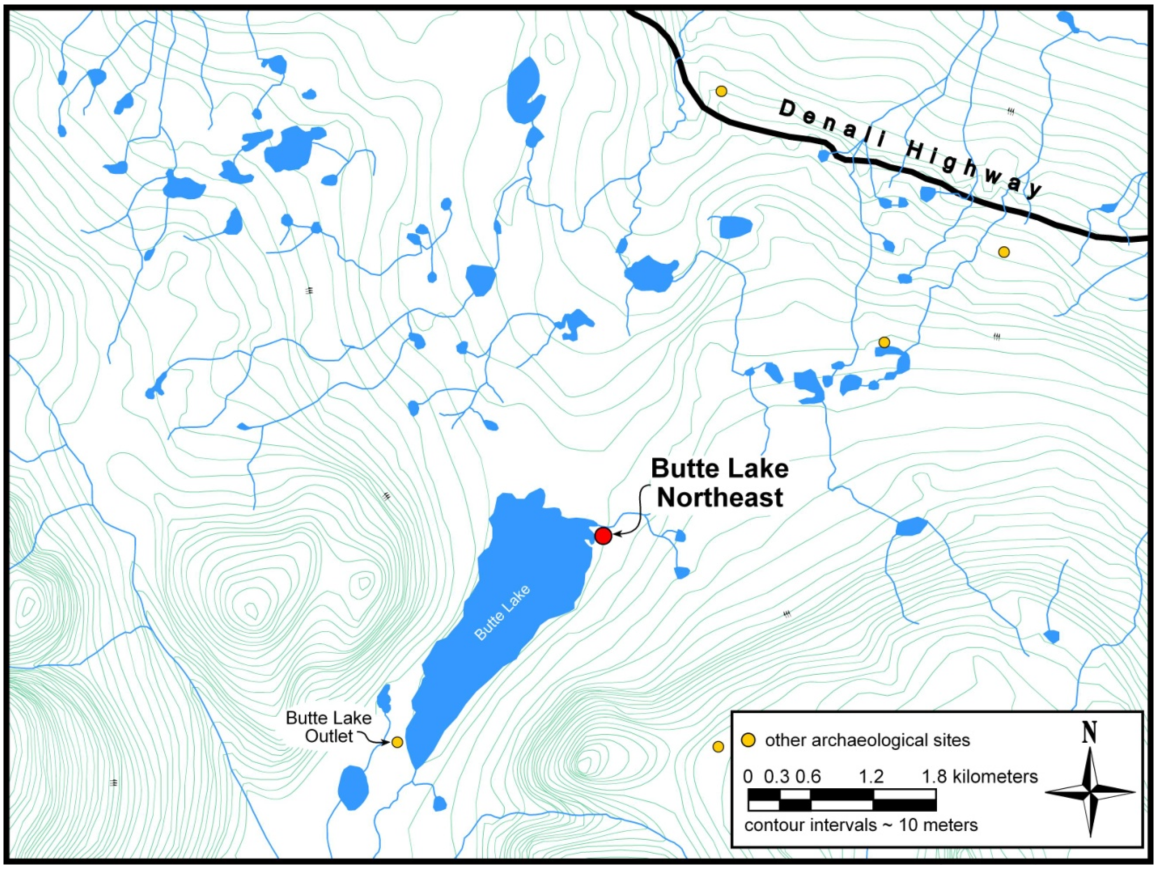

Figure 1-2. General topography around Butte Lake.

The Butte Lake Northeast (HEA-189) site is located on a prominent kame and a peninsula in the northeast corner of the lake near an inlet stream that is presently dammed and forms a small pond (Figure 1-3). The site is above tree line, although spruce can be found scattered among vegetation otherwise associated with poorly drained kettle and kame topography deposited during Late Wisconsin glaciations. The presence of the spruce at this altitude is likely a recent occurrence, however research suggests that spruce may have been more wide spread in the area at approximately 1500 cal BP (Rohr 2001).

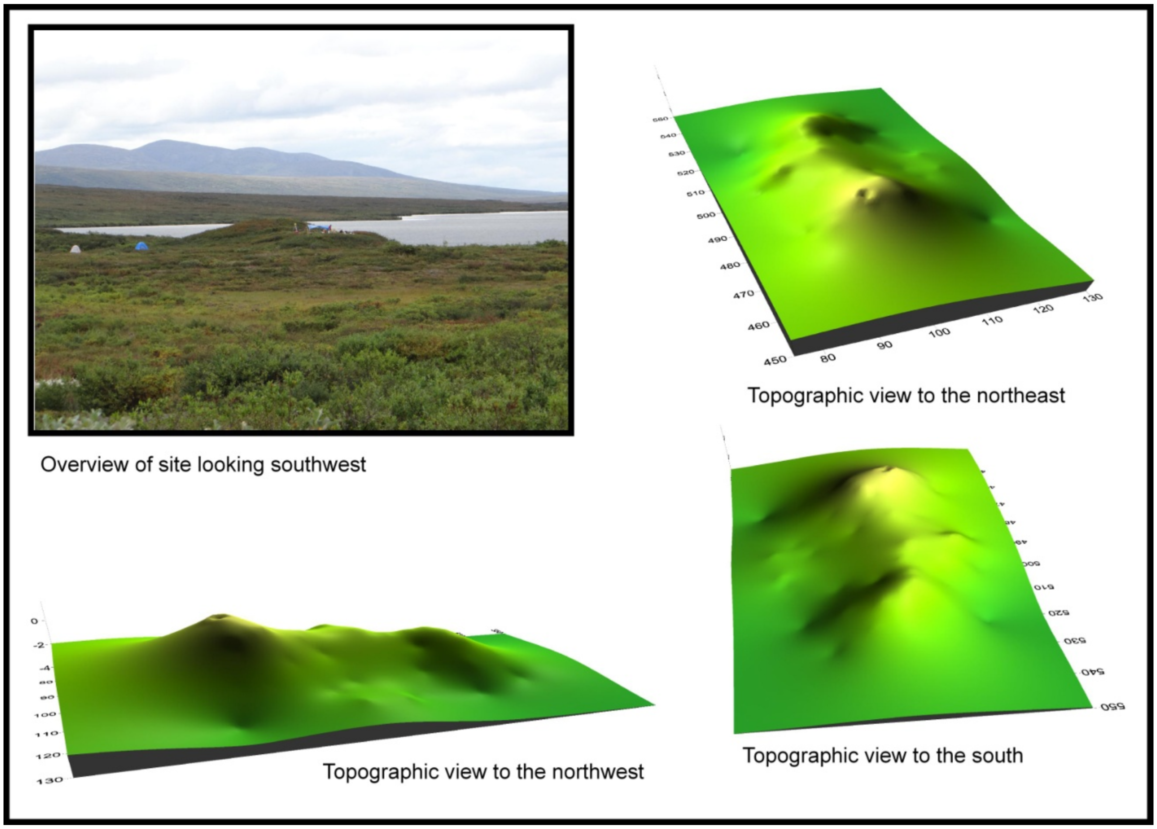

Figure 1-3. Site topography.

The valley floor is dominated by glacial till with some exposed bedrock. Deflation of prominent kame topography is common in the area and can be tentatively associated with high winds as well as seasonal erosion. Winds typically come from the south and up the valley, most likely due to the pressure differential generated within the Monahan Flats by the large glaciers in the Alaska Range, particularly the Nenana, West Fork and Susitna Glaciers with their sources very high in the mountains leading to cold relatively dense air that moves swiftly downhill. The air flow is intensified when funneled between the valley walls at Butte Lake (Shulski and Wendler 2007). The valley walls consist largely of frost cracked boulder fields at the highest elevations.

Thesis Organization

The objective of this thesis is to provide a description of the archaeological site at the northeast corner of Butte Lake in sufficient detail to evaluate the site based on expectations derived from the ethnographic and climate models. These models will be used to form expectations regarding late prehistoric site use and to examine earlier components through comparative analysis. The climate model can also provide expectations based partly on the ethnographic model (how were humans behaving given climate conditions during the ethnographic period), which in turn can be used to explore how a changing climate may have affected site use based on differences between occupational components.

Chapter Two begins with an examination of the previous excavation at Butte Lake and the problems that have been encountered. Chapter Two then presents the research design based on the regional cultural chronology and several overlapping problem domains within the theoretical framework of human behavioral ecology to establish the focus of this thesis. Chapter Two concludes with a description of the field and lab methods used to address the questions and problems outlined in the chapter .

Chapter Three focuses on the models used to evaluate site occupation over time. Chapter Three begins with a detailed model of Ahtna ethnographic subsistence and environment with a focus on site type and the importance of Butte Lake in the Cantwell-Denali seasonal round. This model includes the physiographic and environmental setting, subsistence use of plants and animals, and the seasonal subsistence settlement pattern. The ethnographic model will be followed by a climate model that links mean annual temperature and effective moisture to environmental change over the duration of the Holocene as represented in major terrestrial biomes. This will be followed by a brief overview of major volcanic ash falls represented in the region and specifically recorded at the site.

Chapter Four provides a detailed description of the site excavation beginning with excavation objectives and protocols. This chapter includes a description of all features, cultural horizons, and stratigraphic markers such as provisionally identified tephra horizons and the provisional date of last glacial retreat. The site description will be followed by a detailed site chronology based on datable materials and stratigraphic markers with a description of both lithostratigraphy and pedostratigraphy.

Chapter Five focuses on lithic analysis and will provide a description of material type and component delineation. Chapter Five will present the results of traditional lithic analysis to explore reduction sequences, and behavior represented within each occupational component over time. A critical examination of both similarities and differences within and between components will conclude Chapter Five.

Chapter Six focuses on analysis of faunal remains recorded during the 2012 excavation. These analyses will evaluate faunal remains based on various utility indices, processing indices, and taphonomic indicators that may affect the remains. the results of the analyses will be compared to the ethnographic model to determine site use during the period represented by the faunal remains.

Chapter Seven will present a synthesis of the results from the previous chapters to evaluate the ethnographic and climate models. Chapter Seven will also include both intrasite conclusions and intersite comparisons with other sites in both upland and lowland settings with similar periods of occupation.

Chapter Two.   Research Design and Problem Domains

Archaeological research in central Alaska has traditionally focused on the occupational components of a site to solve problems of mobility and raw material acquisition in the region. As indicated above, occupations are viewed as a cultural phenomenon that links artifacts, faunal remains, and cultural features to change in the strategic use of resources without necessarily investigating the causal relationships that are linked to the development of those associations. The purpose of this chapter is to first, present a summary of prior investigations at Butte Lake Northeast, their contributions, potential problems, and the implications for future research. Next, I will outline the questions that guided research during the 2012 field season. This will be followed by an examination of the theoretical framework used to explore both differences and similarities between the various site occupations. The theoretical approach includes a description of several problem domains and how they will be addressed in this research. Finally, I will present the methods and protocols used for both excavation and subsequent lab analysis of materials from the site with the explicit goal of not only recognizing the structure of each occupation, but also developing hypotheses about how change reflects environmental and economic constraints during the specific periods of time represented within each component.

1984 Excavation at Butte Lake Northeast

Two excavations have been undertaken at the site know as Butte Lake Northeast, the first in 1984 by Robert C. Betts, and the second during the summer of 2012. The 1984 excavation established that the site contained multiple components, and while dating of features proved problematic, the range of artifacts and the relative superposition within the stratigraphic profile was consistent with this conclusion.

Betts described the site at Butte Lake Northeast as a multi-component site clearly defined by natural stratigraphy (Betts 1987a). The site exhibits what Betts described as five occupational components. Component V, which was only briefly noted in his thesis, is a historical component with material clearly representing the post contact to modern occupation of the site and exhibited a complete lack of prehistoric type artifacts. Component IV was considered a proto-historic component defined by the presence of trade beads and iron but also contained bone, antler, stone, and copper artifacts as well as faunal remains. Component III was attributed to a pre-contact Athabascan population complete with copper, bone, antler, and stone artifacts, as well as faunal remains, a house feature, and at least one cache-pit feature. Materials from this component were directly or indirectly associated with two hearth features. One hearth was located within the house feature and the second is believed to be an extension of the 2012 Feature 1 into the east wall of a 1x1½ meter test unit.

Artifacts and features Betts attributed to Component II were the primary focus of his thesis and are linked to the Northern Archaic Tradition. Component II was particularly important due to the age range of 8380 to 5320 cal BP and the cooccurance of microblades in direct or indirect association with two hearth features, and a side notched point and other bifaces indirectly associated with the two hearth features (Betts 1987a, b).

Component I was described by Betts as lying directly on glacial till and possibly representing a late Pleistocene/early Holocene occupation associated with the American Paleoarctic Tradition, however it did not exhibit microblade technology.

While Betts' conclusions about the site are important, several problems may exist with regards to both his interpretation and assignment of artifacts to components, as well as the dates attributed to each of the components. The site was initially excavated in natural stratigraphic layers, as Betts was concerned that arbitrary levels might bisect the natural stratigraphy and lead to false associations between artifacts (Betts 1987a:2). Mixing of artifacts by way of cryoturbation, bioturbation, or cultural disturbance such as digging, were also concerns. While these concerns were not without merit, this design lead to multiple artifacts which could not be assigned to any component (n=487), and represents 48% of the entire lithic assemblage recorded during the 1984 field season.

The site is primarily defined by one - 1 x 1½ meter test unit, and a house-pit. All of the Component I and most of the Component II and III artifacts were recovered from the single test unit (Betts 1987a:11), and although only partially removed, the house-pit accounted for 7m^2 of the total 11m^2 excavated at the site. Additionally, few artifacts were recorded in-situ, and most were recovered during screening.

Four charcoal samples were recorded during the 1984 excavation (Table 5-1), and all four were analyzed using radiocarbon decay methods that required sizable samples resulting in large standard errors and possible contamination. Additionally, two of the assays were analyzed by Dicarb Radioisotope Co. which have since been demonstrated to be problematic (Reuther and Gerlach 2005). The two Component II dates are at once problematic with their large standard deviations, and simultaneously interesting in that they seem to represent a period otherwise associated with a regional cultural hiatus (Hadleigh-West 1996).

The primary focus of Betts' post excavation analysis focused on the relationships between the technological associations regarding side-notched point and microblade technology with an emphasis placed on cultural diffusion regarding the concept of hafting a single projectile point for a weapon system (Betts 1987a). At this point in the development of archaeological theory in Alaska, contemporary researchers were arguing that the record of "pure" Northern Archaic sites, or those sites not affiliated with microblade technology, were likely due to sampling error that did not adequately sample a large enough area to capture the technology as a phenomenon located within discrete loci at a given site (Betts 1987a). While the reasoning behind this hypothesis may or may not be correct, it ran counter to the prevailing paradigm that the two technologies were exclusive to a cultural traditions defined as the Northern Archaic Tradition and the Late Denali complex. This focus provides a valuable clue to the interpretation of the site.

The primary problems that confronts current analysis include the lack of control during excavation, the radiocarbon dates with large standard deviation, and the predilection to assign occupational components based on a cultural historic approach. The latter is of particular concern as microblades associated with the Athabascan component have been dismissed, while all others not directly associated with a feature (n=11 of 15) have been attributed to the Northern Archaic Tradition, regardless of provenience record. This is of particular concern as all other forms of detritus and modified flakes from a similar provenience were not included within a particular occupational component. While it is not inconceivable that all microblades are associated with the Northern Archaic component, and that the component dates to a period that is typically void of regional occupation, this is highly unlikely based on current research.

Research Questions

The site at Butte Lake Northeast has the potential to illuminate many of the problems confronting archaeological research in the region due to the clear separation of occupational components and the presence of stratigraphic markers and datable material. This research will focus on several questions. Firstly, when do people occupy the site? While this thesis uses datable material to answer this question, a broader understanding of context will be addressed through an examination of ethnographic and paleoclimate expectations. For example, the theoretical framework of HBE proposes that humans will employ a strategy that maximizes the mean rate of return while minimizing the risk of variation in return rates. Therefore, based on ethnographic and climate proxies, this research assumes that occupation represents periods of optimal return, and culturally sterile zones represent periods when biological outputs were not adequate to maintain human biological fitness.

This assumption is however predicated on addressing the types of resources being utilized. Resources are defined as both caloric (flora and fauna) and those associated with acquisition of caloric resources. These include materials required for weapon systems, processing, and transportation and include: lithic material for weapons and processing, wood for heating, cooking, and weapon system manufacture; wood for making racks, constructing habitations, or canoes; birch bark for baskets or canoes; and large stones or cobbles for use as hammer or anvil. While much of this can be inferred from the lithic and faunal record, more often than not, the faunal record is confined to only the most recent occupations due to taphonomic processes, and will typically only be associated with certain types of sites. These site types include; kill/processing sites, overnight or transitory camps, family camps, winter villages, hunting camps, and fishing camps, each with its own unique set of characteristics that will be addressed later in this chapter.

Apparent differences in site type over time and at the same location leads to the question; how are resources and the acquisition of resources affected by climate and how might this be recognized in the archaeological record? To address these problems, models characterizing the ethnographic use of resources provide the closest approximation for resource procurement over time however limited. This includes a general understanding of the primary resources being utilized, and how they may be affected by climate. Next, an examination of climate change over the course of the Holocene will provide expectations with regards to resource scheduling and acquisition when linking ecology to the climate variables of temperature and effective moisture (precipitation minus evaporation).

Theoretical Approach

Past research at Butte Lake Northeast, as with much of the research in interior Alaska, has focused on a cultural historic approach for analyzing site structure and the distribution of artifacts and faunal remains. Often times, the distribution of cultural occupation components are evaluated by the formal artifacts that can be linked with a technological tradition or complex, and in turn patterns of mobility, resource procurement, and weapons strategies based on the presence or absence of lithic detritus and faunal elements are evaluated.

Humans are unique in the environmental range they occupy and diversity of behavioral adaptations used to succeed in those environments. The theoretical framework of human behavioral ecology (HBE) provides linking arguments that can be useful in a middle-range theoretical approach that explicitly seeks to explore causal relationships between climate, environment, and economy. Resources are most often measured in currencies of time, caloric input and output, and evolutionary fitness (Torrence 1989).

HBE, which can be considered a branch of evolutionary ecology with its roots in sociobiology, is used to analyze behavior within an ecological context. HBE is a hypothetico-deductive approach that relies on simple models for understanding complex systems. HBE models decision making with theoretical tools and optimization models. Optimization models postulate that the average unit of study will behave in a manner optimizing the fitness of the unit (be it individual or group in the anthropological context). The models are analytical representations of a problem domain used to derive hypotheses regarding behavior, which are tested against empirical evidence to then evaluate and modify the model (Smith 1992a). Specifically, these models are used to form falsifiable hypotheses regarding the optimal use of economic resources given ecological constraints. While this research does not directly develop or test specific models of optimization, it does attempt to reconstruct habitat in which optimal behavior can be expected.

Fretwell and Lucas (1969) on the ideal free distribution of birds describe a habitat or patch as "any portion of the surface of the earth where the species is able to colonize and live". This is true of all animals and includes humans, however not all habitats are equal and the ability to live within a habitat is dependent on available resources. All animals must make decisions as to which patch types to visit and when to leave the patch it is presently in. Hypothetically, if the patch provides resources sufficient to promote optimal fitness, than it will and humans will occupy it based on a strategy that optimizes fitness (MacArthur and Pianka 1966; Smith 1992a; Winterhalder 1986; Winterhalder and Leslie 2002; Winterhalder et al. 1999). As the animal remains in the patch, the rate of return (the resources acquired relative to the time and energy spent acquiring and processing) will diminish and the animal must respond by relocating to another patch (Belovsky 1988; Charnov et al. 1976; Fretwell and Lucas 1969; MacArthur and Pianka 1966).

The presence of cultural material at a site indicates at the very least, the presence of suitable patch environments and subsistence resources within the general area, and based on the nature of those materials, could shed light on local patterns of residential or logistically oriented subsistence strategies associated with each occupation (Binford 1967). This is not to say that all resources necessary for human occupation must be available at the site, on the contrary it only suggests that at least one resource is available at the site, and that the resource provides an optimal return for survival by humans in adjacent patches. It is important to acknowledge that optimal returns do not necessarily equate to either a maximization of returns, or to minimization of risk as these strategies may not differ much and riskier strategies may be preferred under some conditions leading to higher yields (Smith 1992a; Smith 1978; Ugan et al. 2003; Winterhalder 1986; Winterhalder and Leslie 2002; Winterhalder et al. 1999).

This research assumes that strategies optimizing time, calories, and evolutionary fitness are expected with regards to diet breadth (Belovsky 1987, 1988; Charnov et al. 1976; Schoener 1974; Stiner et al. 2000), technological investment (Bettinger 2009; Bright et al. 2002; Shott 1986; Surovell 2003), resource depression (Beck 2002; Charnov et al. 1976), patch choice (Bettinger 2009; Ingold 2000; MacArthur and Pianka 1966; Parker and Smith 1990; Real and Caraco 1986; Sih 1980; Smith 1992a, b), and economic risk (Cashdan 1985; Damas 1972; Elston and Brantingham 2002; Real and Caraco 1986; Winterhalder and Leslie 2002), however, an understanding of scale is required for addressing site specific questions. Furthermore, assuming otherwise would be counterproductive as non-optimizing behavior can be considered random behavior that may or may not be observable within a normal distribution.

This hypothesis is based on the expectation that social and technological organization will change in both the long and short term as an adaptive response to the availability of resources within the ecosystem and procurement range. In the long term for example, change from high residential mobility during the early Holocene to long term residences with increased reliance on storage and logistically organized strategies in the late Holocene (Arndt 1977; Charles E. Holmes 2008; Ketz 1982; Potter 2008a, b;

Yesner 1989), are likely the result of ecological conditions limiting economic productivity within an exploitable patch early in the occupation record and larger predictable and seasonally highly productive patches later on (Hare et al. 2004; Kelly and Todd 1988; Potter 2008a, b). Similarly in the short term, technological organization within a site could reflect seasonal response to material limitations and accessibility or site function (Bamforth and Bleed 1997; Elston and Brantingham 2002; Potter 2008b; Waguespack et al. 2009).

In the following sections, a brief summary of the regional cultural chronology will provide a backdrop on which to examine various problem domains addressed in this research and within the framework of HBE. The overlapping and broadly defined problem domains presented here will be used to evaluate expectations of the ethnographic and climate model as well as illuminate some of the problems that might be encountered within the evaluation and subsequent site analysis. The problem domains include Scale and Prehistoric Economy, Climate and Technological Organization, and Site Use and Faunal Assemblage Patterning.

Regional Cultural Chronology

Diachronic change in archaeology is typically diagnosed by the presence or absence of artifacts described as having a particular set of attributes and is referred to as the cultural chronology of a given region. Interpretation of this diachronic change is affected by the available data and the means by which it is examined at any given point. This has resulted in continually evolving interpretations. Initially, cultural chronologies generated by sites within the region were placed within a cultural historical framework. Within this framework, the term ‘tradition’ is used to describe a continuity of cultural traits that persist over a considerable length of time and often occupy a broad geographical area. The term complex, corresponds with the use of the term “phase” advanced by Willey and Phillips (Phillips and Willey 1953; 1958), in which the term “phase” can be considered the basic “space-time-culture” concept that distinguishes one archaeological classification from earlier or later manifestations within a cultural tradition or from other contemporaneous complexes that posses characteristics that sufficiently distinguish them from other units that are limited by geography, cultural tradition and relative span of time (Phillips and Willey 1953:620).

Over the last decade, researchers have argued for cultural continuity in the western upland area spanning from between 8320 and 7850 cal BP and in the eastern upland and lowlands from prior to 12,000 cal BP to the historic period, based on a relatively continuous occupation denoted by artifact abundance, corresponding radiocarbon dates, and limited change in the local inventory variability (Potter 2008c). In interior Alaska, several weapons systems have been recognized and while they are typically separated by contextual association and radiocarbon dating, research has indicated that these systems may have been linked to environmental conditions. Based on data suggesting technological continuity along with economic and settlement system strategies, a cultural chronology for the region is defined as: (1) American Paleoarctic Tradition (Denali Complex) from 12,000-6000 cal BP; (2) The Northern Archaic Tradition which is associated with the Late Denali Complex due to lithic types and basic settlement patterns from 6000-1000 cal BP; and (3) the Athabascan Tradition from approximately 1000 cal BP to the historic period (Potter 2008c).

American Paleoarctic Tradition

The American Paleoarctic Tradition is based on this remnant steppe-tundra subsistence pattern that utilized grazing animals such as bison (*Bison sp.*), sheep (*Ovis dalli*), and wapiti (*Cervus sp.*) as well as upland bird, and other animals and plants that were available (Dumond 1980). Throughout the terminal Pleistocene and early Holocene, microblades are found in high association with bison, wapiti and/or moose (*Alces alces*), while bifacial technology is often associated with upland resources such as caribou (*Rangifer tarandus*) and sheep. This correlation suggests two weapon strategies that are likely employed seasonally. Microblade technology, believed to represent a single late Pleistocene tradition or a regional variant of the American Paleoarctic Tradition (Anderson 1968; Dixon 1985), may be particularly well suited for coping with climate oscillation and are present in sites assigned to the Denali Complex (Potter 2008b, c).

Research suggests that people using the Denali complex suite of tools may have been highly mobile, utilizing a strategy of residential mobility in predominately lowland environments (Potter 2008c:188). For example, faunal remains from occupations associated with this period at Broken Mammoth indicate a preference for migratory waterfowl followed by bison and wapiti indicative of spring/summer residential occupation. Microblade technology however, was not associated with this component (Holmes 1996). Likewise, faunal remains at Dry Creek component II includes bison and wapiti, but also include Dall sheep and lack migratory waterfowl. Both bifacial reduction and microblade production were associated with component II at Dry Creek and researchers have concluded that the site had been a fall/winter residential hunting camp (Powers et al. 1983). Additional support for a fall/winter occupation is based on the knowledge that bison prefer lowland grass pasture while wapiti tend to move to higher elevations during the summer and herd at lower elevations during the winter where snow depths do not hinder forage. Likewise, sheep tend to forage high in the mountains during the summer where terrain gives them a distinct advantage over predators but will venture much lower in the winter when high altitude foraging becomes difficult.

During the early Holocene, microblade bearing components tend to increase from ca. 13,000 cal yBP and peak at ca. 11,000 cal yBP, with a possible decline ca. 10,000 cal yBP corresponding with the Milankovitch Thermal Maximum (Mason et al. 2001:532) and the earliest occupations in upland settings. The presence of components bearing microblade technology again peaks dramatically between ca. 9000 and 8000 yBP (Mason et al. 2001; Potter 2008b) corresponding with the younger Younger Dryas cooling episode, and eventually become much less frequent by the start of the era typified by the Northern Archaic Tradition suite of tools (Mason et al. 2001). The increase in microblade bearing sites from 8500 to 8000 cal yr BP occur largely in southern areas or in valley bottoms (Mason et al. 2001). This relocation could be intended to take advantage of wood resource and direct sun light to stay warm for example, but could just as likely include more substantive economic pressures associated with shifting resources such as fauna otherwise hindered by conditions at higher altitudes related to both increased aridity and much cooler temperatures.

Northern Archaic Tradition

Within the cultural historic chronological framework of Interior Alaska (Dixon 1985; Potter 2008c), the Northern Archaic Tradition is defined by the presence of weekly side-notched points, but also contains microblades possibly forming separate hunting strategies. While many sites ascribed to the Northern Archaic Tradition contain one or the other and in many cases representations of both, there appears to be an increase in the number of sites during the later extent of this tradition containing microblade technology. This increase is associated with the Late Denali Complex occurring between ca. 3500 yBP and 1500 yBP (Dixon 1985).

The spread and location of the Northern Archaic Tradition appears to mirror the spread of the spruce forest but may reflect a subsistence base that focused on the edges of the forest rather than the core (Mason and Bigelow 2008:62). Mason and Bigelow (2008) view the spreading spruce forest during this period as a virtual lumber yard leading to innovation in technology and resource scheduling. It is likely that the bearers of Northern Archaic technology relied most heavily on moose and caribou based on the number of sites above tree line, however some researchers believe that long term winter occupations may have been located in wood rich valley bottoms along clear water streams and lakes that may have been obliterated by either flooding (Mason and Begét 1991; Reger et al. 2008; Tucker et al. 1999; Yesner 1989) or cultural processes (Potter 2008a). Based on lake levels during this period, many sites may be presently inundated, leading to the conclusion that a significant portion of the annual subsistence range may be underrepresented in the archaeological record, and those that are represented, may have been misinterpreted.

Esdale (2008) suggests that due to the paucity of direct evidence for the use of vegetation, that bearers of the Northern Archaic tool set emphasize and economy based on “fairly specialized large game hunting” strategies. This assumption may be the result of sampling strategy biased by surveys oriented toward identifying lithic artifacts and faunal remains likely removed from areas associated with the processing or consumption of vegetation, or the elimination of digestive waste likely to contain the greatest evidence for the use of local vegetation. It is more likely that the bearers of this tradition incorporated a broad spectrum strategy similar to traditions both preceding and post-dating them (Mason and Bigelow 2008; Yesner 2001).

Athabascan Tradition

The Athabascan Tradition is marked by a de-emphasis of stone projectiles, however, incised organic points with stone or cooper tips and stemmed points of native copper or stone used as arrow heads are common. Alpine ice patch research has dated the transition from darts tipped with side-notched points to bow and arrow technology to ca. 1250 yBP in the southwest Yukon, Canada (Hare et al. 2004). Additionally, Athabascan occupations when visible, tend to be oriented toward seasonally abundant resources such as caribou and salmon based on location and faunal remains. Long term occupations typically exhibit house features and cache-pits far less common in preceding traditions, that include intensive use of birch bark and high frequencies of fire cracked rock. Large heath features are also common in Athabascan contexts and are associated with the elimination of faunal material during the butchering process to keep animals away (Workman 1972, 1976). While stone projectile points are less common, small scrapers made on cobble spalls or flakes and lithic debitage associated with their manufacture and maintenance are often found in contexts associated with processing large ungulates (Dixon et al. 1985; Ketz 1982; Shinkwin 1977; Shinkwin 1979).

The Athabascan Tradition is most associated with the ethnographic past. This research utilizes an ethnographic model in concert with the climate model as a baseline for comparing earlier occupations at Butte Lake to the ethnographic past. This baseline will be used to identify site use through faunal assemblage patterning, and to identify how each component compares with site type criteria.

Scale and Prehistoric Economy

Scale is important for explicitly differentiating complex systems with the goal of capturing the arbitrary components of spatial reality that form a particular perspective on a spatial context leading ultimately to a recognition of change in processes (Ridges 2006). Scale can then be used to focus on the artifact, the feature, the faunal remains, and the location as a resolution to a problem. What, for example is changing at the site, and what is occurring during the time of change. How does the change reflect costs and benefits, and how in turn does this reflect choice? Generally speaking, by inferring scale, context can be implied and used to explore expectations, and analysis of contexts through time can be given more weight (Wobst 2006).

The typical economy of the hunter-gatherer in interior Alaska is often accepted as one based primarily on a broad spectrum diet with a particular focus on large mammals (Mason and Bigelow 2008; Potter 2008b:100; Yesner 2001), and is represented by the particular technology being utilized. This economic view proposes that variety in technology, such as biface projectile and composite microblade technologies, would be part of separate weapon systems related to specific hunting practices (Potter 2008b). While this explanation of variety is plausible, it ignores essential aspects of technological systems by overlooking resources such as wood and animal by-products necessary for the manufacture of the technological system. Viewed as either variables or possible constraints on a technological system and directly affected by climate, they contribute to the success of technology and warrant examination in economic discussions (Binford 1979, 1980; Bleed 1986; Bousman 1993, 2005; Elston and Brantingham 2002; Rots et al. 2006; Waguespack et al. 2009).

Humans however, are unique in their ability to adapt to changing conditions and various habitats. A number of published hypotheses propose that climate driven environmental change has been responsible for hominid speciation, bipedal locomotion, enlarged cranial capacity, and behavioral adaptability including culture and intercontinental migration (Bobe et al. 2002; Laporte and Zihlman 1983; Potts 1996, 1998; Stanley 1992; Trauth et al. 2005; Vrba 1995; Wynn 2004). These hypotheses are based on a causal relationship between global scale climate shift documented in oceanic deposits and hominin evolution events recorded in fossil bearing strata. While there are numerous challenges related to scale in establishing this cause and effect relationship, multiple lines of proxy evidence can be used to support it. Likewise, an examination of the climate impacts on human occupation at Butte Lake can be undertaken by crafting a climate model that takes into account variation is mean annual temperature and mean annual precipitation relative to the ethnographic period to examine site use and disuse over time.

Small scale analysis is site specific and used to evaluate behavior at the site. Medium scale analysis is used to compare intersite correlates within limited parameters, and large scale analysis is used to evaluate the use of landscape over time. Small scale analysis of Butte Lake Northeast will be limited to site formation, lithic analysis, faunal analysis, and site structure. Site formation will be inferred from paleoecological proxies and radiocarbon chronologies and will be used to provide a scale by which to separate occupational components and isolate technological aspects from each component. Simply analyzing each component based on radiocarbon data, material correlates, and associated features and faunal remains could lead to spurious conclusions that have little to do with optimizing behavior over time. The use of a climate model as a scale, can be useful for inferring when the environment was suitable for occupation and how changes affected what people used the site for.

Medium scale analysis will focus on comparisons with other sites within the region to form an approximation of landuse strategy and the role that Butte Lake played at various points in time. By doing this, a basic understanding of the role of environment can illuminate changes in resource scheduling at the site reflected in the behavioral correlates including lithic assemblage, features, and faunal remains. This type of analysis will also be used to examine evidence of long distance or large scale trade networks.

Large scale analysis will focus primarily on the cultural chronology of the region and the specific weapon strategies used within each tradition, as well as the substance foci and settlement patterns evident within each occupational component.

Climate and Technological Organization

Information regarding technological and settlement-subsistence response to ecological conditioning is ambiguous in nature and tends to rely most heavily on stone artifacts and associated fauna and taphonomy to explain the presence or absence of formal tools within an archaeological context. This thesis examines technological organization at Butte Lake as a response to climate change. Artifacts recorded during the 2012 field season, provides the most reliable provenience data and are examined at a number of levels including artifact class, lithic material classification, attribute, size class, spatial distribution, feature, and occupational component. While all levels of examination are important, analysis of occupational components provides the most useful link to the potential implications associated with climate change in the region.

How and why technology changes over time requires a basic understanding of time, or more specifically the climate constraints placed on resources over time. In general, archaeologists ascribe cultural meaning to artifacts based on classification, description, and analysis of attributes. Scale can be established by applying a controlled use of analogy in archaeological reasoning where hypothesis can be tested through experiment or comparison. The use of hypothetico-deductive epistemology, is built on the recognition that there are no absolute truths but that conclusions and theories should be continuously tested and encourages the ongoing establishment of new theories and the search for new observations and experiments to confirm or refute a hypothesis.

Comparison by observation and classification are important because they can lead to an understanding of mechanics, measurement, quantification, and new concepts while experimentation is essentially observation under controlled conditions (Mayr 1982). Experimental archaeology for example, provides a comparative scale by which to examine particular attributes such as those recorded in lithic debitage, but due to the paucity of linking arguments between human behavior and those attributes, direct analysis of the lithic assemblage at a site is limited to data exploration and pattern identification.

Behavior is not technology represented by a tool, but rather a conditioned response to risk, and risk should be viewed within the analytic framework of cost-benefit arguments (Bamforth and Bleed 1997). Specific technological knowledge includes not only how to use a tool, but also how to acquire and construct the tool. Based on the cost-benefit argument, all flake stone technology must solve problems of material availability, must produce adequate tools for a task, and must accomplish the desired results from use of the technology. People use technology to manipulate their environment, and since variation in the environment is at least partially predictable (e.g. seasonal change), response to risk should be an ongoing concern as preparation for predictable change.

Seasonal variation can greatly affect both the supply and demand as well as the effective utility of tools (Elston and Brantingham 2002; Waguespack et al. 2009) which optimally, must be reliable and maintainable relative to the conditions being used (Bleed 1986). For example, the replication of performance characteristics of both organic and flaked stone points through experimentation (Ellis 1997; Knecht 1993, 1997) has lead to conclusions that while the morphology of organic tools is limited, and the time required to make them is considerably more than stone points, they are far more durable in cold weather, they are relatively easy to repair, and they are reusable. Shifts in technology or innovation may then be the result of limited material availability and a need to maximize technological investment in such attributes as the amount of cutting edge for example (Sheets and Muto 1972). The use of organic tools then can be viewed as a means of managing risk through material conservation when procurement is hindered (i.e. snow cover) or materials are susceptible to cold weather breakage (Bleed 1986; Elston and Brantingham 2002; Mason et al. 2001; Waguespack et al. 2009).

This view may be supported by the peak in composite microblade technology during an extended period of cooling between 8,500 and 8,000 cal BP (Mason et al. 2001; Potter 2008b), and may also reflect seasonality as a function of variability in subsistence-settlement patterns and lithic procurement strategies (Potter 2008b). In addition, such strategies should be reflected in the material culture as local and regional climate oscillations impose long term climate forcing adaptations such as material conservation.

Site Use and Faunal Assemblage Patterning

The assemblage of faunal remains in an archaeological context can be useful for inferring a great deal about site use, site structure, seasonality, and available resources for example. However, the examination of the faunal material should not proceed within a vacuum contrived of statistical analyses used to identify differential transport and fragmentation as a product of decision making or taphonomic processes alone, but must include when possible, an analysis of spatial density and cultural features directly, indirectly, or provisionally associated with the remains, as well as the lithic artifacts. Confronting site use and assemblage patterning, also requires the limited use of ethnographic proxy for forming and exploring hypotheses about the remains.

The site at Butte Lake Northeast, contains faunal remains from only a single occupational component, however, the use of ethnographic proxy in concert with climate proxies can provide a useful baseline for exploring site use and seasonality within each occupational component. Several site types in the region for example, can be linked to the presence or absence of faunal remains, as well as the type of faunal remains, features, and lithic assemblage. For example, ethnographic subsistence has focused on the pursuit of caribou in the study area, and however limited, this focus can be extended to the distant past and the Northern Archaic Tradition based on the number of components in upland settings associated with caribou remains (de Laguna and McClellan 1981; Dixon et al. 1985; Esdale 2008; Gillespie 1992; Ketz 1982; Potter 2008a; Skeete 2008).

Pollen analysis is inadequate for producing quantitative data about the representation of lichen among understory species, therefore climate proxies and ethnographic records may provide the most valuable information. The caribou diet, which is weighted toward the consumption of lichen, can tolerate a diverse number of shrubs, including willow and birch. Moose also tolerate a diverse number of plants, but willow, birch, and aspen constitute nearly 90 percent of the diet, and moose rarely consume lichen. Caribou have traditionally been successful in cold and arid conditions and warm summers may inhibit lichen production. Deep snow can also keep caribou from reaching forage, thus snowfall may contribute to the southern extent of caribou populations (Mason et al. 2001). Warm winters are also a hindrance as freezing rain can prevent caribou from reaching forage leading to higher calf mortality, and refreezing rivers can slow migration.

The modern Nelchina herd has been associated with archaeological sites throughout the region (Ketz 1982). The Nelchina heard shares a common winter range with three other major interior herds in the eastern interior. The herd makes an annual migration south through the Alaska range and across Paxson Lake and the Gulkana uplands to their calving grounds on the Nelchina River (Brown 2005). The herd summers in the northern reaches of the Talkeetna Mountains, Chulitna Mountains, and into the Monahan Flats and Tangle Lakes area (Schwanke 2011). Figure 2-1 provides a generalized model of this annual migration and includes the seasonal distribution of the Nelchina herd based on geospatial data acquired from the State of Alaska Department of Natural Resources Geodatabase Clearinghouse.

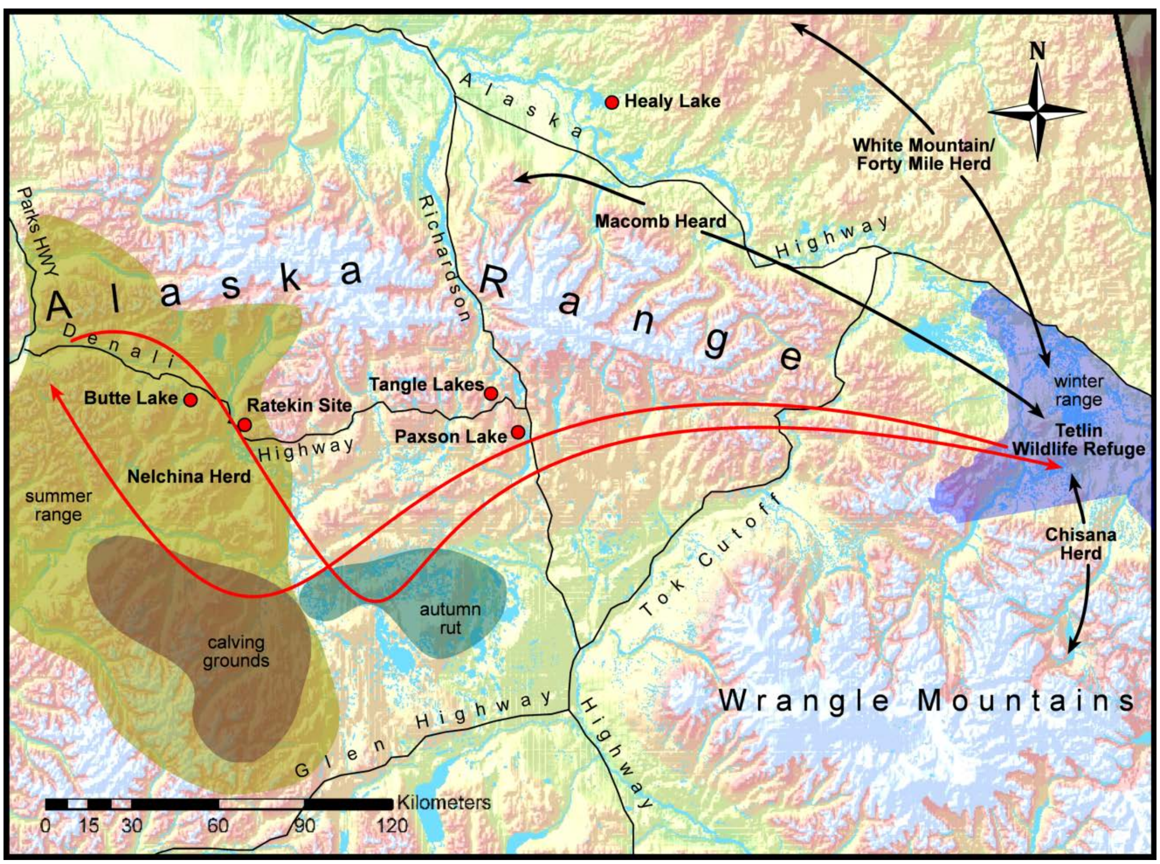

Figure 2-1. General migration and seasonal habitat of the Nelchina caribou herd.

Field and Lab Methods

Fine grain recording of in-situ material was undertaken in order to more accurately map the density of artifacts over time, thus allowing for a controlled reconstruction of the site including artifacts and faunal remains and any clear separation of components within the stratigraphic column. The sampling strategy was crafted as a response to the earlier excavation at Butte Lake Northeast where depth provenience lacks consistency and artifacts are grouped within major units of natural stratigraphy (up to ~30cm deep). Although the site was clearly divided into multiple cultural components consisting of materials attributed to particular cultural traditions or complexes, assessing separation between the components has been a primary focus of this research. While the total station provides valuable data points, photographic images and plan views have proven especially useful for reconstructing site structure

Lab analysis was undertaken at various levels on all data recorded in the field. All lithic materials uncovered in-situ were recorded with a Leica tcr407 total station. All faunal material with diagnostic properties were also recorded with the total station. Points recorded with the total station have been used to generate 3-dimensional maps and separate components. High density lithic concentrations and features were collected as matrices. The starting and ending depth of each matrix as well as the observable borders were recorded with the total station. Likewise, a control matrix was also collected from a provenience similar to each of the sample matrices for lab comparison. All matrices including soil samples have been partially analyzed by using nested sieves. The methods and results are presented in Chapter Four.

Radiocarbon samples were collected directly from the hearth matrices. All charcoal samples used for radiocarbon dating were later identified by genus however species was difficult to determine. Radiocarbon dating was conducted using Accelerator Mass Spectrometry (AMS), the results will be presented in Chapter Four. Further description of field methods and excavation protocols will also be presented in detail in Chapter Four. Behavior represented within the lithic assemblage will be addressed using traditional analytical approaches (Ahler 1989; Andrefsky 2005; Kuhn 1994; Shott 1994;

Sullivan and Rozen 1985). All lithic material with the exception of those recovered from matrices that are less than 3milimeters in greatest dimension, have been measured and described using the methods described in Chapter Five. All identifiable fauna was also measured, described, and analyzed in Chapter Six using traditional analytical methods (Behrensmeyer 1978; Binford 1978b; Lyman 1994; Lyman 2008; Reitz and Wing 2008; Villa and Mahieu 1991).

Chapter Three. Ethnographic and Climate Models

Ahtna Ethnographic Subsistence and Environment

Expectations

Problems that underscore the understanding of resource use by prehistoric people are often compounded by the limited data from the archaeological context regarding landuse patterns. Additionally, people by definition are highly adaptable as a product of culture, possibly too adaptable to limit the identification of predictable behavior as a pattern that can accurately be represented as a use of landscape. Part of this problem might be overcome with the limited application of modern ethnographic proxy from the study area, to identify and categorize how resources are used by ethnographic inhabitants. These would include a general understanding of geographic assets and limitation, traditional annual and seasonal subsistence patterns, and technology and the use of plants and animals. The ethnographic model provides an expectation that the site will produce data consistent with the ethnographic record. Inconsistencies are then expected to produce greater insight into site use that may or may not be indicated in the ethnographic record.

The ethnographic model for this project focuses on the subsistence practices of post-contact Athabascans, and in particular on the area traditionally inhabited by the Western Ahtna. This chapter provides a summary survey of the ethnographic use of land and resources in the Upper Susitna River drainage, Copper River basin, and the Gulkana uplands by identifying resources utilized by prehistoric humans (based on modern ethnographic proxies), habitation requirements for those resources, and the seasonal availability of these resources, with the ultimate goal of generating expectations regarding seasonal use of the landscape at Butte Lake.

For the purposes of this study, ethnographies conducted in or near the study area as well as at least one from a more northern latitude will be used. The reason for these differences is to account for the modern local traditional routes as well as resource uses that pertain both to local modern populations and modern populations who utilize resources typically associated with the upland study area and the time period prior to local primary use of salmon and salmon streams associated with the Athabascan Tradition. The following section will provide: (1) a geographic overview of the study area, (2) a brief ethnographic description of the study area, including traditional annual and seasonal subsistence systems and technology, (3) an ethnographic account of the seasonal round of the Cantwell-Denali Band of the Ahtna and the importance of Butte Lake, and (4) a discussion regarding a possible course of action for illuminating problems understanding upland seasonality.

Physiographic and Environmental Setting

The Copper River drainage makes up the main body of the region. The drainage is surrounded by massive mountains, permanent ice fields, glaciers, high rugged peaks, and narrow passages. They include the Alaska Range in the north, the Wrangell Mountains in the east, the Chugach Range to the south, and the Talkeetna Mountains in the west (Wahrhaftig 1960). This makes up the primary source of the Copper River drainage.

The Copper River basin runs between 610 and 914 m asl (2,000 and 3,000 feet above sea level), with the majority of the flat land at about 610 m asl. Spruce and poplar cover the wide level benches and at about 900 m asl the mountains rise steeply (Reckord 1983:7). The ice fields in the mountains affect the water system. Most of the rivers run cold, fast, and silty during the summer. Glacial Lake Ahtna existed only 5,000 years ago and covered most of the basin (Reckord 1983:7). Temperatures in the region range from 35°C (95°F) to -54°C (-65°F). The overall temperature swing is about 89°C (165°F) with the coldest temperatures occurring at the lowest points in the basin, particularly near the river (Reckord 1983:7). The mean annual temperature in the region is -4°C (Shulski and Wendler 2007). The region receives between 10 and 31cm of precipitation per year, most of it in the form of snow typically 1 to 1.5 meters deep in most places (Shulski and Wendler 2007). The rivers and lakes freeze solid around the end of October and remain this way until the end of April. Breakup is typically in late April and May (Reckord 1983; Shulski and Wendler 2007).

The Copper River valley has a typical boreal environment. Moose, caribou, Dall sheep, mountain goat (*Oreamnos americanus*), porcupine (*Erethizon dorsatum*), beaver (*Castor canadensis*), hare (*Lepus americanus*), lynx (*Lynx canadensis*), arctic ground squirrel (*Urocitellus parryii*), red squirrel (*Tamiasciurus hudsonicus*) black bear (*Ursus americanus*), red fox (*Vulpes fulva*), otter (*Lutra canadensis*), and birds are plentiful during different seasons. Salmon run in large numbers in the region starting in the spring and continuing into the autumn. Temporal fluctuations in both plant and animal populations characterize the region and are central to subsistence. Varied topography, subdivide the region into biomes and each biome can exhibits differences in climate as well as flora and fauna.

The ethnographic region of focus is east of the Cantwell Mountains, south of the Alaska Range and north of and including the Talkeetna Mountains to the Fog Creek Upland. The study area is limited to the south and southwest by the upper Susitna River, Susitna River Canyon, and its tributaries. The area is also limited to the east by the Gulkana Upland, to the north by the Clear Water Mountains and the northwest by the Upper Delta River Drainage. The area covered by this summary equals approximately 20,000 square kilometers.

The Talkeetna Mountains are an oval highland with a compact group of extremely rugged ridges from 1830 to nearly 2700 m asl with few passes and steep U-shaped valleys. The Fog Creek upland separates the Talkeetna Mountains from the Chulitna Mountains to the southwest. The Susitna River flows across the Talkeetna Mountains in a steep narrow gorge that in places is over 300 meters deep (Wahrhaftig 1960:57).

The Clearwater mountains to the north consist of two or three rugged east-trending ridges that rise to altitudes of 1677 to nearly 2000 m asl and are separated by valleys 900 to 1067 meters high (Wahrhaftig 1960:59). The Clearwater Mountains are drained by the Susitna River.

The Gulkana Upland consists of east-trending ridges that are separated by lowlands 3 to 16 kilometers wide. The ridge crests are 1067 to 1677 meters in altitude and 6 to 24 kilometers apart, cut at 8 to 24 kilometers intervals by notches and gaps that were eroded by glaciers or glacial melt water. The lowland floor shows morainal and stagnant ice topography with large esker systems (Wahrhaftig 1960:60). The southeastern and eastern part drains south via the Gulkana River; the western extent drains southwest to the Susitna River; and the north-central portion drains north via the Delta River (Wahrhaftig 1960:60). Tangle Lakes, a series of long narrow and irregular lakes, occupy the rock-cut basins and morainal topography (Wahrhaftig 1960:60).

Subsistence Use of Plants and Animals

Caribou roam in great herds on the higher plains in the northern and western areas of the region. Dall sheep occupy the higher elevations of the surrounding mountain ranges and only rarely travel into the lowland riverine ecozones. They are primarily used as food with peripheral use of horn (Reckord 1986; Simeone 2006). While berries and rhubarb (*Poygonum alaskanum*) grow in abundance in the southern areas where the ecological influence of the coast is apparent, the upper river valleys produce significantly fewer species of berries. The intraregional variation is the primary cause for diversity of human settlement type and pattern and social organization in the Ahtna region (Reckord 1986).

Tools were typically fashioned from locally available resources, and copper hammered from nuggets found in several streams from the region is the signature material for the Ahtna tool kit (Workman 1976). Additionally, materials such as bone, antler, and stone were used. Furs, skins, sheep horn, bark, sinew, porcupine quills, fish skins and igneous cobbles were also common materials (Reckord 1983; Workman 1976).

Plants such as spruce, quaking aspen, and balsam poplar were typically used as fire wood for cooking and heating. White spruce (*Picea glauca*), was usually cut during the winter, and was also used for various types of construction including canoe frames (traditionally covered by birch bark or skin), paddles, tent poles, beaver snare toggles, temporary bridges, poles for pushing boats in shallow water, drying racks, and handles. Rotten spruce is used for smudge fires to keep flies away from drying racks and for smoking hides. Spruce bows also make good bedding when camping. Spruce pitch is used as medicine on infections and sores, and spruce gum is chewed (Nelson 1986:33-38). The roots are also used for making dipnets (Reckord 1983:26).

Paper birch (*Betula papyrifera*) was also used as firewood because it is dense, slow burning, and burns when green. It is also used for toboggans, hardwood sleds, and snowshoe frames. Most notably is the use of the bark for baskets, cache lining, and material for canoe skins before being replaced by canvas in the historic era (Nelson 1986; Reckord 1986). Birch fungus (*Fomes igniarius*) is used for starting fires, where flint is sparked into the fungus which is highly combustible and makes good kindling material (Nelson 1986).

Willow (*Salix* sp.) and alders (*Alnus* sp.) are also sometimes used for firewood especially in environments where other fuel sources are not readily available. The inner fiber of willow bark is also used to make fishing lines and was used for food during times of starvation. Willow is also used in the construction of fish traps. This type of vegetation grows very thick and can be a difficult obstacle when traveling, leading to the use of well maintained trails throughout this vegetation type. These plants can be very useful in the construction of fence lines used for corralling herding animals such as caribou, sheep, and moose (Nelson 1986).

Low bush cranberries (*Vaccinium vitis*), rose hips (*Rosa acicularis*), blue berries (*Vaccinium uliginosum*) , Labrador tea (*Ledum palustre decumbens*), and wild rhubarb are all utilized seasonally as food (Nelson 1986).

Moose are browsing animals that feed on the shoots of willow, birch and aspen. Their habitat is best in thickets along stream, rivers, and lakes. During the spring, they are attracted to meadows to graze on sedges and pond weeds. The general fearlessness of bulls and predictability of location, makes hunting during the rut ideal in the interior (Nelson 1986). Moose move up and down during the winter months and descend into the river valleys during the spring and then move “all over the country” during the summer feeding wherever the feeding is good (Nelson 1986:87).

Salmon is the primary subsistence resource along the Copper River basin. Spawning salmon were taken in the late spring and summer. Whitefish and grayling play an important role in the western Ahtna region, particularly on the lakes where they provide a stable food source during the winter months. Two forms of fishing, hook and line and fish traps, are historically available and could also have been present earlier based on the archaeological record (Workman 1976, 1977). Fish traps are typically laid in creeks and are made of willow and/or rawhide (Nelson 1986:57). Ice fishing on rivers and lakes could be done by either hook and line, or spear (Nelson 1986:66). Fish bones were often saved in birch bark boxes for use in broth during times of starvation or were cached in trees for retrieval at a later date (Reckord 1986:33). Much of the time however, fish bones were deposited back into the water to keep other animals away from camp (de Laguna and McClellan 1981). While fish are important across the Ahtna region, they are just as unpredictable and susceptible to the types of population fluctuations observed in other resources.

Migratory waterfowl is typically hunted along rivers and on lakes and spring hunting typically occurs on land. The availability of migratory waterfowl is susceptible to variation in weather, particularly temperature variations and prevailing winds. Summer hunting on lakes require the use of the canoe. Molting ducks for example, are susceptible to herding and can be taken in large numbers, which in turn required large numbers of hunters in canoes (Nelson 1986). Upland birds such as Grouse and Ptarmigan have cyclical population outputs and are hunted frequently. Upland birds are typically taken during the winter months using snare made of little twigs in areas where these birds are often encountered (Nelson 1986:81). Snowshoe hare is often captured in the same manner.

While highly cyclical, snowshoe hare is a staple when available, especially during the winter when their trails are visible. If hunting animals with a projectile technology, such as blunt arrows, cooperative hunting and herding hare was common (Nelson

1986:133). Besides its use as a food, the skin is dried and used as socks, insoles, for lining in mittens, and as a scarf (Nelson 1986:142).

Red squirrel and arctic ground squirrel can be caught by snare and are also used for food. The utilization of the animal was very important; fat was collected from most animal during the meat-drying process, including the grease from squirrels. Slow cooking allowed for the rendering of fat into small birch bark or carved wood pans and the grease was seasonally prepared with blueberries (Reckord 1986:33). Squirrel bones were also ground down for soup for invalids (Reckord 1986:33).

The Ahtna snare marten, ermine, mink, river otter, wolverine, and muskrat for both trade and material needs such as clothing, blanket, packs, tents, and bags (Reckord 1983:26). Jaw bones of some furbearers' such as beaver have been fashioned into implements and have been unearthed on archaeological sites. Although taken with snares and used for some purpose, fur bearing animals were most likely peripheral to the prehistoric subsistence economy.

Caribou is primarily used as food. The Ahtna distinguish between migratory barren ground caribou and woodland or mountain caribou called *ts'igge'c'estsiine'*, literally 'local meat' (Simeone 2006:3). The mountain caribou tends to be larger and heavier with larger antlers, and the meat, according to informants tastes more like moose (Simeone 2006:3). Calves were killed for meat and skin. Skin is used to make socks and parkas (Simeone 2006:8).

Game fences are common in the region and were built by hunters who would gather scrub brush found along stream beds and bending saplings over a moose trail to channel moose down into stream beds or narrow canyons to be speared. The Ahtna distinguish between a linear game fence – used for either moose or caribou (*tsic*) – and a caribou corral (*tl'aztaani*) (Kari 1990:494). Moose were more often caught in single snares placed along a trail or in snares set in long fences that ran straight across the land. Because caribou are gregarious they can be guided into a corral. Snares were then set inside the corral. These snares entangle the caribou until they can be dispatched with a spear or knife (Simeone 2006:5).

The hunting canoe is used on rivers and lakes and is important for summer travel, as it is small, light and easy to potage between lakes. The *kayak-form* canoe is typical among nearly all Athabascan peoples (Nelson 1986). The kayak-form canoe was widely employed in the northwest and was highly developed in both model and construction. It was essentially a portage and hunting craft, ranging in length from 3.5 to 5.5 meters, with a beam width of 61 to 69 centimeters and a depth between 23 and 31 centimeters. In areas where the Kayak-form was used as a family and cargo canoe, the length would be as great as 6 to nearly 9 meters and the beam might reach 76 centimeters (Nelson 1986:44). These canoes are swift and easy to paddle making them ideal for the environment in which they are used, although they also tend to be unstable and prone to swamping in rough water (Nelson 1986:44). Methods for capturing caribou include spearing from skin boats on lakes. The Ahtna word *silnidaek* means to" kill caribou from a canoe with a spear" (Simeone 2006:33). Fences or drive lines were built for herding the caribou into lakes or through box canyons.

Hunting is only one step in food preparation. After animals are secured, the meat is boned and then smoked. Once the meat has been prepared, the hunter moves down the trail and stops at predetermined relay spots with high drying racks to continue the preservation process. All of the heavy items (bones, head , and hooves) are consumed at camp (Simeone 2006:39). Food belonged to the individual that acquired it, but, "the distribution of food was an integral part of the traditional Ahtna culture and took place both informally and formally" (Simeone 2006:40).

Ahtna Ethnography

Traditionally, there are three main Ahtna clans (Reckord 1983:10). The Red Paint clan are believed to have come north from the coast and through Wood Canyon, up the Copper River. The Sea Otter clan is said to have come from the west and Cook Inlet. The Caribou clan is thought to be indigenous to the caribou-rich areas associated with the Central and Western Ahtna (Reckord 1983:10). Archaeological excavations in the 1970's by Bill Workman indicate that trade with the coast existed some 700 yBP.

Traditional Ahtna territory covers an area of 37,000 square kilometers including the entire Copper River drainage and the upper ends of the Matanuska, Talkeetna, and Susitna River drainages. Within that area are four groups corresponding to the four dialects of the Ahtna language and four geographical sub regions (de Laguna and McClellan 1981:641-642). The Upper Ahtna territory included the upper Copper River, from around the mouth of the Sanford River to the upper Slana River and Tanada and Copper Lakes and the modern villages of Chistochina and Mentasta (Simeone 2006:26). The Lower Ahtna territory encompassed the entire Chitina River drainage and the Copper River from below Wood Canyon to at the mouth of the Tazlina River. Today this area includes the villages of Chitina, Copper Center and Tazlina (Simeone 2006:26). The Central Ahtna territory included the lake district of the Copper River lowlands westward to Lake Louise and the Gulkana and Gakona River drainages. The modern villages of Gulkana and Gakona are included in this area (Simeone 2006:26). The Western Ahtna territory included the area around Lake Louise and the drainages of the upper Susitna and Matanuska Rivers (Simeone 2006:26). Most Western Ahtna now live in the village of Cantwell and are referred to as the Cantwell-Denali Band.

The Western Ahtna (the inhabitants of the study area – *Hwtsaay hwt'aene*) lived on the lakes dotting the higher elevations between the present day Glenn and Denali highways (Kari 2008, 2010). These people are known as the little tree people and inhabited an area not dominated by the Copper River. Trade in the region was directed toward the Dená ina region south of the Susitna River and down the Susitna River and Matanuska River to Cook Inlet through matrilineal relationships (Reckord 1983:30). The primary resource available in this area was caribou as opposed to the salmon exploited by most Ahtna (Reckord 1983:30). According to genealogies, the western villages were small and usually centered around male sibling groups, and made the region distinct in social organization and subsistence orientation (Reckord 1983:30).

The Ahtna have traditionally followed an annual routine that was based on a sophisticated knowledge of animal behavior and availability. A simplified model illustrated in Table 3-1 describes the relation of season to subsistence activities. Animals central to this pattern include salmon, caribou, moose, black bear, arctic hare, Dall sheep, mountain goat in coastal mountains, beaver, porcupine, lynx, arctic ground squirrel, various species of freshwater fish, waterfowl (migratory birds), and upland fowl (Reckord 1983:25). Through planning and efficient storage in underground caches, the Ahtna were able to hedge against both seasons of little and temporal fluctuations in subsistence productivity (Reckord 1983:24). This pattern reflects the intensification of subsistence practices during the long summer days and limitations imposed by little sunlight during the long winter months. This research focuses primarily on the ethnographic use of upland resources during the late summer and fall.

Table 3-1. Adapted from Potter 1997 Table 2; page 10.

Month	***Settlement***	***Resource***	***Exploitation Method***
November	Winter village	stored fish and meat	cached supplies
December		whitefish, etc.	caught through the ice
January		small mammals (hare, etc.)	snared
February		muskrat	snared on small lakes
March			
April	starvation period	stored fish and meat	cached supplies
May	Fishing camps (1-3 kilometers from winter village)	salmon	dip nets (in glacial streams), speared or harpooned (in clear water streams)
June			
July			
August	dispersal to highland areas		cached supplies
	Hunting camps	moose, caribou (fall migration)	drives, drag poles, and snares
September		caribou, sheep and goat, moose, non-anadromous fish, berries	
October		caribou, game animals	trapping and hunting

For the Ahtna living on the Copper River, the subsistence season is initiated with the return of salmon in the spring . People would gather annually at fish camps in the river lowlands, or at the lake outlets and streams for the purpose of gaining access to salmon (Reckord 1983:26). Once salmon were caught, they were hung to dry and smoked with alder for preservation. Fish were caught using large spruce root dipnets, after which, the fish was cut and spread on green branches. They would then smoke the fish and store it in birch bark baskets placed underground in a cache (Reckord 1983:26). Large caches were usually lined with birch bark in sheets and then filled with baskets of foodstuffs, each basket holding only one kind of item, such as berries, fish, etc. (Reckord 1983:34)

After the salmon runs ended in mid-August, the people would move to the upland hunting grounds where they would hunt caribou, sheep, goats and moose well into the first snows. The men hunted on traditional locations and the women would collect berries and other vegetables that were ripe during the fall (Reckord 1983:27). Meat and vegetation were cached until freeze-up when travel became easy. Moose hunted throughout the winter was opportunistic in nature and depended on encounters as they came into the areas where browsing was easier, particularly along the river banks (Reckord 1983:27; Nelson 1986:87). Beaver, lynx and goat were also taken during the winter by hunters with snow shoes (Nelson 1986; Reckord 1983).

Hunger and starvation were common in the spring prior to the first salmon in the lowlands (Reckord 1986:35). During this time, hare, whitefish, grayling, and muskrat became very important. If a particular species, such as caribou became abundant in an area, it would attract people from throughout the region.

The cyclic or non-cyclic fluctuation in almost every significant food resource had an effect on local populations. Five potentially critical resources – moose, fish, snowshoe hare, grouse, and muskrat, experience changes of considerable magnitude, while waterfowl and caribou are subject to changes in annual availability resulting from prevailing weather condition or migratory patterns. During a given year some species are likely to be abundant, others uncommon or rare; but there is usually some resource to fall back on. There are times, however, when all important resources coincide with a low ebb leaving populations vulnerable to starvation (Nelson 1986: 276). The variability and availability of resources during the year, and year to year, have led to strategic choices at each point in the annual cycle to stave off starvation (Reckord 1983:27).

Ethnographic Site Types

In the archaeological record, several site types are representative of the seasonal round and subsistence focus (Table 3-2). Based partially on Binford (1978b) and Skeete (2008), a model of site types has been crafted for the purpose of recognizing variation based on site attributes that include location, season, archaeology, fauna, activities, and structures.

Transitory/overnight camps for example are identified by the absence of cache pits and structures. Faunal remains typically consist of the burned or calcined remains of small game that has been transported from a kill site and disposed of in a hearth feature. Often times, bones will be disposed of in a river completely eliminating the presence of faunal remains from this type of site. Lithic material will consist of broken hunting gear or debitage related to tool maintenance or production.

Kill/processing sites typically contain only low utility faunal elements and will be located some distance from a base camp as part of a logistical subsistence strategy. Most often, highly fragmented and calcined cranial fragments along with metapodials and phalanges remain at these sites unless they are required for tool manufacture or grease production. This type of site would not exhibit high utility elements or small game, as these are expected to be removed to the base camp for further processing. Kill/processing sites will also be located in areas conducive to ambush, trapping, or otherwise disadvantaging prey such as a box canyon or lake. Lithic material would include broken hunting gear or field processing gear and related debitage. Typically, only highly curated male tool kits will be associated with this site type.

Family camps are typically centered on hunting, trapping, and processing small animals. Large animals would also be processed for marrow and grease making them highly fragmented, and will typically include only high utility elements. Faunal remains are most often burned or calcined and directly associated with a hearth. Typically, structures such as house or cache-pits will not be associated with this site type. Lithic material will include both highly curated hunting gear and processing tools as well as edge modified flakes to facilitate processing.

Winter villages are located along clear water rivers and streams and will include multiple semi-subterranean house features and cache-pits. Typically, small game hunting will result in faunal material at the site, and only high utility elements from large ungulates will be associated with this site type, however, this site type will also exhibit marrow, grease, and fat processing areas. Winter villages will also contain high quantities of fire cracked rock, hunting, butchering, processing, and tools associated with the manufacture of clothing, as well as debitage associated with tool maintenance. Highly curated and expedient tools will also be present. Organic tools are often prevalent at this type of site, as is the likelihood of European trade goods.

Hunting camps are typically situated in upland settings and are most often associated with caribou remains. House features are not expected but cache-pits are not uncommon. Animals are typically killed and butchered away from this site type. Select elements are brought back to the camp for further processing and drying, grease, and marrow processing will take place for the duration of the stay. Faunal remains are expected to be highly fragmented and burned/calcined due to extensive processing and will often be associated with large hearth features. Highly curated tool kits for both hunting and butchering will also be expected as will expedient tools and debitage associated with tool maintenance. Both anvil and hammer stones will also be present at this site type.

Table 3-2. Summary of site-type model.

Site Type	*Location*	*Season*	*Archaeology*	*Skeletal Elements*	*Activities*	*Structures*
Transitory/over night	Primarily on high ground throughout the procurement range	spring to fall	fire cracked rock, hunting and processing tools	burned/calcined and unburned bone, small animals, low utility elements	tool maintenance, processing, fishing	temporary structures, drying racks
Kill/processing	areas conducive to ambush, box canyon, lake, open landscape	year round	broken tools and weapons, highly curated male tool kits	small game, low utility elements, burned/calcined bone, cranial fragments	kill and butchering for transport	none
Family camps	uplands and lowlands, near clear water streams or lakes	spring to fall	highly curated tool kits and edge modified flakes	burned/calcined bone in hearth, high utility elements	processing for meat, grease, and marrow	temporary structures
Hunting camps	uplands, near clear water streams or lakes	spring to fall	highly curated and expedient tools and debitage, anvil and hammer stones, fire cracked rock, large hearth feature	high and low utility items, highly fragmented burned/calcined and unburned bone	extensive processing for meat, grease, and marrow	cache-pits, drying racks, temporary structures
Winter village	lowland settings along clear water streams and lakes	winter	fire cracked rock, hunting and processing tools, tools associated with clothing, debitage	small game and high utility elements, highly fragmented burned/calcined bone	processing of meat, grease, and marrow, long term storage, butchering	semi-subterranean house features, cache pits

Cantwell-Denali Ethnography and Butte Lake

Butte Lake is located within the traditional Western Ahtna region bounded to the west by the McLaren River, to the east by the Chulitna River, to the south by the Susitna River, and to the north by the confluence of the Yanert and Nenana Rivers (Greiser et al. 1985). Three bands are associated with the historic period, the Tyone, Talkeetna, and the

Cantwell-Denali (Greiser et al. 1985). Both the Talkeetna and Tyone bands have direct access to salmon while the Cantwell-Denali band rely much more heavily on caribou for most of the year, requiring more mobility. A basic pattern of seasonal mobility that included Butte Lake was constructed by R.C. Betts (1985) from interviews with Ahtna elders in Cantwell, Alaska. Figure 3-1 presents a model of overland and water travel during the late summer and fall based on those interviews. The following section relates the knowledge imparted during those interviews and focuses on the role the region played during the fall caribou migration.

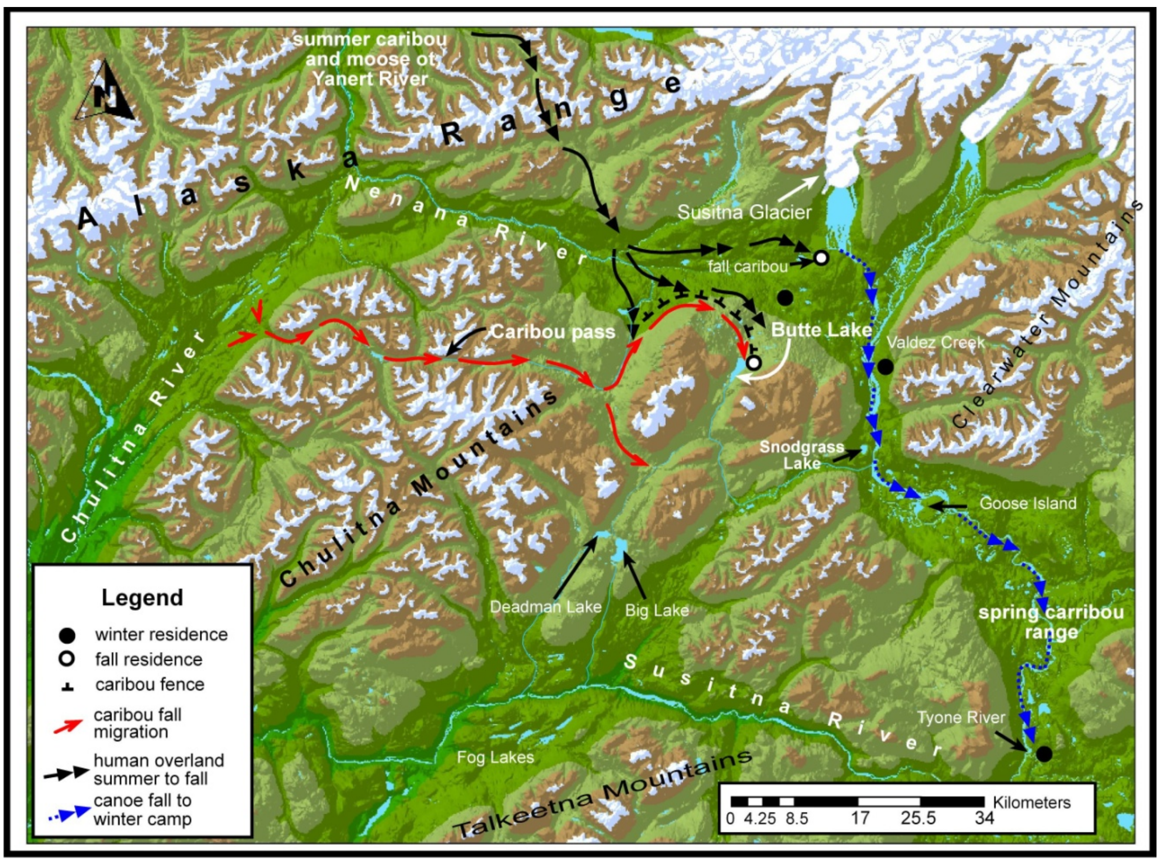

Figure 3-1. Generalized map of ethnographic seasonal round.

Much of the fall caribou hunting occurred in the vicinity of the West fork and Susitna Glaciers. Caribou are often found near glaciers and windy ridges during the summer and fall, where insect activity is substantially reduced . Ice patch research

(Dixon et al. 2005; Farnell et al. 2004; Hare et al. 2004; Vanderhoek, Tedor, et al. 2007; Vanderhoek, Wygal, et al. 2007) has produced evidence strongly suggesting that prehistoric people utilized this type of resource to ambush large mammals for at least the past 8000 years. During ethnographic period, five to six families would typically hunt and then dry the meat on open racks taking advantage of the wind produced by the glaciers. Once the meat was dried, it would be transported via skin boat down the Susitna to Valdez Creek or the Tyone River where families would winter. Whitefish were harvested during the transit (Greiser et al. 1985).

The Ahtna used both skin and bark canoes, but only skin boats are mentioned for fall travel (Betts 1985). Wet skins were stretched over a spruce frame and stitched together with spruce root. Spruce gum was the used for waterproofing the seams (Betts 1985). The boats were capable of transporting considerable weight as noted by Lt. Allen (1887:56).

Winter caribou in the region was hunted using snares placed in draws and ravines that naturally channeled animals. Snares were checked often to insure against losses due to predation or decomposition. Typically, two to three families would camp together and remain far enough from the snares not to disturb, or alert animals to their presence (Betts 1985).

While salmon rarely come above Devil Canyon on the Susitna River, they were traded with other bands. Sheep was hunted during the winter when high altitude forage was hindered and their movement was restricted, making them easier to run down (Betts 1985). Along with caches of dried meat, fish, and berries, the Cantwell-Denali band snared small game including hare. Porcupine was eaten year round and was captured by smoking them out of their dens and would often produce many porcupines. Winter fishing was typically under taken with basket traps, occasionally yielding “hundreds of trout, lingcod, whitefish, and grayling” (Betts 1985).

During the spring and early summer, the Cantwell-Denali band moved northward to the upper Susitna region. Traditionally, movement of supplies across country to set up camps was accomplished on foot or with dog pack. Spring caribou migrations were very important to the Cantwell-Denali band. One major camp is located near Swampbuggy Lake north of the Denali Highway. Two archaeological sites, the Ratekin site and the Hosley Ridge site were first uncovered during the 1950's during the construction of the highway. Skarland and Keim (1958) describe the Ratekin site as a killing/butchering ground due to the large numbers of broken arrow heads, blades, and scrapers. Based on ethnographic accounts, this area was likely used to funnel caribou based on the presence of a narrow corridor with muskeg to the south and steep foothills to the north. Skarland and Keim (1958) suggest that the Hosley Ridge site was a drive location where weapons were prepared and used elsewhere based on the density of flaking debitage. They concluded that the caribou were driven into the lake and hunted by canoe. The majority of materials recorded at both sites were located on the surface over a large area. Swampbuggy Lake is home to large populations of ducks and muskrat and provides a good source of whitefish as well (Betts 1985). After the spring caribou harvest, the Cantwell-Denali band would move to the Yanert River for the summer. This pattern was drastically altered after the discovery of gold on Valdez Creek in 1903 (Betts 1985).

Like caribou, moose were also snared, but only appear to have arrived in Monahan Flat during the early 20th century. Bear, while not a major food source for the Cantwell-Denali band, were hunted with a lance made of straight birch and tipped with copper or bone. The lance was typically 6 to 9 centimeters in diameter and was planted in the ground during a charge to impale the animal (Betts 1985).

Butte Lake plays an important role in the seasonal subsistence as well. Ethnographically, Butte Lake was occupied by several families during the fall caribou migration. Caribou migrating through Caribou Pass, would often split in the Brushkana Creek drainage, some of the herd would head north toward Monahan Flat, and others south toward Deadman Lake (Figure 3-1) (Betts 1985). Drive fences were constructed to redirect some of the herd moving toward Monahan Flat, to Butte Lake.

Twenty five to thirty people would camp at different locations around the lake in order to drive the animals into the lake. Fences were constructed to appear as a line of people using sticks or poles as tall as a man with moss placed on top. Women and children would spread out along the fence to keep the caribou moving toward the lake, taking advantage of a tendency in caribou behavior to move parallel to linear features for some time before crossing (Betts 1985). Once in the lake, a hunter in a birch bark boat would paddle alongside two caribou swimming in tandem and spear the one to the outside. Caribou float when dead, but when wounded, tend to thrash violently. Spearing the animal closest to the boat was dangerous and could result in capsizing the boat or at worst, killing the hunter.

According to the Ahtna elders, caribou were butchered at a camp on the north end of the lake near the inlet stream. People would camp a short distance from the shore of the lake along the inlet creek due to the winds that come off the lake and the lack of firewood in the area. Fresh meat was not often eaten at the kill site, but dried first. Hunters typically gave away the caribou they killed to another family and ate only caribou that was given to them. Meat was butchered by everyone in camp. After the skin was removed, the animal was quartered. The antlers were hung and used to keep meat off the ground and clean while drying. Bones were smashed with stones to obtain marrow, which was then boiled to render the grease. The grease was placed in a basket or caribou stomach and frozen. Often berries and dried meat were mixed in with the grease before it was frozen. In addition to caribou; muskrat, hare, Arctic ground squirrel, fish and ducks were also captured at Butte Lake.

Small thumbnail scrapers were used to scrape the skin. The heart was dried and the tongue and head were eaten. Once the meet had been wind dried at the lake, it was carried down Canyon Creek using dog packs. Winter camp was typically established below tree line in the Monahan Flat where shelter and firewood were readily available (Betts 1985).

Discussion

Based on the ethnographic record and use of Butte Lake, excavation at the site should produce data consistent with that record. The site is expected to contain evidence of caribou processing in particular, complete with evidence of marrow processing, grease processing, and meat drying. Additionally, small scrapers and lithic debitage associated with the manufacture and maintenance of tools used for butchering and scraping hides should also be present if the ethnographic record provides an accurate account of activity at the site. Ethnographically, the kame at the northeast corner of Butte Lake should only produce evidence of kill and butchering activity and not a long term residence or camp site, which ethnographically would be located on the leeward side of the kame along the inlet stream and out of the wind. However, the presence of a house pit feature recorded on the kame in 1984 may contradict portions of the ethnographic record and force a reexamination of its interpretation.

Given the ethnographic accounts of the site and the continuity in technology and settlement-subsistence strategies over the past 6000 years, there is little reason to expect that the site would exhibit any substantial change over that period. However, if change is evident in site structure, site use, and technological attributes over time, then a causal relationship that underscores variation in temperature and precipitation may provide clues to how terrestrial biome affects resource scheduling and subsistence strategies in the region over time.

Climate Model

Expectations

Understanding the paleoclimate of the region, from the distant past to the present is important for several reasons. To begin with, present climate conditions promote particular terrestrial biomes and ecological conditions that are linked to two climate variables: temperature and effective moisture (precipitation minus evaporation). The present conditions can then be viewed in concert with the ethnographic model to generate a baseline scale that maps biome distribution and the effects on subsistence.

The graph in Figure 3-2 models the distribution of major terrestrial biomes using Whittaker's (1975) Biome-type classification scheme and includes an approximation of current climate conditions in the interior and the Cooper River basin (Shulski and Wendler 2007). Note for example that just a few degrees increase in mean annual temperature Celsius without an increase in effective moisture associated with periods of aridity can lead to adverse ecological conditions and possible desertification. Likewise, increased effective moisture associated with glacial advance can result in greater tundra or coniferous forests at warmer altitudes.

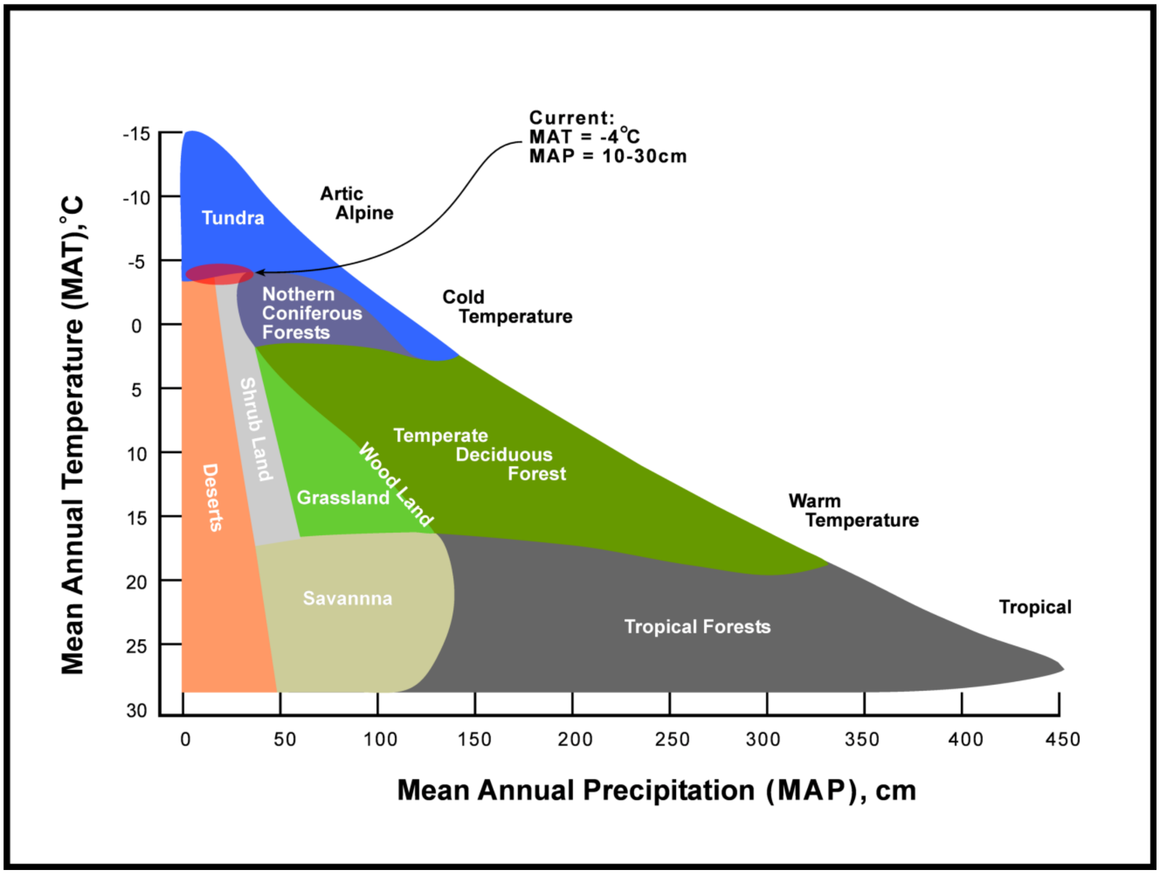

Figure 3-2. Distribution of major terrestrial biomes with respect to mean annual temperature and mean annual precipitation.

Paleoclimate data also provides a useful scale by which to measure the site chronologically. Although this data is imperfect, and interpretations of the timing and extent of regional chronozones may vary, the correlation between site occupation and climate does not appear to be circumstantial, and it should not be overlooked for its potential to generate hypothesis about risk coping and technological strategy during the Holocene as well as demographic and population shifts within and potentially, out of the region. Furthermore, based upon the expectation that the region or site is habitable only if adequate subsistence resources are available, sterile zones should correspond with periods that exceed some real threshold where economic returns based on caloric intake, are consistently lower than currency investments or caloric inputs. This suggests that while particular weapon strategies may result from specific hunting practices or species being pursued (Potter 2008a), it is equally plausible that weapon systems are linked to the availability of productive habitat that includes not only caloric resources, but also access to lithic and organic resources and that species is tangential to season of pursuit.

The following sections summarizes information based on an extensive literature review for the purpose of modeling climate and terrestrial biomes in the region. In these sections, climate is divided by major chronozones constructed from pollen cores that have been used to calculate temperature and effective moisture. The climate model will begin with an overview of climate conditions prior to the arrival of human occupants in the area adjacent to Butte Lake. Data derived from pollen cores analyzed by Rohr (2001) from Swampbuggy and Nutella Lakes (Figure 3-3) are used to approximate site specific climate expectations during the middle and late Holocene and evaluate site use based on those expectations.

Peat and lacustrine silt and clay data published in Reger and Bundtzen (1990:14) is used to provisionally date the last glacial retreat in the region adjacent to Butte Lake (see Figure 3-3 location of core samples and Table A-1 for dates). The samples originate from Watana Creek valley, Upper Deadman Creek Valley, a small lake south of Snodgrass Lake near the mouth of Butte Creek, Upper Boulder Creek, and at Cantwell Creek valley.

A pooled average was calculated to estimate an approximate age range for the last glacial retreat in the study area using IntCal09 (Table A-1.). Five out of six samples were statistically the same at two sigma and a sixth was statistically outside of the normal distribution of dates and was not included in this research. The difference in the sixth date, which was collected from the Denali Highway corridor near the Mclaren River Bridge, is likely the result of greater exposure to solar radiation and a lower altitude leading to earlier retreat at the location. The other five samples come from creek valleys at higher altitudes that are at least partially shaded by the surrounding topography. The mean pooled radiocarbon age for the these five samples is 9317 ± 85 rcy BP and range from 10710 to 10260 cal BP leading to the reasonable conclusion that deglaciation at Butte Lake occurred sometime after ca. 10,700 yBP . This date provides the lowest limiting age for site occupation.

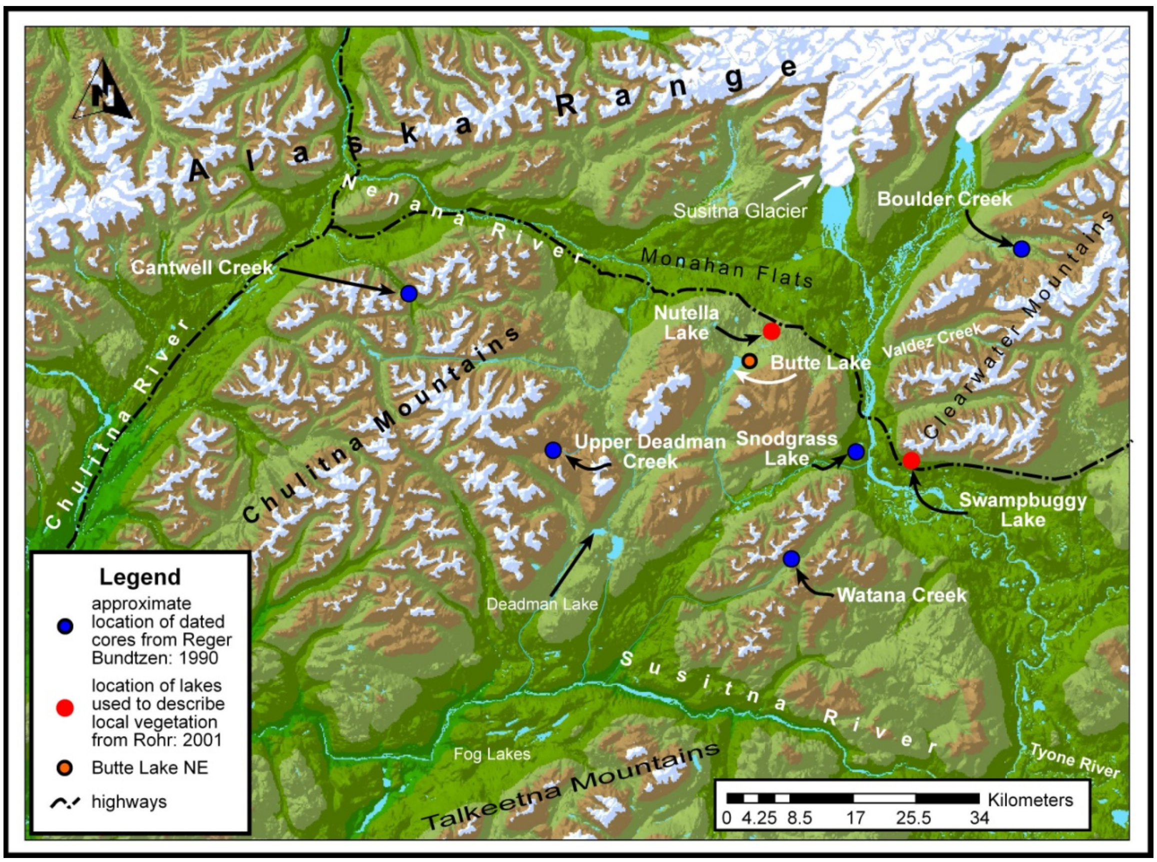

Figure 3-3. Core data locations.

Late Pleistocene

By the end of the Late Glacial Maximum (LGM) ca. 14,000 cal BP, the Alaskan climate was far drier and colder than present throughout the high latitudes and unglaciated parts of Beringia. Pollen reconstruction throughout Alaska (Bigelow et al. 2003) suggests that forests were highly restricted or even absent in Interior Alaska. The resulting mosaic of steppe and tundra biomes of the LGM are clearly different than those present in the interior today (Bigelow et al. 2003) and follows that so too would be the fauna exploiting those resources.

Following the LGM, the Younger Dryas (ca. 14,000 to 11,000 cal yBP) was marked by rapid warming and increasing effective moisture that had some effect on vegetation but apparently little effect on people (Bigelow and Powers 2001). From ca. 14,000 to 13,000 yBP, the vegetation regime underwent a shift from herb and forb to shrub tundra indicative of a major climate change. The change in climate is attributed to a shift in polar orbit that resulted in summers that were warmer than at present (ca. +6%), as well as winters that were colder than at present (ca. -20%) (Bigelow and Powers 2001:188). This combination resulted in the rapid expansion of cold adapted vegetation on the landscape and particularly shrub birch (*Betula sp.*) (Bigelow and Powers 2001) . While effective moisture was significantly less than modern levels, lake level analyses at Windmill Lake (North of the Alaska Range at an elevation of 640 m asl) and Birch Lake (in the Tanana Valley) rose markedly after 14,000 years to levels close to modern levels (Bigelow and Powers 2001). This is most likely due to glacial melt and thawing permafrost. Many of the earliest archaeological sites recorded in Alaska date from this period and are located in the middle of the Tanana River Valley and its tributaries that drain north from the Alaska Range.

Early Holocene

The Holocene Thermal Maximum (HTM) was concentrated in the northwest North America between ca. 11,000 and 9000 cal yBP and mean annual temperatures are estimated to be 1.6 ± 0.8°C higher than present day (Kaufman 2004). The HTM is associated with a substantial expansion of *Populus* and *Picea* (spruce). *Populus* usually grows in well drained floodplains (*P. balsamifera* [cottonwood]) or on south facing slopes (*P. tremuloides* [aspen]). The taxon thrives in warm summers and is not sensitive to winter cold (Bigelow and Powers 2001). Archaeological evidence suggests that the warmer summers attributed to this period may have been a hindrance to people in central Alaska, possibly due to pressures related to available water resources evident in lower than present lake levels throughout the region (Bigelow and Powers 2001; Mason et al. 2001). The Holocene Milankovitch thermal maximum (MM) occurs during this interval at ca. 10,000 to 9000 cal yBP and drove temperature 5° to 8° C above present in as few as 5 to 50 years (Hoek and Bos 2007; Mason and Bigelow 2008). Most occupations associated with the MM occur at higher elevations including the earliest occupations at Tangle Lakes (Mason et al. 2001). Change in the Alaska Range via documentation of archaeological contexts at Phipps and Whitmore Ridge, suggest that populations took advantage of changing habitat and adapted their subsistence strategy to opportunities presented in a grass and herb environment rather than abandon the region in pursuit of familiar flora and fauna regimes. By ca. 9000 yBP the climate was generally warmer and wetter than earlier, but not by much.

Between ca. 9000 to 8000 cal yBP, the Northern Hemisphere underwent another major cooling (Klitgaard-Kristensen et al. 1998) of a magnitude similar to the late Holocene Neoglacial advances (Mason et al. 2001) but without an increase in moisture required for glacial advance. The event is referred to as the Mesoglacial or the “younger Younger Dryas” and is supported by the decline of post-glacial spruce population around ca. 8000 cal BP. Peat sections collected (ca. 8200 cal BP) near Fairbanks document this episode and the aridity associated with increased cold weather (Mason and Bigelow 2008; Mason et al. 2001) .

Changes in the climate during the early Holocene lead to greater diversity in vegetation patches than had been present during the late Pleistocene or LGM. The resulting parkland environment most likely contributed to high quality foraging that provided opportunities for grazers such as wood bison and wapiti to thrive while limiting resources required by mammoth (*Mammuthus primigenius*) and horse (*Equus sp.*) leading to their extirpation from the environment.

Middle Holocene

The Hypsithermal effectively begins at the end of the younger Younger Dryas cooling period ca. 8000 cal BP and coincides with a mid Holocene ecological reorganization and the spread of boreal forest environments. Several lines of evidence including both aeolian and pollen data suggest warming and increased aridity throughout the interior as compared to current mean annual temperature and precipitation (Mason and Bigelow 2008:60). Climate change on the scale suggested by researchers after ca. 8000 cal BP may have had substantial consequences on the habitability of many upland areas including substantial desertification that may be reflected in the cultural hiatus observed at Tangle Lakes and many other upland sites during this period.

Evidence for glacial advance during the early to mid Holocene is sparse, particularly in coastal Gulf of Alaska and is consistent with continued aridity in the interior (Calkin et al. 2001) from ca. 9000 cal BP to approximately ca. 5000 cal BP. By ca. 6000 cal BP, large areas of Alaska were dominated by alder or a combination of tundra and other arboreal species (Mason and Bigelow 2008:54). The advance of spruce in the interior is a patchy phenomenon with black spruce expanding more rapidly between ca.7800 to 6800 cal BP (Mason and Bigelow 2008). Although cooler than the early Holocene, the mid Holocene is dominated by highly flammable black spruce that thrives on cold and waterlogged substrates in contrast to white spruce (Mason and Bigelow 2008).

Mason and Bigelow (2008) note that the distribution of northern Archaic sites is normal with a mode (greatest number of sites recorded) around 5300 cal BP, and suggest that the technology is a response to "climatic forcing conditions" centering on a 5500 to 5300 cal BP cooling episode accompanied by increased precipitation and effective moisture (Mason and Bigelow 2008; Mason et al. 2001). This episode is recorded at ca. 4500 cal BP in pollen samples from Swampbuggy Lake and Nutella Lake (Figure 4-2) in the region near Butte Lake and indicate an increase in spruce pollen resulting from increased spruce forest density around the lakes associated with cooler wetter conditions (Rohr 2001).

The combined effects of both falling temperatures and rising precipitation lead to the onset of the Neoglacial, which effectively begins at ca. 4000 cal BP (Calkin et al. 2001). The Neoglacial is marked by climate change resulting in much colder conditions and increased storm activity in the Gulf of Alaska by ca. 3500 cal BP (Ager 1983; Heusser 1995). Two major glacial advances associated with this period were centered at ca. 3300 to 2900 cal BP and ca. 2200 to 2000 cal BP (Barclay et al. 2009). A decrease in glacial advance at the end of the Neoglacial between ca. 2000 cal BP and ca. 1500 cal BP was followed by another advance, termed the Medieval advance that effectively ended by ca. 1300 cal BP (Calkin et al. 2001). Pollen cores from Swampbuggy and Nutella Lakes indicating a major decline in terrestrial vegetation between ca. 3500 cal BP and 1500 cal BP coincides with these major advances and suggest that the cold wet environment had a substantial impact on the ecosystem near Butte Lake (Rohr 2001) that may have resulted in a second cultural hiatus from the region. This may also have been exacerbated by a potentially catastrophic ash fall episode that occurred between 4420 and 3620 cal BP. Specific volcanic ash falls and their potential impacts on the site will be addressed later in this chapter

Late Holocene

Near Butte Lake, a sharp increase in terrestrial vegetation after ca 1500 cal BP coincides with both the end of the late glacial advance in the coastal Gulf of Alaska and the onset of the Medieval Optimum. The Medieval Optimum exhibits warmer than prior temperatures in the region without a substantial difference in precipitation. Based on the pollen cores from Swampbuggy and Nutella Lakes, this period is marked by both higher than present temperatures and effective moisture as well (see Figure 3-2 for implications) (Rohr 2001). The increase in terrestrial vegetation includes a substantial influx of spruce pollen into the region indicating that the alpine tree line was also rising to higher altitudes than at present.

Following the Medieval Optimum, the so called Little Ice Age lasted from ca. 750 cal BP to the 19th century (Calkin et al. 2001). During this same period, spruce influx declined and tundra species began to dominate the terrestrial vegetation near Butte Lake (Rohr 2001) resulting in a lower tree line than prior and likely similar to present.

However, current research indicates that alpine tree lines in Alaska are rapidly advancing into higher altitudes relative to the recent past (Lloyd 2005).

Temperature and effective moisture play an important role in a ecosystem, and effects on the lowest trophic levels will have corresponding effects on the habitability of the system by humans. Table 3-3 summarizes the late Pleistocene and Holocene climate by regional chronozone and date range. The dates for each chronozone are not expected to be accurate, but rather broadly general time frames in which change occurs. However, records determining the extent of the Medieval Optimum and the Little Ice Age can be considered more accurate based on written documentation during the historic periods in Europe and North America. Likewise, change in the terrestrial biome near Butte Lake can be considered more accurate based on the core analysis undertaken by Rohr (2001).

Epoch	Regional Chronozone	Date Range	Climate
Late Pleistocene	Late Glacial Maximum	ending ca. 14,000 yBP	Far drier and colder than present throughout high latitudes. Forests in Interior Alaska are highly restricted to absent resulting in mosaic steppe and tundra biomes.
	Younger Dryas	ca. 14,000 - 11,000 yBP	Marked by warmer than present summers (+6%) and colder than present winters (-20%) with increasing effective moisture, however drier than present. Increase in grass and herb forb tundra environments. Increase in cold adapted vegetation particularly shrub birch.
Holocene	Holocene Thermal Maximum	ca. 11,000 - 9000 yBP	Increased warm temperatures (1.6±0.8°C) and expansion of poplar and spruce. Holocene Milankovitch Thermal Maximum centered between 10,000 and 9000 yBP, drove temperatures 5° to 8°C above current temperatures in as few as 5 to 50 years. Marked by decrease in effective moisture.
	Mesoglacial/ younger Younger Dryas	ca. 9000-8000 yBP	Major cooling event with increasing aridity.
	Holocene Hypsithermal	ca. 8000-3500 yBP	Climate warming with continued aridity associated with the spread of the boreal forest environment between 8000 - 5000 yBP. Cooler temperatures and increased effective moisture after 5000 yBP.
	Neoglacial	ca. 3500 - 1500 yBP	Locally, major decline in terrestrial pollen productivity associated with this period marked by colder temperatures and increased storm activity in the Gulf of Alaska with major glacial advances.
	Medieval Optimum	ca. 1500 - 750 yBP	Sharp increase in local spruce pollen after ca 1500 corresponds with the onset of the Medieval Optimum marked by warmer temperatures with no substantial decrease in effective moisture continuing through the Little Ice Age.
	Little Ice Age	ca. AD 1250 - AD 1900	Local decline in spruce influx while tundra species dominate the terrestrial vegetation near Butte Lake. Moisture similar to present conditions.

Table 3-3. Summary of Climate Model.

Volcanic Ash Fall Episodes

The Holocene is a period defined by oscillating temperatures and effective moisture although several major volcanic episodes may have also affected subsistence strategies and technological innovation, as well as large scale migration (Workman 1972). Particularly, the Hayes vent tephra deposits may have had a direct impact on habitation at Butte Lake by increasing soil acidity, resulting in declines in floral species that may have been a foundation for the biodiversity required to sustain patch habitability. In Addition, the Hayes vent and the so-called Devil tephra deposits provide useful bracketing dates for habitation at Butte Lake.

The Hayes vent tephras originate in the Tordrillo Mountains approximately 150km northwest of Anchorage, Alaska. The Hayes vent tephras have a widespread regional occurrence and possess a distinctive mineralogic and chemical composition with a known limited age range (Riehle et al. 1990). The age range of the Hayes vent deposits is accepted at 3650 ± 150 rcy BP (Begét et al. 1991; Riehle et al. 1990) and a calibrated age of 4420 to 3620 BP (Reimer et al. 2009).

The Devil tephra is contextually situated above the tephras associated with the Hayes vent episodes referred to in literature as the Cantwell, Lower Watana, and Upper Watana (Begét et al. 1991; Dixon 1985; Riehle et al. 1990). Based on Dixon (1985:52), a provisional date range has been constructed for this research using radiocarbon assays recorded above and below the Devil tephra. Three radiocarbon dates recorded above the tephra were pooled to estimate an upper limiting date. Four dates were supplied by Dixon, but one Dicarb date was eliminated due to problems exposed by Reuther and Gerlach (2005). In addition, five radiocarbon dates from below the Devil tephra and above Upper Watana tephra were pooled to estimate a lower limiting date (Dixon 1985). Age estimates were calibrated using CALIB v. 6.0 with the IntCal09 terrestrial calibration curve at two sigma (Reimer et al. 2009). The resulting mean pooled samples represented in Table A-2 indicate a calibrated age range estimate of ca. 1293 - 1357cal yBP (1425 ± 23). Studies further limiting these dates are underway at the time of this research but are not yet available, therefore, the provisional date ranges will serve as chronological markers for further analysis of the site at Butte Lake.

Discussion

Based on archaeological, palynological, and geological data, a model of subsistence centered on seasonal availability of key resources can be inferred. This inference can be extended over the span of the Holocene by linking the presence, absence, or mixing off material culture (weapon strategy) within the archaeological record, as well as the location of sites during this period, to indications of climate change and identifiable geologic events. By doing so, a strong correlation appears to exist between the use of a particular weapon strategy and the large protein packages being pursued. This correlation is viewed as a seasonal strategy based on the types of animals (faunal remains) and the location of the sites within upland or lowland settings, however the climate model may support the hypothesis that prey choice is tangential to the season and weapon strategy is less oriented toward prey choice than as a means of optimizing returns given climate driven ecological constraints.

Chapter Four. Site Chronology and Formation

The purpose of the following chapter is to address the site chronology and site formation and is a prerequisite to examining changes in technological organization and subsistence strategies at the site. Chronology will be analyzed by applying the climate model outlined in Chapter Three to changes in soil and sediment formation, the presence or absence of observable human occupation with datable materials, and stratigraphic markers such as the Hayes Vent and Devil tephras. The models outlined in Chapter 3 are crafted to infer scale and explore the hypotheses that: (1) occupation at the site is determined by the availability of resources at any point in time, where resource availability is a function of climate driven ecological constraints, (2) that occupation of the site represents the seasonal exploitation of a predictable resource, and (3) strategies employed by late prehistoric Athabascan populations represent a strategic continuum embedded in deep time.

Excavation Objectives

The research objectives outlined in Chapter One are analytical objectives that required fine grain documentation of the site during excavated. Therefore, the overriding objective for excavation during the 2012 field season was to capture and document a portion of the site outside of the house feature and adjacent to the 1984 1x1½ meter test unit with as much precision as possible given limits on time, funding, and personnel. It is important to note that excavation is the controlled destruction of an international cultural resource. It is also important to note that while excavation was undertaken using best practices and controls, many decisions were made as problems were encountered.

Excavation Protocols

Prior to excavation of the site at Butte Lake Northeast during the summer of 2102, two site surveys were undertaken in part to relocate the grid established during the 1984 excavation. Despite the use of a handheld magnetometer, no spikes from the previous excavation were found. However, a number of small 8d nails were located near the edges of excavated units, two of which were approximately 50cm apart. Based on the presence and position of these nails, an approximate location of the 1984 grid was estimated. This was accomplished using two of the nails, one located at what was believed to be the southwest corner of Betts' 1x1 ½ meter unit, and the other at the northwest corner of the house pit excavation. The location of the nail was assumed to be the northwest corner of the house excavation and was established as the primary datum for the excavation. Subsequent analysis in the lab has since shown that the datum location was off by approximately 9° or 50cm to the south of the actual northeast corner of the house excavation. The datum was established as point 500N and 100E with an elevation of z=0.

Location of the grid was established to capture the area north of the house feature while attempting to avoid cultural disturbance associated with the initial excavation of the house by its occupants. Likewise, the 1x1 ½ meter unit from which the majority of the 1984 artifacts were recovered was also a concern, so the grid was tied in as close as possible to capture more of that unit. Figure 4-1 is provided to indicate the relative positions of both the 1984 and 2012 excavation grids. Two blocks were excavated during the 2012 excavation. Block A was the primary focus of the excavations that were expanded during the final days of the field season to include Block B as a southern extension of the 1984 1x1½ meter unit. Also included in Figure 4-1 is a depiction of the site microtopography as recorded using a total station.

Site excavations were undertaken in 5 cm arbitrary levels with the exception of the root mat which was considered Level 1 regardless of thickness. All units were 1x1 meter in size with the exception of the two E93 units. A 20cm baulk was placed in these units at the eastern extent to better capture differences in stratigraphy on an uneven surface. The baulk was not excavated due to time and the assumption that it would not contribute significantly to the data already collected.

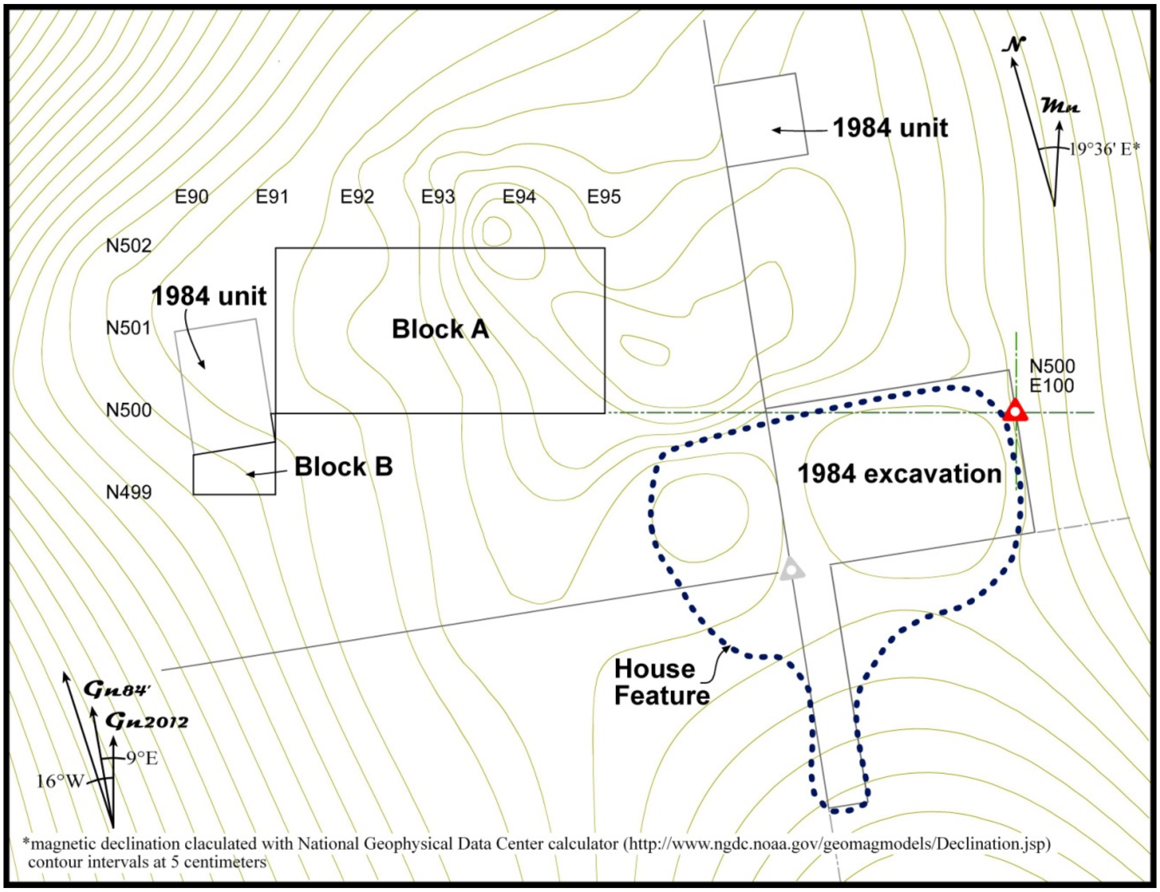

Figure 4-1. Site micro-topography and grid layout for 1984 and 2012 excavations.

All materials including the root mat were screened through ⅛" mesh. Visqueen was used to limit impacts on the property. Features, tephras, and high density lithic concentrations were collected as matrices to be analyzed in a lab setting. Additional matrices were collected as control samples from the same provenience (depth and quadrant) for the purposes of comparison. The starting and ending depth of each matrix were recorded by level and quadrant, and the margins were mapped using the total station.

All artifacts uncovered in-situ, including debitage, were plotted using the total station for the purpose of capturing three dimensional resolution. Orientation was also recorded as horizontal, oblique, or vertical for the purposes of identifying site disturbance or other taphonomic processes. All artifacts, features, faunal remains, tephra samples, and matrices were also recorded by level and quadrant.

All faunal remains within the upper three levels were plotted using the total station. Recording fauna below Level 3 was limited to identifiable or diagnostic elements there after due to time constraints. No faunal remains were located below Level 4. Vertical depth was measured from one of three secondary datums. The location and depth of each datum was recorded with the total station and used to control level depth and record all other artifacts by quadrant and level.

The documentation of the site during the 2012 excavation has proven especially useful for developing the site chronology and delineating occupational components. The following section will be used to describe the site chronology based on documentation. The chronology is provided prior to site description for the purpose of providing context to the excavation and clarity of association.

Site Chronology

The documentation of site chronology is based on several criteria including: (1) provisionally dated sediments and tephra horizons, (2) radiocarbon determinations based on charcoal from hearth features, and (3) relative stratigraphic placement of cultural components in relation to lithostratigraphic units and tephra horizons. An accurate chronology is required to examine relationships between site use and the paleoclimate at the site throughout the Holocene, as well as assessing site type based on the ethnographic model. The following section provides a description of the soil and sediments and site chronology. This will be followed by a detailed description of the site excavation.

Five radio carbon samples were collected from the site (Table 4-1). Two were directly associated with hearth features, one was recorded as a single piece of charcoal associated with both faunal elements and lithic debitage, and two were recorded in the column of mixed soil. The mixing of soil is substantiated by the mixing of lithic debitage from both lower and upper contexts and will be discussed further in Chapter Five. All carbon samples were wood charcoal and each sample was identified by taxon. Table 4-1 includes all radio carbon data collected from the site during both the 1984 and 2012 field seasons.

Table 4-1. Radiocarbon and calibrated date ranges of material from Butte Lake Northeast.

Sample	Material	Stratum	Context	$\delta^{13}C$ ($^{0}/_{00}$)	^{14}C age yr BP	Calibrated age (IntCal09)(2 σ cal BP)
DIC-3068	charcoal	A	hearth feature	N/A	110 ± 60	281 - 0
Beta-334203	charcoal (*Salix*/*Populus spp.*)	AB	N500E94, possible root burn in Level 3	-23.2	160 ± 30	290 - 0
DIC-3069	charcoal	A	hearth feature	N/A	180 ± 60	307 - 0
Beta-333868	charcoal (*Salix*/*Populus spp.*)	A	Feature 1 hearth	-22.6	410 ± 30	510 - 330
Beta-334204	charcoal (*Betula sp.*)	AB	N499E90, mixed soil	-22.9	540 ± 30	630 - 520
Beta-333869	charcoal (*Betula sp.*)	AB	N499E90, mixed soil	-24.6	670 ± 30	675 - 560
Beta-333870	charcoal (*Salix*/*Populus spp.*)	AB	Feature 6 hearth matrix	-24.1	4220 ± 30	4850 - 4650
Beta-10751	charcoal	AB	hearth feature	N/A	5030 ± 200	6270 - 5320
Beta-10750	charcoal	AB	hearth feature	N/A	6390 ± 580	8380 - 5990

Twenty soil samples were collected at the site (Table A-3) from various levels. These samples included samples of soil horizons, tephras, feature samples, flake matrices, and control samples. Control samples were collected from the same provenience as the tephra, feature, and flake matrices. A sieve analysis was undertaken to asses particle size distribution within the column. Each sample was separated using nested sieves with the intent of examining various accumulations of sediments within the column. Sieves used include ¼" (6.35mm), No. 12 (1.68mm), and No. 16 (1.18mm). Pedostratigraphic units are based on standards provided by the North American Commission on Stratigraphic Nomenclature (2005) and the United States Department of Agriculture (Schoeneberger et al. 2002). Figure 4-2 is a generalized representation of the lithostratigraphic and pedostratigraphic units identified during the 2012 excavation. The figure includes the Munsell color for each unit.

Site Stratigraphy

The top 3 to 7 centimeters of the stratigraphic column is a thick O horizon or sod with a dense root mat and organic debris. Below the O horizon, an organic-mineral A horizon grades into an AB horizon with unsorted colluvial accumulation and residual organic concentration. Soil acidity was not tested for this research but many of the artifacts from the AB horizon exhibit humic stains. A sharp contrast in both color and sediment accumulation defines the contact between the AB horizon and the underlying C1 horizon.

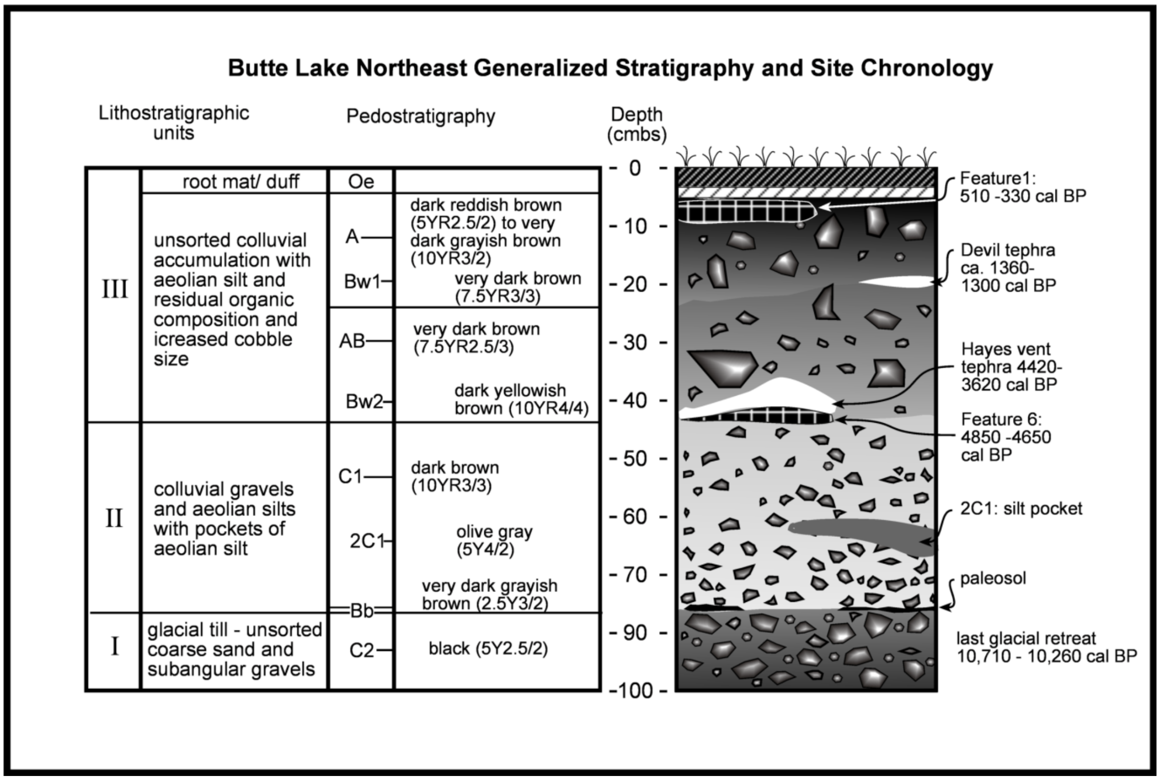

Figure 4-2. Generalized stratigraphy.

The C1 horizon contains fewer fine sediments but colluvial accumulations appear consistent throughout the stratigraphic column. However, the C1 horizon exhibits pockets of aeolian silts with little or no colluvium (2C1). The pockets appear to have formed in depressions possibly deposited by snow or ice melt containing windblown silt.

Aeolian sediments in the C1 horizon do not appear to be laminated as a result of seasonal accumulations.

Glacial till (C2) lies beneath the C1 horizon and is separated in places by a discontinuous and weakly defined paleosol (Bb). The glacial till contains no aeolian deposits. All of the cultural material recovered from the site were located in the AB horizon or the Bb horizon. The C1 horizon was sterile throughout.

All soil horizons contain a number of large very angular to well rounded stones, most with no noticeable patterns of battering or wear to indicate cultural use. The position of these stones is likely due to frost heave or needle ice which can have a substantial effect on large stones by moving them upward in the stratigraphic column while having a lesser affect on smaller objects (Bowers et al. 1983; Hilton 2003).

Within the AB horizons, the soil color and consistency varies little but does however vary in small isolated pockets or intermittent stains (Bw1 and Bw2). The Bw1 stains were typically discontinuous and very thin (depth measured in millimeters). When possible, samples of these soil anomalies were collected (n=2). Both samples contained little or no colluvial aggregates and easily passed through a No. 200 sieve. The color, texture, and relative position within the stratigraphic column have resulted in the conclusion that the two samples are consistent with other volcanic tephras observed in the region.

The lowest of the samples (Bw2) was located immediately above Feature 6. Feature 6 has been dated to between 4850 and 4650 cal BP (Table 5-1). Based on this limiting date, the tephra is likely associated with the Hayes Vent tephra deposits 4420 to 3620 cal yBP (Begét et al. 1991; Riehle et al. 1990). The upper stain in provisionally identified as the Devil tephra.

Very little soil disturbance has been identified at Butte Lake Northeast aside from the house feature. While ground squirrel activity was noted during the course of the excavation, few rodent burrows were identified, and those that were, were typically beneath the edge of large boulders. One exception is a disturbed area in the southwest portion of the excavation in Block B, which incidentally appears to originate from beneath a large boulder.

The following section will provide more specifics on the excavation of the site including the location and depth of feature, tephra horizons, and cultural material associated with each occupational component. The section is meant to provided a comprehensive examination of the results of the excavation during the 2012 field season.

Site Structure

The excavation undertaken during the summer of 2012 identified three cultural features, two tephra horizons, and one buried soil horizon. Figure 4-3 provides a three dimensional perspective of the location of each of these site attributes complete with microtopography recorded with the use of the total station.

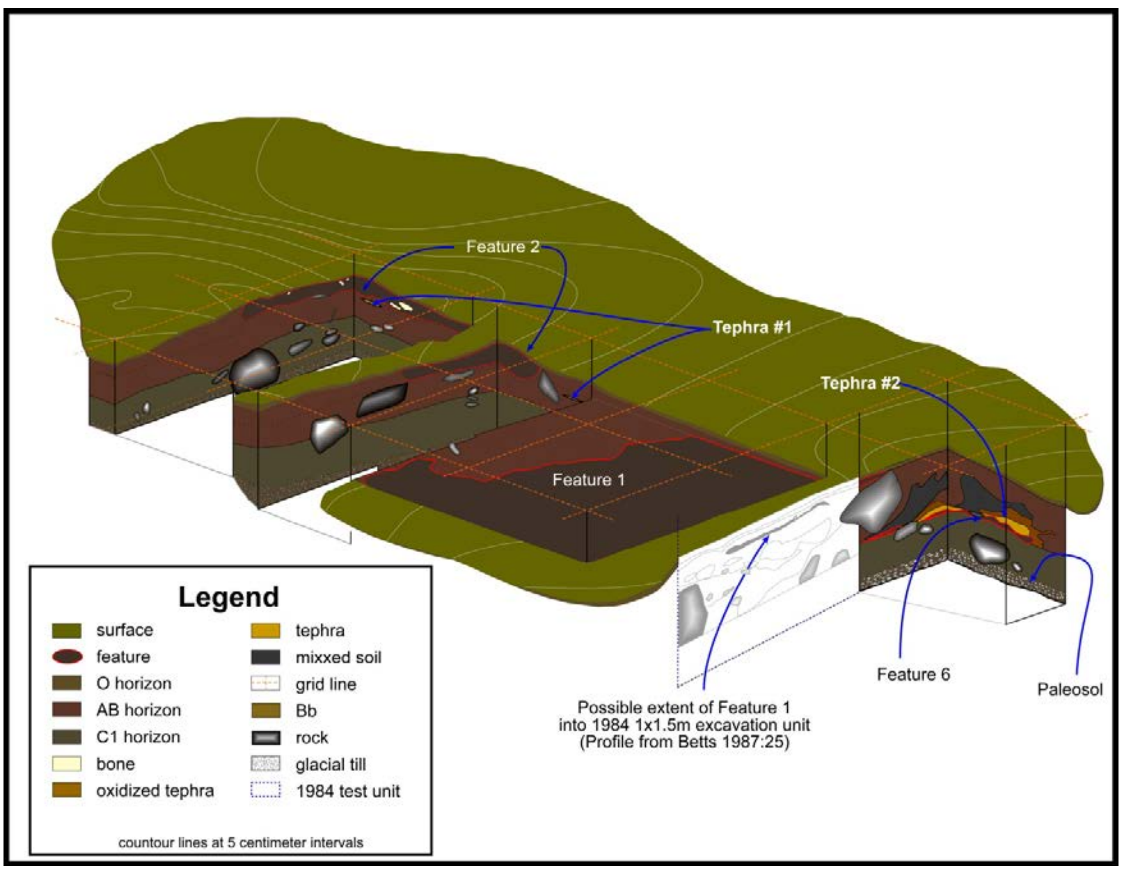

Figure 4-3. Overview of site stratigraphy as recorded in 2012.

Beginning at the end of excavation, a discontinuous buried soil horizon was recorded directly overlying glacial till (Figure 4-4). The glacial till was recorded at Levels 12 and 13 depending on excavation unit. The paleosol was only recorded in Block B, however all of the artifacts associated with the lowest component (n=9) were recorded either within the paleosol or directly on the glacial till. The paleosol is provisionally dated to between 10710 to 10260 cal BP based on the last glacial retreat (Table A-2) (Reger and Bundtzen 1990).

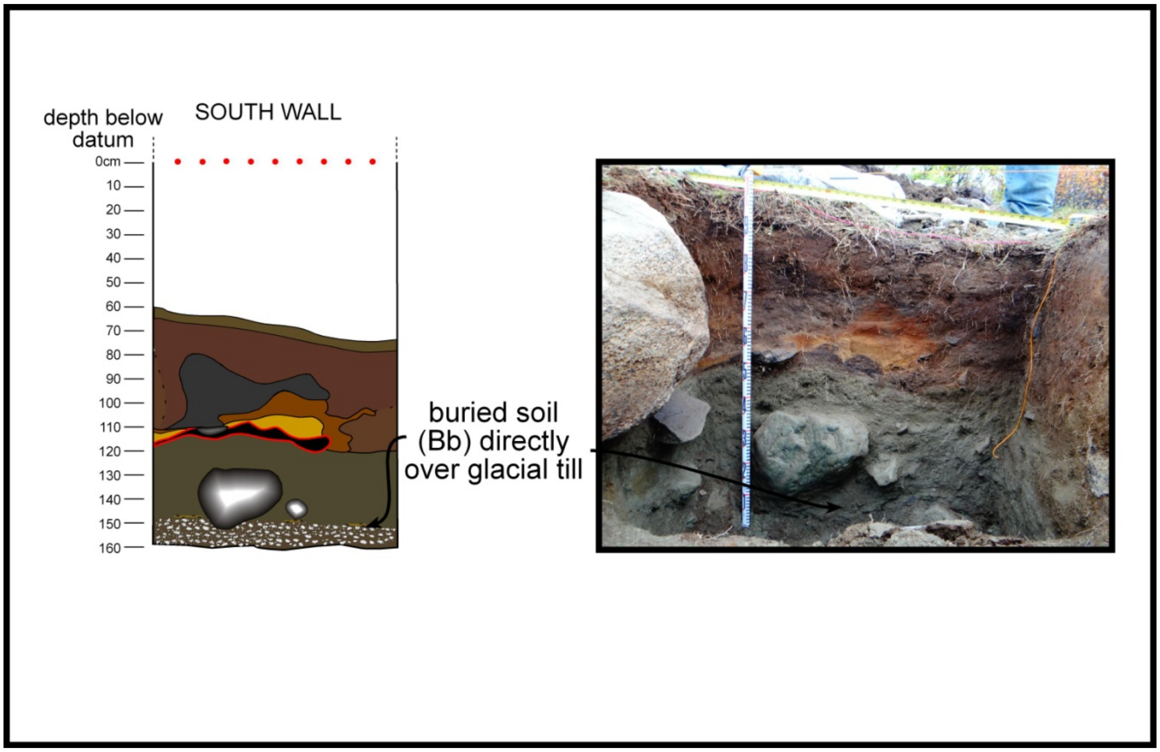

Figure 4-4. Location of paleosol in stratigraphic column.

Located approximately 35 cm above the paleosol and topping a culturally sterile zone, Feature 6 was recorded as a single small hearth within Block B. Initially, the feature was recorded as two separate features, 5 and 6, but subsequent sieve analysis in the lab revealed lithic material types and detritus common to both features leading to the conclusion that the feature had been bisected at some point in the past. While no small animal bones were found in the area of disturbed soil to suggest bioturbation, lithic material located directly within the hearth was found throughout the column. This has lead to the conclusion that the area may have been excavated by a bear, which is not uncommon when attempting to dig up rodent burrows. Rodents were common in the area and a number of burrows were noted during excavation. All of the burrows were partially located beneath large rocks similar to the bolder covering a portion of Feature 6.

Figure 4-5 shows the location of the two halves of the feature and includes depth lines based on total station data. The lines represent 1cm intervals. Note that the feature is between 6cm and 8cm deep, indicating long term or continual use over time. Figure 4-6 shows the location of Feature 6 in the stratigraphic profile and includes the disturbed soil in both the photographic image as well as the profile drawing.

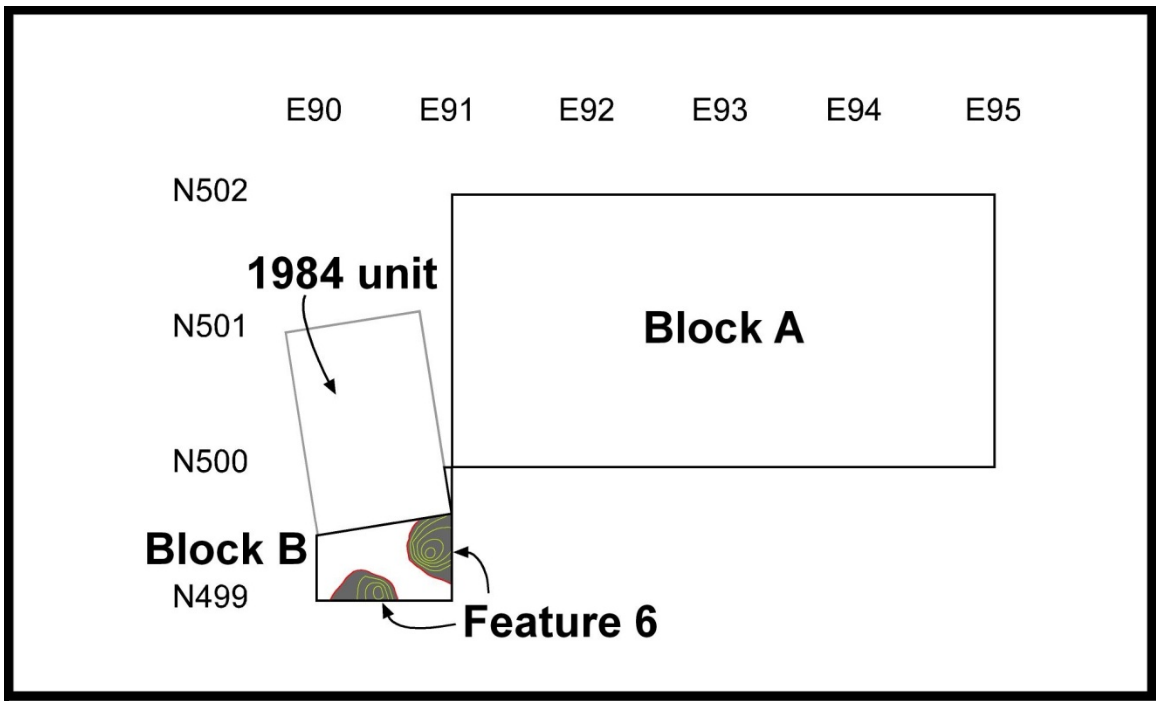

Figure 4-5. Location of Feature 6.

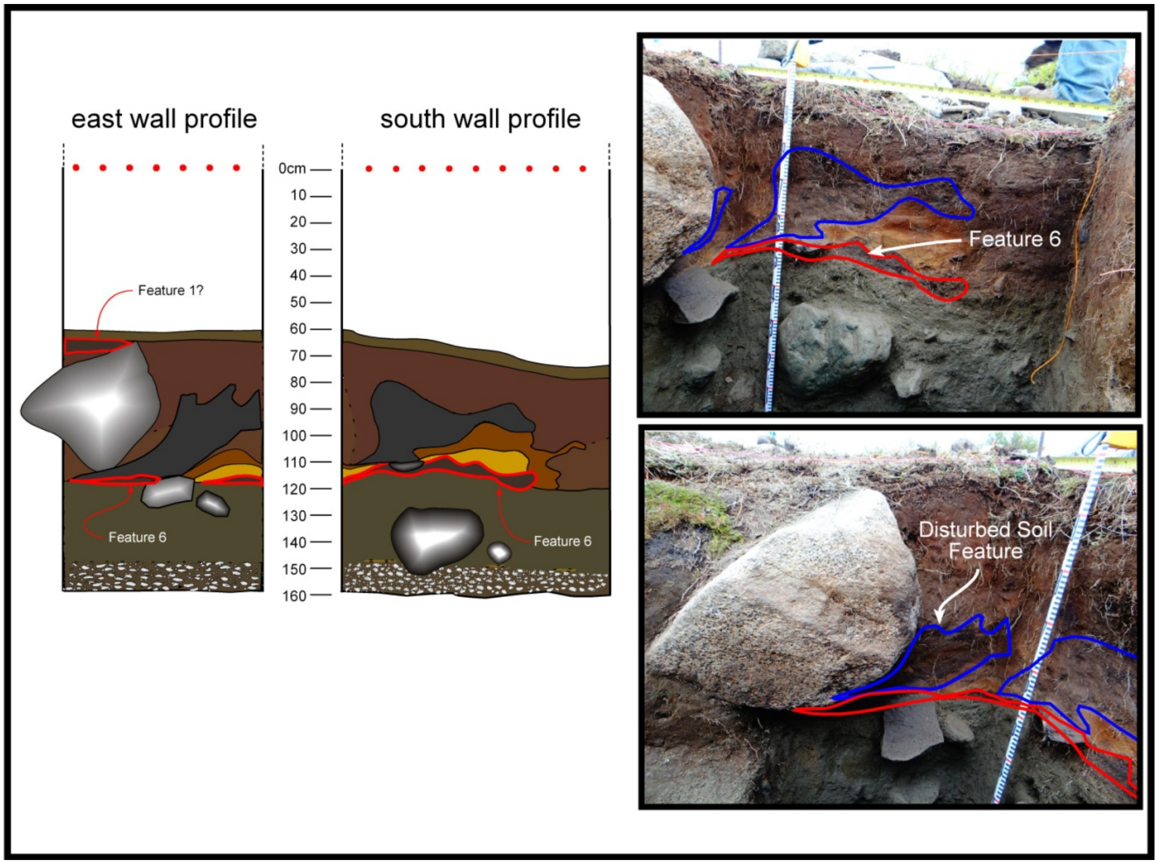

Figure 4-6. West and south wall profile in Block B depicting Feature 6 and disturbed soil.

Figure 4-7 shows the location of FS# 014-168, a side-notched point recorded directly within Feature 6 and beneath a large boulder that may have served as a wind break (Binford 1978a). Feature 6 was recorded in Levels 8 and 9, at between 40 and 50cm below surface, and has been dated to between 4850 and 4650 cal BP (4220 ± 30) (see Table 4-1 page 62).

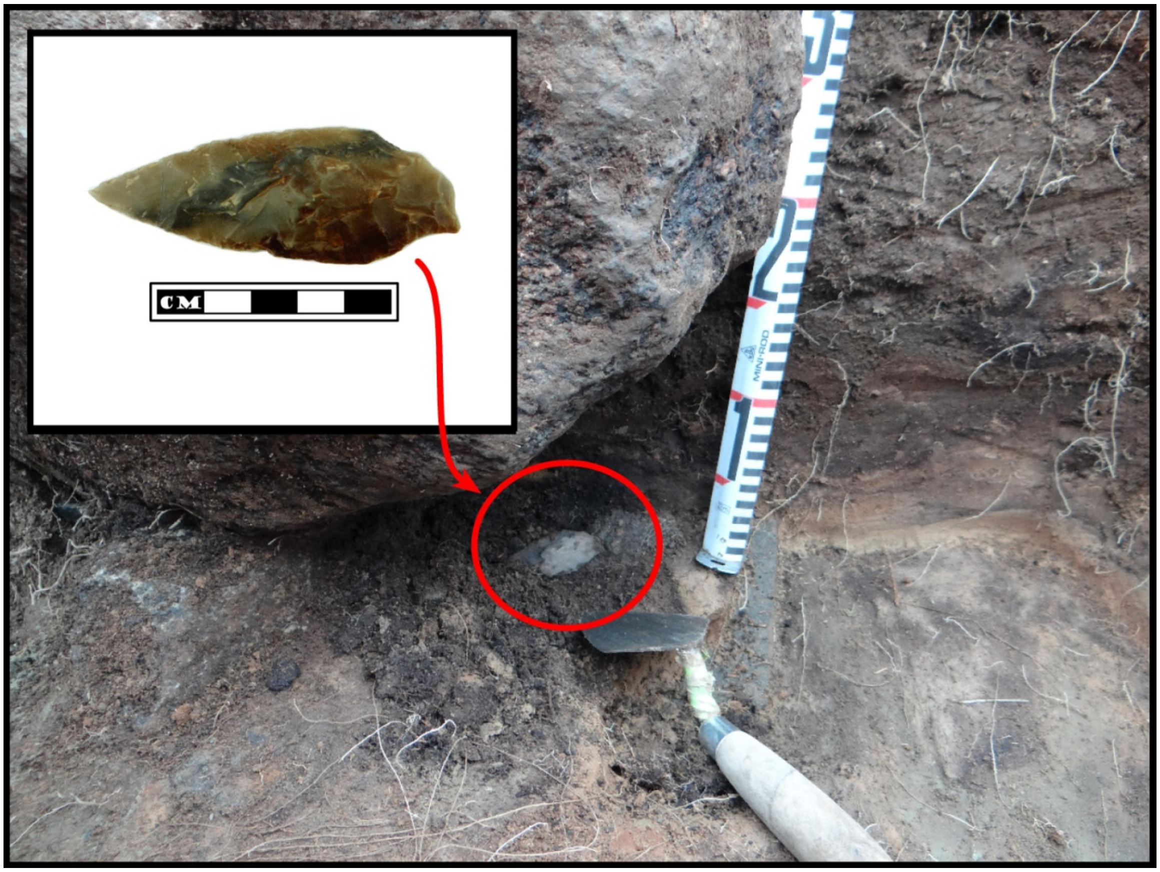

Figure 4-7. Side notched point recorded within Feature 6.

Directly overlying Feature 6 (Figure 4-8) is the provisionally identified Hayes Vent tephra that dates between 4420 and 3620 cal BP (Begét et al. 1991; Reimer et al. 2009; Riehle et al. 1990). This date is supported by the tephras contextual relationship with the Feature 6 date. The tephra horizon is discontinuous and was only recorded in Block B, and like Feature 6, has been disturbed in the portion of the Block with mixed soil. The Hayes Vent tephra was recorded primarily within Levels 7 and 8 at 35cm to 40cm below the surface. Microscopic identification of the tephra has been inconclusive as phenocryst attributes associated with Hayes Vent tephras were not readily identifiable. This could be due to the distance from the source as indicated by Riehle et al.(1990).

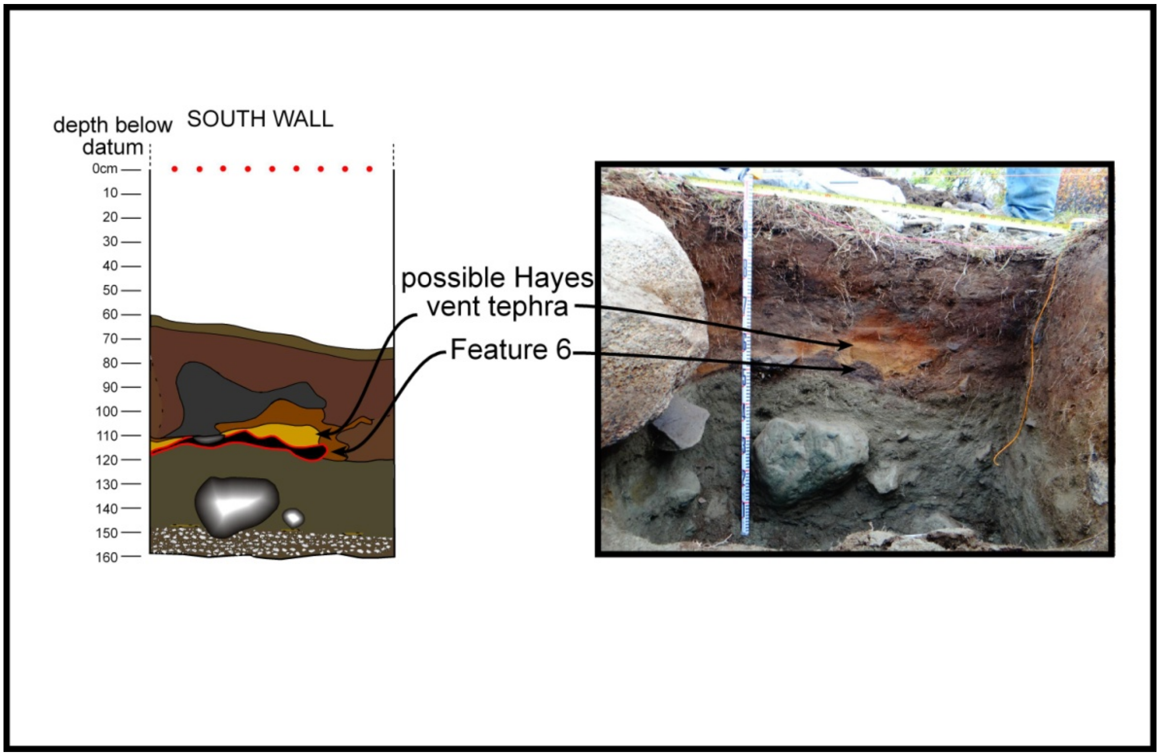

Figure 4-8. Hayes Vent tephra overlying Feature 6.

Block A contributed the greatest number of artifacts and faunal remains as well as two features and a second tephra horizon. The Devil tephra was recorded approximately 20cm below the surface at the bottom of Level 4. FS# 014-133, an iron bit, was recorded at the same depth and in a similar provenience (Figure 4-9) and is similar to one recorded in RkIk House 5 at Hahanudan, dated to between 1300 and 990 cal BP (Clark 1977). The Devil tephra is provisionally dated to between 1360 and 1290 cal BP (Dixon 1985; Riehle et al. 1990) and appears to limit the lowest extent of cultural material recorded in the Block A excavation units.

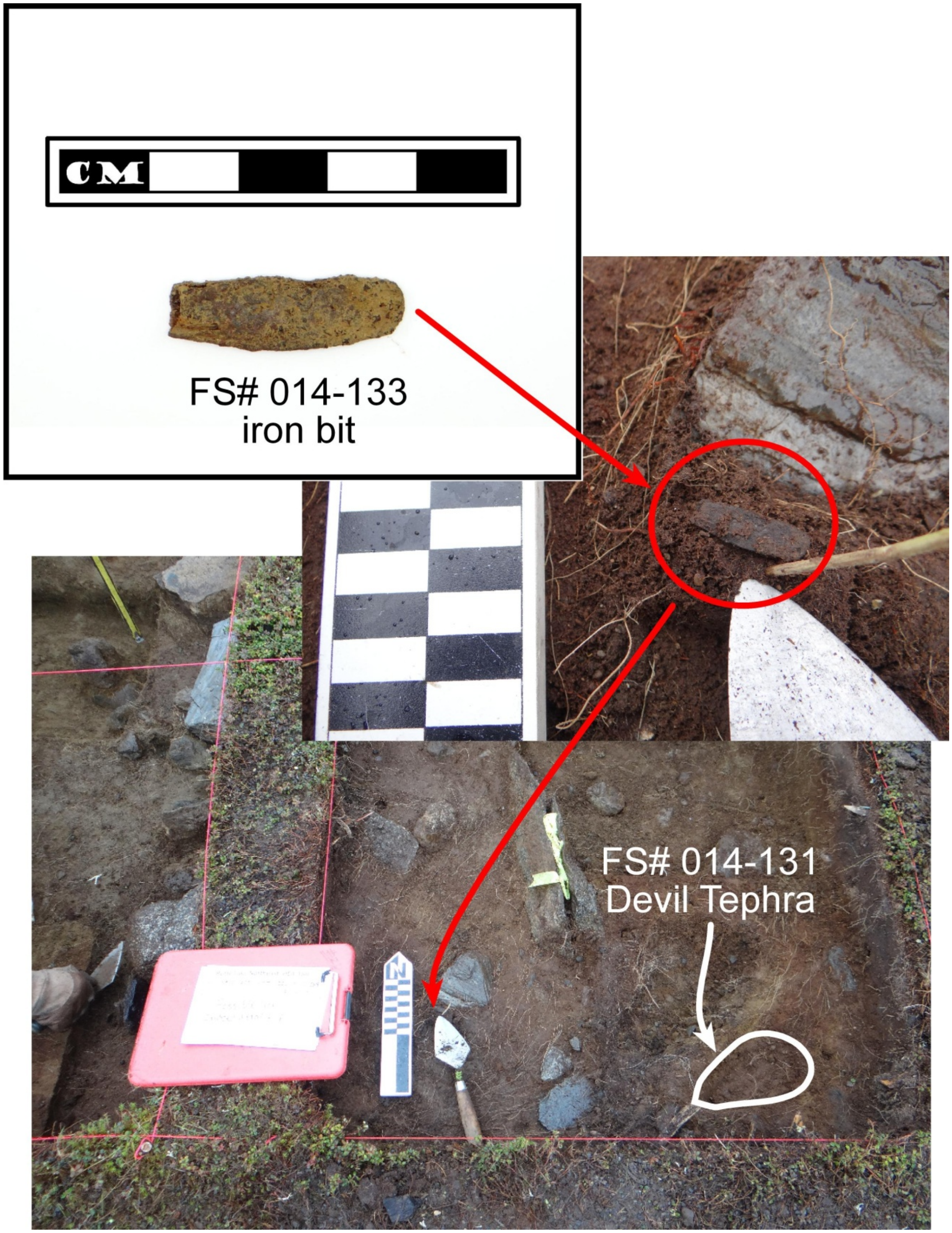

Figure 4-9. Location of Devil tephra and FS# 014-133 iron bit in similar provenience.

Figure 4-10 shows the recorded locations of the Devil tephra that were sampled during the 2012 excavation. The date range for the House 5 iron artifact and the provisional date of the Devil ash fall episode also indicate a consistent age correlation although separated by some distance. PXRF analysis has been undertaken on the iron artifact in an attempt to identify if nickel is present. The presence of nickel in amounts greater than 5% would be indicative of meteoric iron (Mason personal communication). This artifact did not exhibit nickel in any measurable quantity, and while an extraterrestrial source may be ruled out, further analysis will be undertaken to identify whether it may be telluric or to otherwise identify elements associated with the smelting processes.

Feature 2 is located at the eastern extent of the Block A excavation (Figure 4-11) and is associated by provenience and ethnographic expectations with the large Feature 1 hearth. Figure 4-12 shows an image of the eastern most excavation units that contain a anvil and several possible hammer stones. Feature 2 is unlike both Feature 1 and Feature 6 in that it is not a hearth, however, due to the presence of the anvil, hammer stones, the majority of faunal remains, and a high density of lithic material, Feature 2 stands out as an important site attribute where processing of animals has been undertaken (Figure 4-14). The type of processing as well as much of how site type is interpreted for this upper most occupational component will be addressed in Chapter Six based on faunal elements recorded as part of Feature 2.

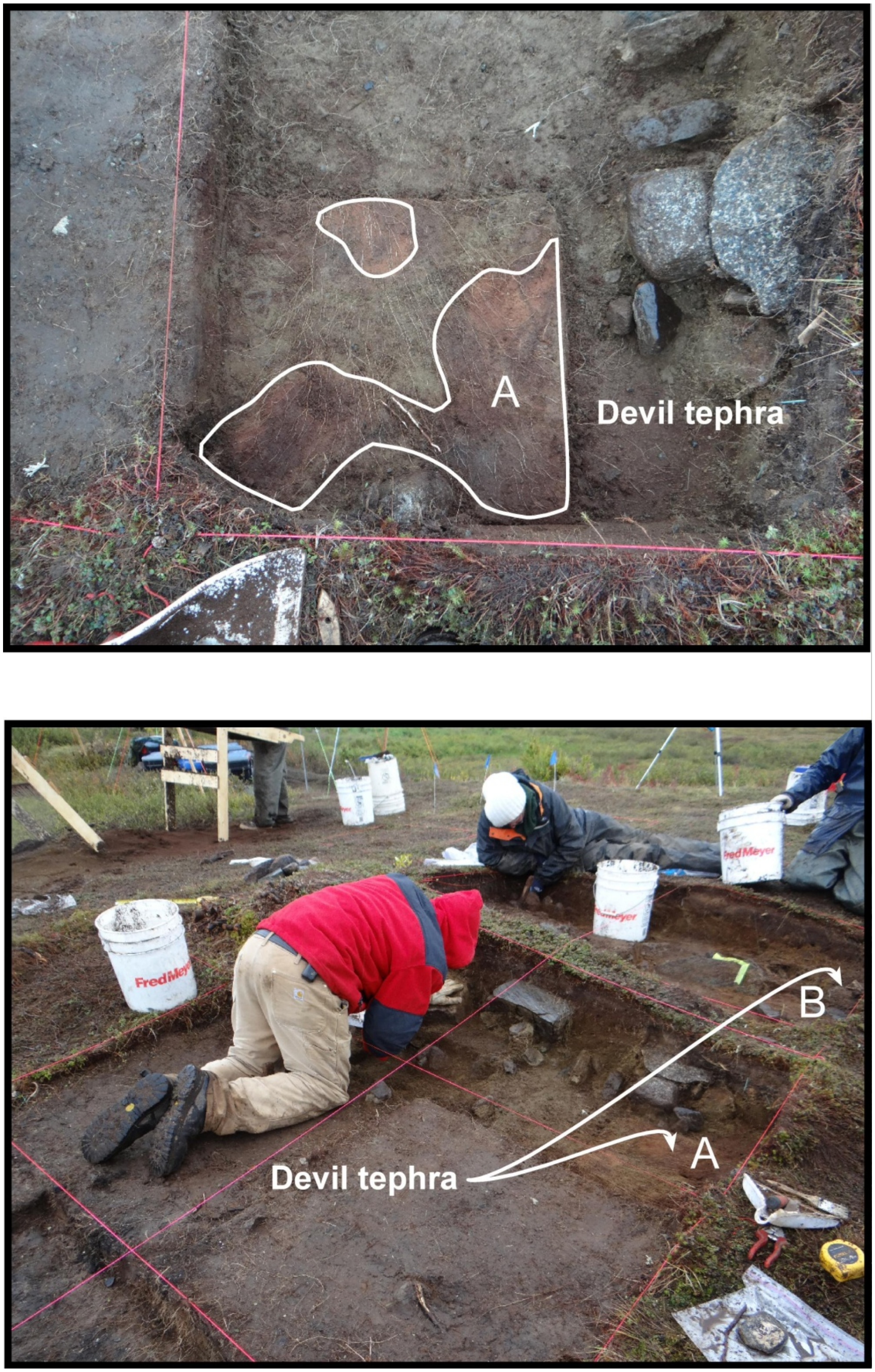

Figure 4-10. Location of Devil tephra recorded in Block A.

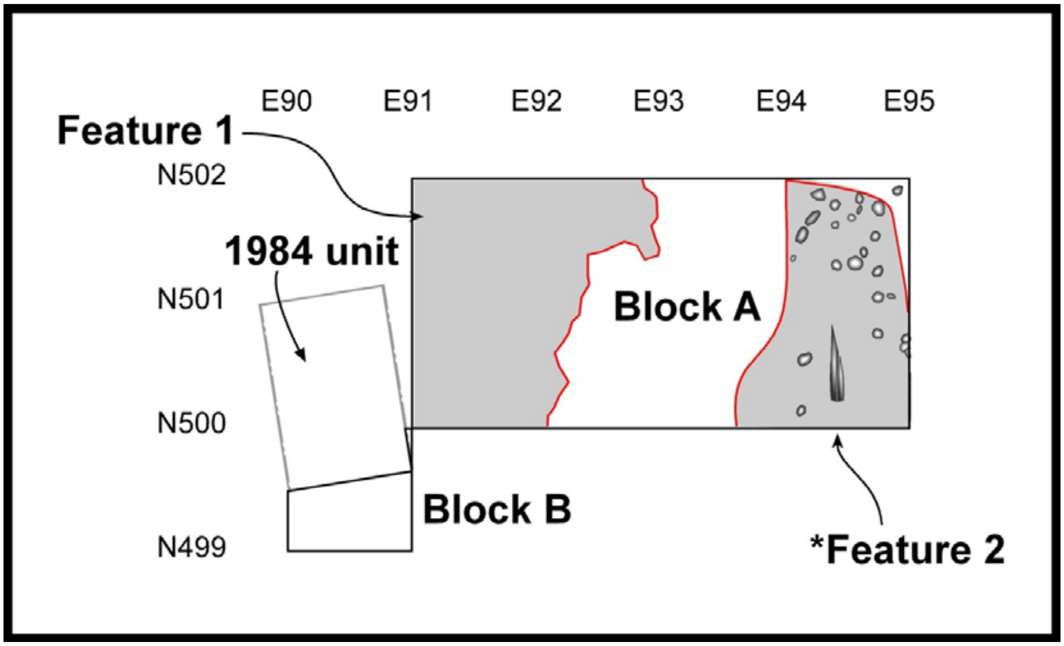

Figure 4-11. Feature 1 and Feature 2. *Denotes approximate extent based on high density of faunal remains.

Figure 4-12. Lowest extent of Feature 2. Anvil stone marked by yellow flagging.

Both Feature 1 and Feature 2 contain numerous highly fragmented faunal remains however, Feature 2 provided most of the identifiable materials (Figure 4-13 and 4-14), while fauna from Feature 1 was too highly fragmented for identification in addition to being calcined. Feature 2 also produced the only copper tool recorded at the site (Figure 4-15). FS#011-212 is a symmetrical copper projectile point recorded in Level 2 in Block A. The proximal end or portion intended for hafting, is approximately 1.5 millimeters thick with good uniformity. The blade portion has been hammered out from a center axis resulting in a traditional arrowhead form and is 1.1 cm wide by 4.5 cm long.

Figure 4-13. Faunal remains in Feature 2 mapped with the aid of 50x50cm provenience grid.

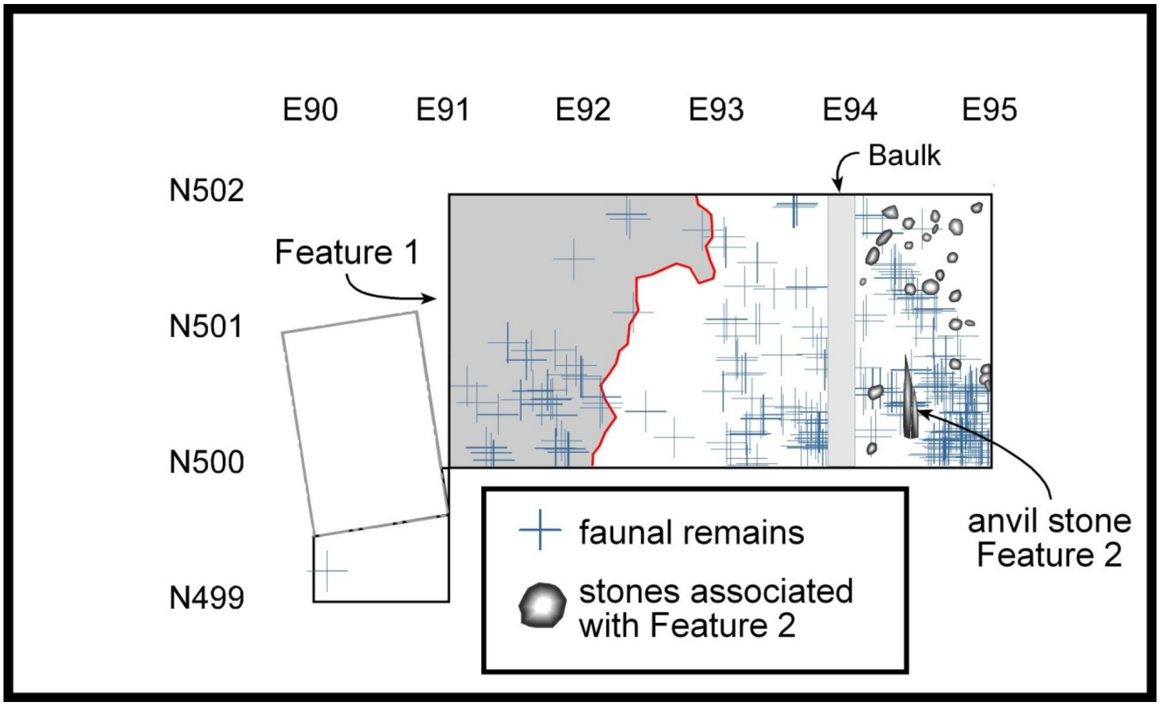

Figure 4-14. Contextual association between faunal remains recorded with the total station and Features 1 and 2.

Figure 4-15. Copper point located near Feature 2.

Feature 1 (Figure 4-16) is a large hearth consistent with those typically used by Athabascan populations to dispose of waste during the processing of animals (Workman 1976). Approximately 3.5m² of the hearth was exposed during the 2012 excavation. While a small portion (approximately .05m³) was collected as a matrix, the remainder of the feature was reburied under visqueen for future excavation due to time and budgetary concerns. Additionally, Feature 1 appears to extent into the east wall profile of Betts' 1984 1x1 ½ meter unit (see Figure 4-3). While Feature 1 contained numerous fragmented faunal remains it contained very few lithic artifacts (n=37).

Figure 4-16. Feature 1 hearth. Tooth picks represent the location of calcined and highly fragmented faunal remains.

While component delineation is dealt with in the following chapter, excavation by level has exposed clear stratigraphic separation. Reconstruction of the site chronostratigraphy provides a series of positive date ranges that can be compared to the climate model and expectations inferred from the ethnographic model. For the purposes of this research, optimizing behavior for each occupational component is assumed. This assumption provides for the expectation that human occupation at the site was for the explicit purpose of acquiring resources whether directly or tangential to the locus itself. Therefore it is reasonable to infer that human occupation of the site represents a period of positive economic returns. This does not mean that returns are equal at each occupation, nor does this mean that strategies being utilized will remain constant, it only suggests that ecological constraints unique to a period of time will be reflected in the material record and that material correlates can be used as a means of identifying specific behavior associated with specific time intervals represented by the climate model.

In the following two chapters, component specific questions will be addressed by means of traditional lithic and faunal analysis. The explorative nature of lithic analysis is expected to provide insight regarding site type based on the ethnographic record and specific lithic attributes associated with each component. Likewise, faunal analysis is expected to provide insights regarding specific activity areas and how the combination of feature, artifact, and faunal remains can illuminate behavior adapted to an oscillating Holocene climate.

Chapter Five. Lithic Analysis

The purpose of this chapter is to explore behavior at the site as it is represented in the lithic assemblage. Specifically, the behavior being inferred may relate to mobility, raw material availability, and food resource structure. This will be done by examining the lithic assemblage in sufficient detail to provide appropriate units for technological and spatial analysis. The chapter is divided into four sections. The first will address specific research questions and methods used in the lithic analysis. The next section will provide a description of component delineation based on material type and provenience. A detailed description of material classification and associated attributes will follow and data on lithic raw material types will be furnished. This section will be divided by occupation component for added clarity and will include formal artifacts associated with each material class. The final section will provide a discussion of the results of the explorative analysis under taken.

Lithic analysis of materials at Butte Lake Northeast included materials from both the 1984 and 2012 excavations and where possible, were used in conjunction. Given the sampling strategies of both excavation, differences do however occur and the 2012 materials will be treated appropriately given the added provenience data. Explorative analysis is the explicit goal of this research with regards to lithic attributes due to the inability of any single attribute to define the manufacturing technique or stage of lithic reduction (Ingbar et al. 1989).

Methods

Lithic analyses of materials recorded at Butte Lake is undertaken for the explicit purpose of identifying site use, raw material acquisition, and mobility based on expectations inferred from the ethnographic record. Specifically, this research focuses on tools and tool production through debitage analysis to narrow the general range of tools being produced during an occupational period. This assumes that general tool types can be inferred and broadly correlated with site type based on a comparative analysis that includes the results of faunal analysis and an analysis of site structure. This approach also assumes that raw material type and classification can be used to determine lithic resource availability and mobility through a procurement range.

Lithic analysis are conducted in three stages: (1) data classification and basic description, (2) development of research objectives, and (3) specific statistical and formal analysis. Formal analysis is undertaken by first examining reduction stages through size class distribution, and types and percentage of cortex. This analysis will include an intrasite comparison of individual components recorded in both 2012 and 1984 to explore possible sources of error due to sampling strategy. Additionally, intracomponent comparisons are examined to identify possible variation in behavior at the site. Finally, an exploration of attributes such as platform preparation, platform angle, flake fragment, and other attributes will be used to qualify the possible variation.

Inter and intra-component statistical analysis is undertaken utilizing the PASW Statistics 18 analytical tool. Parametric data includes weight and size class and will be examined using ANOVA and the Tukey post hoc test for homogeneity to compare means against the null hypothesis that sample populations are the same, or will exhibit means that are not statistically different when $\alpha=0.05$. All other attributes are considered nonparametric and are qualified as either ordinal, nominal, or dichotomous and are ranked. Inter and intra-component attributes are explored by using Pearson's chi-squared (χ^2) to test the null hypothesis that the observed frequency of attribute distribution within and between components is statistically equal to a theoretically expected distribution at $\alpha=0.05$. The Alternative hypothesis states that the distribution is not the same within and between components based on the results of the 1984 and 2012 excavations.

All artifacts from the 2012 excavation, and all lithic artifacts from the 1984 excavation were analyzed without regard to horizontal or vertical locations. Classification and description included five data groups. The descriptive group consisted of Field Specimen number, excavation unit and quadrant, level, depth, and orientation. Orientation is used to assess site taphonomy and site fabric of artifacts in the field and was recorded as horizontal, oblique, or vertical, based on the best judgment by the individual excavator (Enloe 2006). The second group consists of material descriptions and includes Munsell color (Munsell rock color book 2009 revision), material type, inclusions, opacity, luster, grain, thermal alterations, and material quality. Group three consist of all tools, iron, copper, and microblades. Group four consists of all debitage. Debitage characteristics included size, weight, percentage and type of cortex, completeness of flake, flake shape, flake fragment, platform angle, platform preparation, the presence of platform lip or flake bending, as well as the type of termination fracture.

Using a modified Sullivan and Rozen's (1985) typology (SRT), each flake has been characterized as either complete or broken. Flake fragments were also classified as proximal, distal, or medial, and debris is used to classify flakes that do not fit the first three classifications. Shatter is considered anything with the general characteristics of broken glass but without the characteristics associated with a flake, particularly the presence of a clearly defined ventral surface.

SRT is primarily utilized to identify formal tool production and core reduction. Through experimentation, Tomka (1989) concludes that formal tool production should result in greater quantities of complete flakes, while core reduction will lead to more broken or split flakes. However, Sullivan and Rozen (Rozen and Sullivan 1989; 1985) assume that core reduction produces more complete flakes and nonorientable fragments, and tool production results in greater quantities of proximal, medial, and distal fragments. Prentiss (1998) argues that SRT is not sufficient for identifying core versus tool production, and that the completeness of a flake is more dependent on the technique and application of force, edge configuration, and hammer types resulting in various flake size dimensions.

For this analysis, SRT will be supplemented by identification of several attributes that posses various levels of analytical strength and include size class, type and percentage of cortex, relative amounts of shatter, platform preparation and angle, relative dorsal scar counts, and flake termination characteristics. Platform attributes posses the strongest analytical strength for determining the application of force, edge configuration, and hammer type. Descriptions of all lithic attributes except size class, were recorded as present or absent, or were measured as a relative percentage (Andrefsky 2005; Andrefsky

1994; Esdale 2009; Sheppard et al. 1991; Surovell 2003; Tomka 1989; Wyckoff et al. 1992). Additionally, lithic resource stress is addressed by identify bipolar reduction, however, none of the debitage recorded at Butte Lake exhibited this type of reduction.

Flake size was grouped by size class measured in 5mm intervals (e.g. SC1=0-5mm, SC2=5-10mm...SC16=75-80mm (Potter 2005) (Table B-1). Any flake larger than SC16 was measured using a Spi digiMax model 30-440-2 digital caliper with 0.0mm of precision. Debitage smaller than 3mm was not described. All artifacts were weighed using an OHAUS Adventure Pro scale with 0.01gram precision. The fifth group included source analysis of obsidian samples using a Bruker Tracer III-V no. 510 portable X-ray fluorescence (pXRF) utilizing RJS Obsid Cal 4-30-09.CFZ calibration (Cook 1995).

Platform preparation was recorded as crushed, abraded, complex, or flat and platform angle was classified as greater than 75°, or less than 75° due to the difficulty in measuring and then duplicating measurements (Andrefsky 2005; Esdale 2009). Flake scar counts were also measured at a nominal scale of greater than three, and less than three per flake (Surovell 2003). Flake termination fractures were classified as feathered, hinge, step, or outré passé (Andrefsky 2005).

Platform preparation and flake termination possess a moderate level of analytical strength, and may be indicative of the objective being reduced (Andrefsky 2005). Cortical platforms for example, are indicative of initial core of flake production. Cortical platform preparation will not be included in this analysis as none were present. Flat platforms are usually indicative of non-bifacial thinning such as the bulbous end of an endscrapers. For example, endscrapers typically exhibit step fractures where multiple flakes have been removed from the scraping edge. Additionally, this type of fracture results in a snapped flake with an abrupt termination (Andrefsky 2005). Bending flakes with flat platforms can also be indicative of this type of objective. Both flake types are the result of the placement and direction of force applied to the objective (Andrefsky 2008). Bending flakes and the presence of platform lips is indicative of the use of a soft billet, such as antler, for the removal of the flake as well as being indicative of late stage reduction of tool production. While flake bending has been catalogued during the description portion of analysis, due the very low occurrence of this attribute in any component (>0.01%), it will not be included in the analysis.

Platform and dorsal surface facets are also moderately reliable measures of reduction stage. Complex platforms are usually rounded, exhibit multiple facets, and an angular surface created by the removal of several striking platform preparation flakes (Andrefsky 2005). On very small flakes, it can be difficult to identify differences between complex or faceted platforms and abraded platforms. Abraded platforms likewise, are a good indication of late stage reduction and reveal extra preparation to the objective for the purposes of gaining added purchase for the controlled removal of a flake during the final stages of production and investment (Andrefsky 2005:97). Crushed platforms are usually concave in appearance and have been crushed to the extent that the platform cannot be distinguished.

Dorsal flake scars refer to the facets on the dorsal surface of a flake. A count of these facts are indicative of both reductions stage and bifacial or unifacial reduction where flakes exhibiting less than three dorsal flakes scars are associated with initial core or flake production, flakes exhibiting one to three are associated with mid stage reduction, and flakes exhibiting three or more dorsal scars are associated with late stage bifacial thinning (Magne 1985; Surovell 2003; Wyckoff et al. 1992).

The platform angle can also be diagnostic of the objective being produced. The platform angle is the angle between the dorsal surface and the platform. Difficulty in accurately assessing platform angle is overcome by defining this angle as approaching a right angle or an acute angle. Bifacial reduction flakes are expected to have acute platform angles (< 75°) and will exhibit more complex or abraded platforms (Andrefsky 2005). Unifacial production is more difficult to identify but in general, flakes associated with unifacial reduction should be characterized by ventral surface platforms (flat) and platform angles will often approach a right angle (Frison 1968) but should decrease as the objective is thinned.

Cortical flakes possess medium to strong analytical strength and are diagnostic of various stages of reduction (Amick et al. 1988; Mauldin and Amick 1989; Tomka 1989) where the greater the percentage of cortex exhibited within larger sized flakes is indicative of early stage reduction (Magne and Pokotylo 1981). Besides the amount of cortex present on the debitage, it is useful to distinguish between mechanically weathered and primary geological cortex for the purposes of understanding procurement of raw materials (Esdale 2009). Type of cortex was recorded as primary or incipient and percentage was scaled as 0-5%, 5-50%, and 50-100% (Esdale 2009). Relative amounts of shatter are also consistent with early stage production or poor quality material although shatter possess poor analytical strength as expressed in the dearth of literature covering the subject.

Size class sorting has the strongest implications for inferring manufacturing stages (Ahler 1989; Prentiss 1998). The histograms depicted in Figure 5-1 represent the expectation of various stages of lithic reduction based on experimentation. Early stage reduction is marked by the production of large flakes, but large flakes are likely to be further reduced. As reduction proceeds, flake size is expected to decrease and range of sizes will become more homogenous (Baumler and Downum 1989; Gilreath 1983; Magne and Pokotylo 1981; Stahle and Dunn 1982; Tomka 1989). Through experimentation, Tomka (1989:145) found that the majority of pressure flakes created during the final stages of production were less than 1 cm across the maximum dimension (SC1 and SC2 for this research).

Identification of raw materials provides a basis for linking tool and debitage attributes to site structure and organization. For example, the use or high quality or rare material can be useful for documenting mobility and/or long distance trade (Bamforth 1986; Kelly 1988; Kelly and Todd 1988; Kuhn 1994). The continual use of materials, especially in an inter-component context may also presupposes some familiarity with a region (Bousman 1993; Kelly and Todd 1988). Mobility can also be predicted from a reliance on small, portable tools (Kuhn 1994) as well as selective pressure for finished tools useful for a variety of activities (Andrefsky 1994). For this reason, flake clusters were defined to characterize individual flaking events and capture the greatest amount of variability within the site.

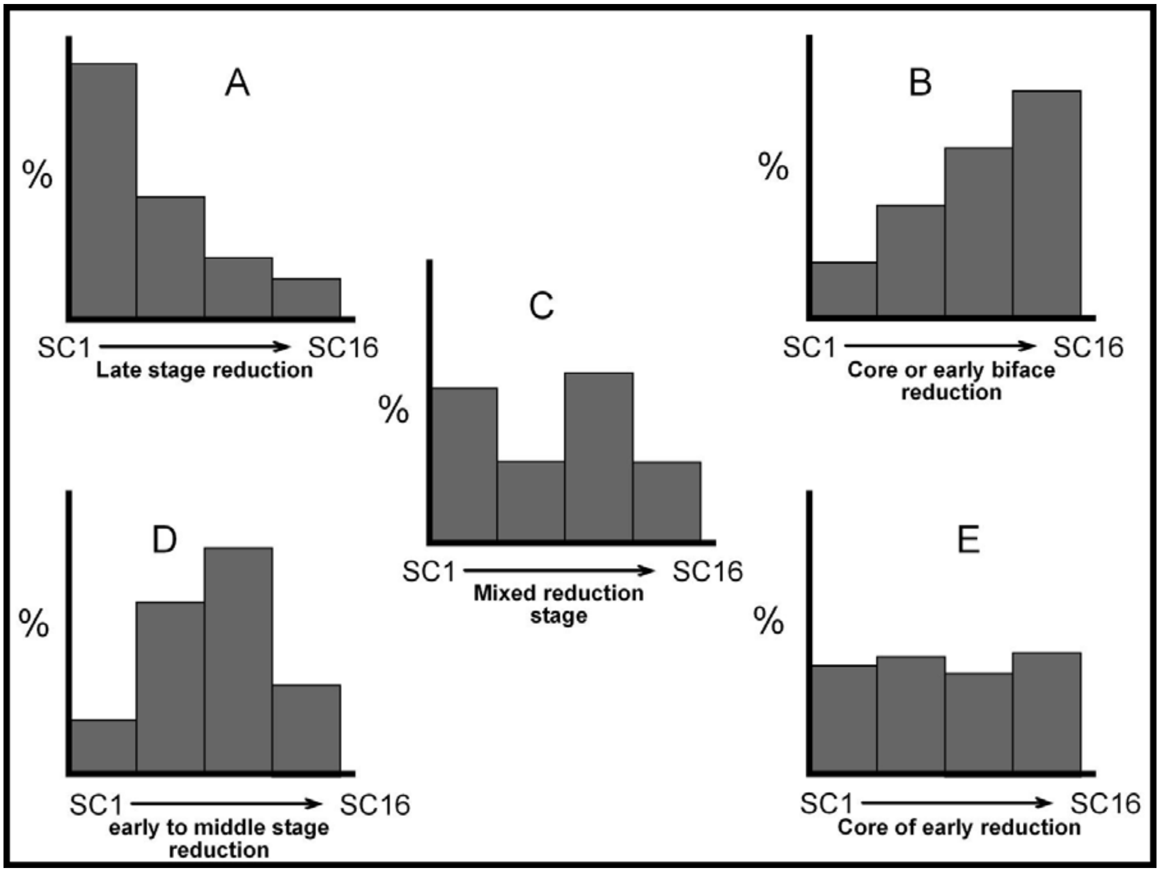

Figure 5-1. Size-class histogram typology modified from Sheppard et al. 1991:65.

Readily identifiable material classes include obsidian, basalt, quartz, quartzite, rhyolite, and jasper, but subtle differences in color, texture, and opacity, as well as simple misidentification of material type, can provide a source for interobserver error. This is especially true of the local appearance of siliceous tuff, which is typically identified as rhyolite, argillite, or mudstone in the literature based on its color and other properties (Stout 1976). To overcome this obstacle, lithic materials from the 2012 excavation were classified according to the size of their crystalline matrix (Sheppard et al. 1991) by using an Olympus SZX16 Research Stereomicroscope under 40X magnification. Classification of lithic material from the 1984 excavation was left unmodified as poor provenience information made it difficult to identify the precise location of most artifacts. The matrices were classified as macrocrystalline (X), microcrystalline (M), and cryptocrystalline (C). For this study X was defined as being observable to the naked eye, C was observable at 10X magnification, and M was observable under 40X magnification. Once crystalline structure was ascertained, artifacts were compared to material types under 40X magnification for the purpose of grouping.

In addition, two material types were simply identified as quartz and obsidian. Obsidian analysis was undertaken to identify the source and appropriately identify and analyze diachronic association within the stratigraphic column. Sourcing was conducted at the University of Alaska Museum of the North.

From the 2012 lithic assemblage, 47 individual material types were identified and plotted by point provenience and density contour as data permitted. Both density contours and point plots were generated using Golden Surfer8 and are based on the total number of artifacts by classification within an individual quadrant. Only point plots were generated for any material that was found in concentrations of one or fewer points per quadrant. If all material from a material class was recorded by level and relatively few were recorded in-situ, a density contour was used. For this research, material classes exhibiting a statistically significant sample size ($n \geq 30$) are analyzed directly, however, some containing less that 30 specimens were also analyzed. All other statistical analyses are done by component.

Components Delineation

For the purposes of this research, material classes are used to delineate cultural components and the level and relative provenience of each artifact has been assigned to a component. While materials are present in all levels above Level 10, they are most concentrated at Levels 2 through 4 and at Levels 6, 7 , and 8. Artifacts located directly on the glacial till are assigned to Component 1. All material classes directly recorded within Feature 6 and dated to 4850 to 4650 cal BP, or with primary distributions recorded within a general provenience associated with Feature 6 and Levels 7, 8, 9 and 10, have been assigned to Component 2. All artifacts in the upper portion of the excavation or with a primarily distribution encompassing Levels 1 through 4 have been assigned to Component 3. Material class C1 (n=76) is a common type in both Component 3 and

Component 2 and has been assigned artifact by artifact to a component based on general provenience and flake attributes. All other material classes recorded within multiple components have been assigned likewise. Figure 5-2 shows the result of the component delineation by material classification and three dimensional points for all material recorded in-situ. This figure includes the location of the tephra samples and charcoal samples used to date the chronology of the site. All points were recorded with the total station. Aside from a brief description of the stratigraphic origin of the material classes, a full description will follow in the lithic analysis section of this thesis.

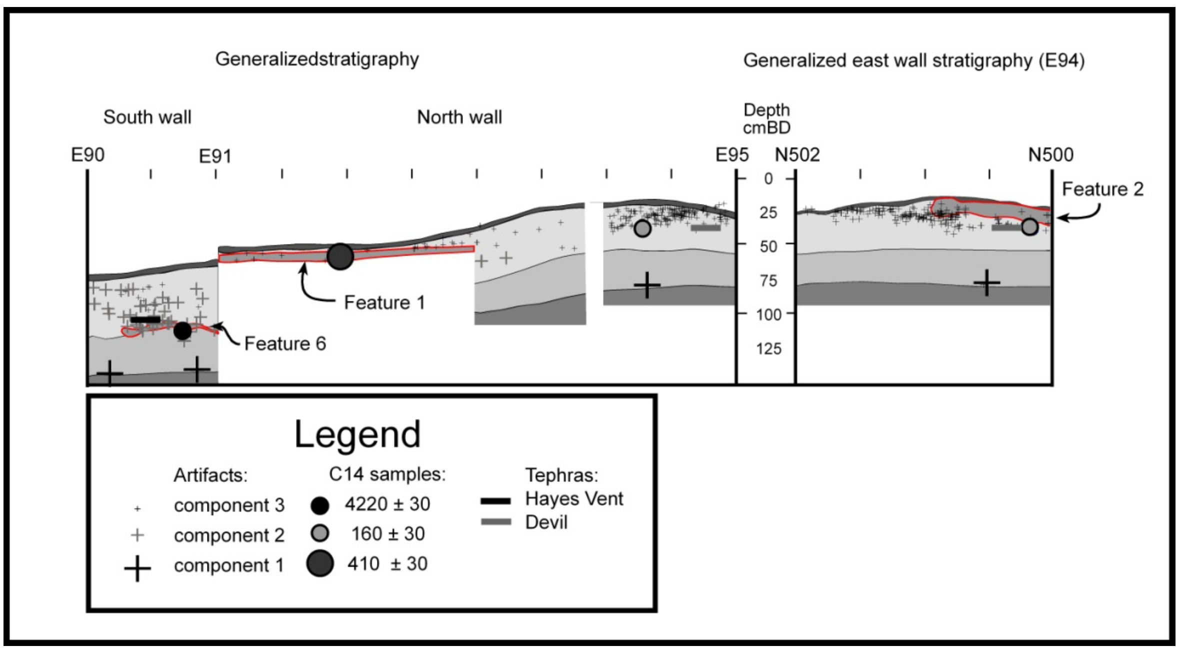

Figure 5-2. Three point distribution of lithic material by component superimposed on north and south wall profiles.

Three components at Butte Lake Northeast were identifiable by stratigraphic location and radiocarbon dates. Identification of occupation components was accomplished by splitting and then lumping lithic material into classes and then identifying the original context of each material as accurately as possible. This was done for the purpose of identifying both material type and individual nodules or objectives being reduced and was particularly useful during the examination of material recorded in the Block B excavation unit. Forty seven material classes were identified and several were isolated to individual features.

Component 1 artifacts (n=9) are isolated to the contact between the C horizon and the glacial till. Of the nine artifacts associated with this component, two were recorded within a discontinuous soil horizon (Bb) in Block B.

Component 2 artifacts (n=212) are primarily associated with the Feature 6 hearth (Figure 5-3). Table 5-1 is provided to show all of the material directly recorded in Feature 6, the percentage of all materials associated with Feature 6, and the percentage of all materials recorded in Component 2. Many of the artifacts that were recorded in Block B came directly from this feature and moved upward through the stratigraphic column (and will be demonstrated below), although it is currently unclear as to what forces caused this upward movement (Figure 5-3).

Table 5-1. Feature 6 material classes.

Material Class	Within Feature 6	Associated with Feature 6	Associated with Feature 6	Total Site
	n	%	n	%
C1	7	3.70	52	24.53
C22	3	1.59	7	3.30
C23	3	1.59	6	2.83
C25	4	2.12	8	3.77
C29	1	0.53	3	1.42
M12	3	1.59	5	2.36
M3	43	22.75	66	31.13
M6	28	14.81	42	19.81
total	92	48.68	189	89.15

Twenty five material classes were located in Block B and of those, twelve were directly associated with Component 2 at Levels 7, 8, and 9. Eight of the forty seven material classes recorded at the site originate from within Feature 6 including one biface and a biface fragment, a flake core, a modified flake, and a bifacial thinning flake. These artifacts are consistent with those recorded during the 1984 excavation in a similar provenience (Figure D-1). Figure D-4 shows all of the unifacial scrapers attributed to Component 2 (II) by Betts after the 1984 excavation, however provenience information on these materials is unclear and many of the artifacts may be associated with Component 3 based on material classification. The remaining material classes are concentrated in the upper Levels and represent a combination of Component 3 artifacts recorded in-situ and mixed downward through the column.

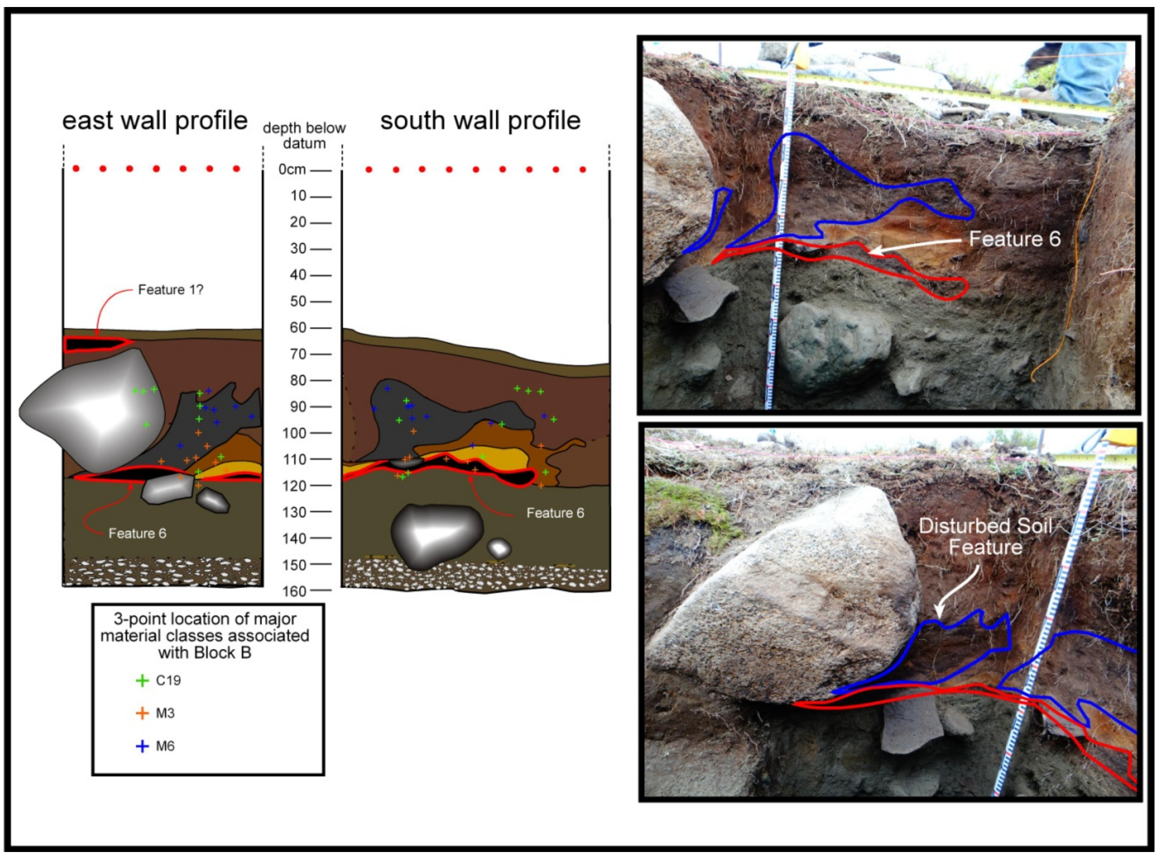

Figure 5-3. Location of Feature 6 with disturbed soil emanating from beneath large boulder. Also 3-point location of three material classes representing 50.8% of all material recorded in Block B.

Component 3 artifacts (n=820) were recorded in both Block A and Block B, but dominates the assemblage in Block A. While the majority of artifacts recorded in Block

A are associated with Component 3, which includes microblade technology, several artifacts from two material classes were recorded in similar provenience as that seen in Component 2 of Block B. In both Block A and Block B, identification of artifact classes has revealed a zone of potentially sterile sediments approximately 10 to 15cm deep separating Component 3 artifacts from the lower Component 2 artifacts.

Component 3 artifacts within Block A are typically located above Level 5 at a maximum depth of approximately 20cm below surface (Figure 5-4) while Component 2 artifacts were recorded between 35 and 45 cm below surface. Additionally, the lowest Component 3 artifacts and faunal remains are located in a provenience similar to the provincially identified Devil tephra.

Figure 5-4. All Component 3 artifacts and fauna are isolated above the line. All material recorded in these two units in associated with Component 3 or Component 1.

Several material classes were recorded at multiple levels and in contextual association with multiple occupation components. In addition, many of the material classes were very similar to others and exhibited only small differences, and while it is unlikely that each of these was removed from a common nodule, it does suggest that many of the materials used at the site were obtained from a common source and over a long period of time suggesting familiarity with common material sources. Procurement of these resources could be part of either an embedded strategy from which material is collected during the normal seasonal round, or result from a direct procurement strategy meant to obtain high quality materials from a single location tangential to a productive resource patch.

Technological Analysis

In the following section, description of major material classifications will be accompanied by density contour maps for those material classes that are assumed to represent the normal distribution of attributes within the entire class population. This is particularly true of material classes with thirty of greater specimens. Due to limited sample size, this will be extended to material classes with fewer than thirty but greater than 10 specimens with caveats. All material classes with fewer than ten specimens will be described by material class and will then be lumped by component with the assumption that all materials associated with an occupational component represent a normal distribution of attributes expected within the total population of the component. The following section will be divided by major distribution (density of materials) within each component starting with the most recent occupational component at the site, Component 3.

Component 3 Lithic Analysis

Component 3 contains the greatest number of lithic artifacts (n=820) and the only iron and copper (Table 5-2). The component also contains the greatest number of tool classes and is the only occupational component to exhibit obsidian from multiple sources. Figure 5-5 includes all of the tool classes recorded in Component 3, and Figure 5-6 includes all of the microblades recorded in Component 3. The artifacts in Figure 5-5 are arranged by depth below surface from top to bottom. Tables 5-3 and 5-4 provides descriptions of each material class and microblade fragment. All of the microblades were located at a similar depth below surface and are associated with the earliest materials recorded in Component 3.

Table 5-2. Material classes assigned to Component 3.

Material Class	Component 3	by Material Class	Total Component	Total Site
	n	%	%	%
BT	2	100	0.2	0.2
C1	24	32	2.9	2.3
C10	6	86	0.7	0.6
C12	5	100	0.6	0.5
C15	5	100	0.6	0.5
C16	3	50	0.4	0.3
C18	1	100	0.1	0.1
C19	22	100	2.7	2.1
C2	9	90	1.1	0.9
C21	1	100	0.1	0.1
C28	2	100	0.2	0.2
C3	41	98	5.0	3.9
C32	1	100	0.1	0.1
C4	1	100	0.1	0.1
C5	27	100	3.3	2.6
C7	578	100	70.3	55.4
K	3	100	0.4	0.3
M10	7	50	0.9	0.7
M11	2	100	0.2	0.2
M13	4	100	0.5	0.4
M2	6	100	0.7	0.6
M4	17	100	2.1	1.6
M5	22	100	2.7	2.1
M7	11	100	1.3	1.1
M8	1	100	0.1	0.1
M9	11	100	1.3	1.1
T1	3	75	0.4	0.3
WP	2	67	0.2	0.2
total	820		100.0	78.6

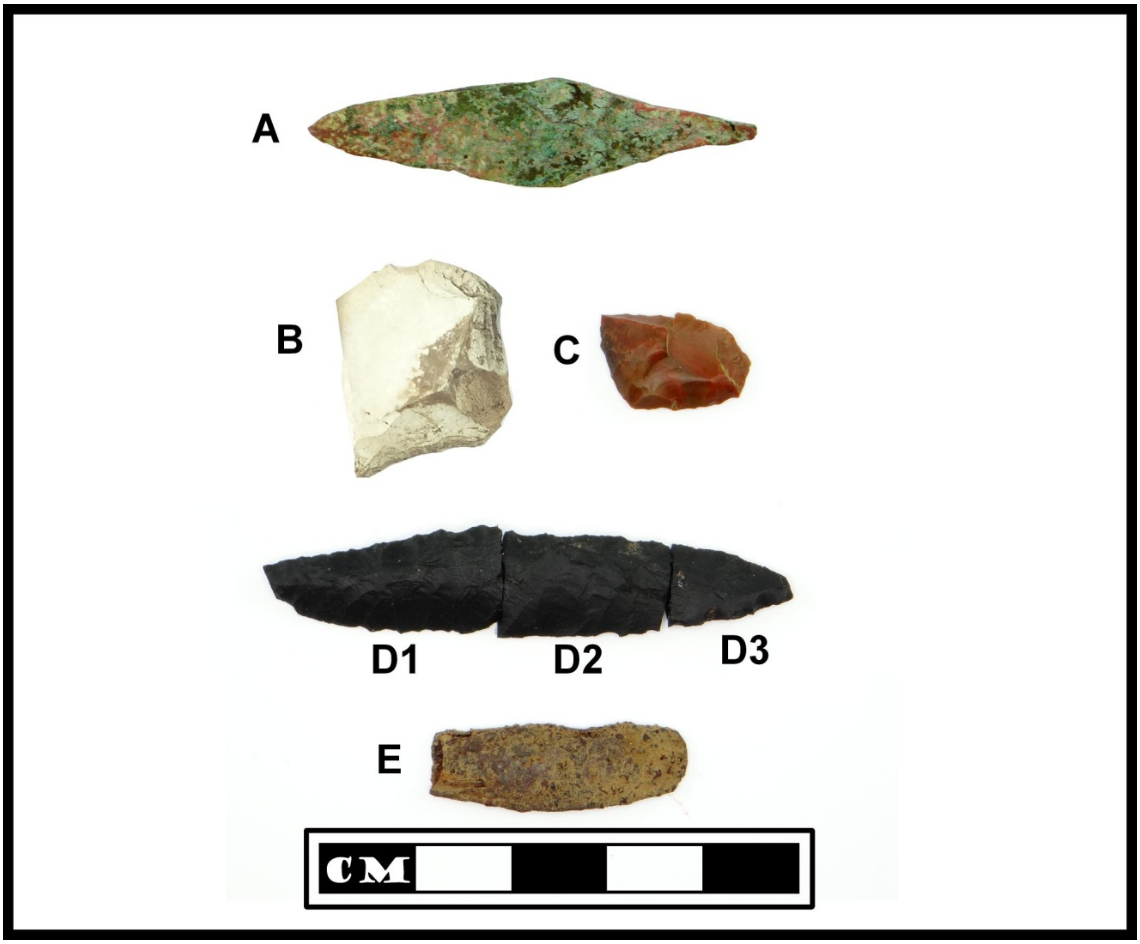

Figure 5-5. A: copper point; B: unifacial scraper; C: bifacial scraper; D: lateral side blade; E: iron bit.

Table 5-3. Component 3 tools.

	FS #	Artifact Type	Max Length (mm)	Max Width (mm)	Max Thick (mm)
Tool Classes					
A	011-212	copper point	44.1	10.8	1.5
B	011-272	unifacial scraper	12.9	18.0	2.2
C	014-138	bifacial scraper	15.6	9.9	3.7
D1	014-070	lateral side blade	23.3	10.1	3.1
D2	013-209	lateral side blade	16.3	9.5	3.4
D3	013-204	lateral side blade	11.8	7.8	2.7
E	014-133	Projectile Point	76.8	28.1	8.6

Figure 5-6. Microblades recorded in Component 3.

Table 5-4. Component 3 microblades.

	FS #	Artifact Type	Max Length (mm)	Max Width (mm)	Max Thick (mm)
Microblades					
A	010-007	microblade fragment	7.6	6.2	1.8
B	013-277	microblade fragment	18.2	3.7	1.4
C	010-063	microblade fragment	14.3	4.7	1.2
D	011-190	microblade fragment	7.5	2.8	0.9
E	010-090	microblade fragment	21.5	6.3	1.3

Material classes C19, C7, C5, and C3 make up 64.1% of the entire lithic assemblage and 81.1% of the Component 3 lithic assemblage recorded during the 2012 excavation. Figure 5-7 shows the location of four of the major material classes using density contour maps.

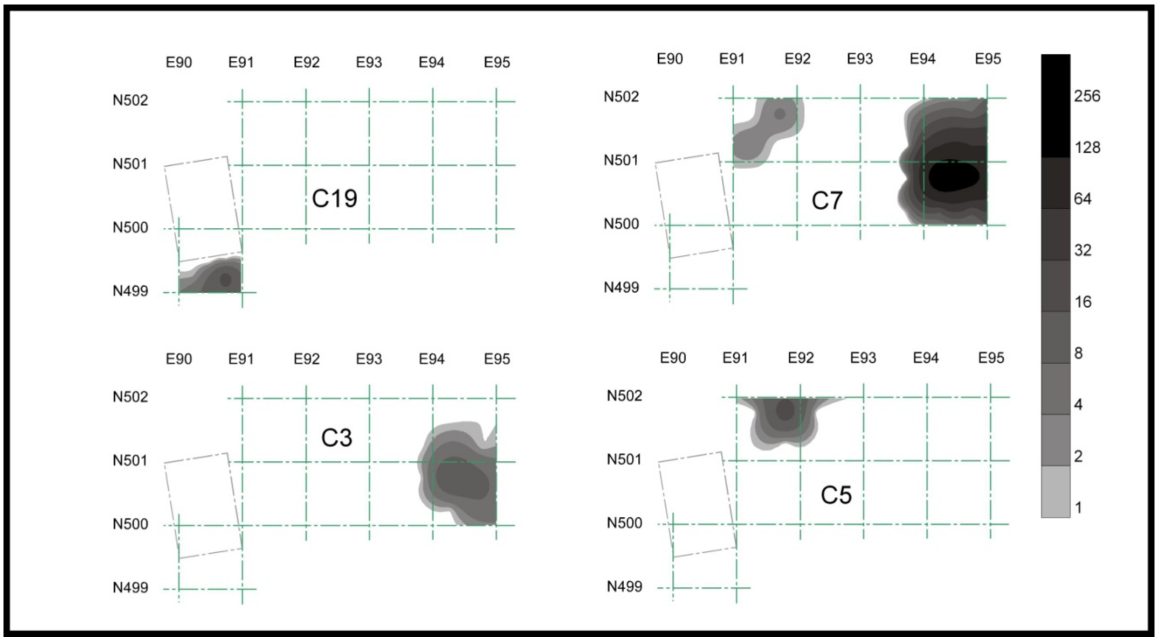

Figure 5-7. Material Classes C19, C7, C5, and C3 with major distribution in Component 3.

C7

Material class C7 produced the greatest number of artifacts recovered from the site. A total of five hundred and seventy eight flakes accounting for 55.4% of the assemblage were collected from a relatively small area at the top of Level 3 and the bottom of Level 2. One hundred and sixteen artifacts were recovered in-situ (20%) and two hundred and seventeen (38%) were recovered from three soil matrices. Each matrix consisted of 0.0125 cubic meters of material. C7 varied in color from dark gray (N3) and pinkish gray (5Y 6/1) to pale yellowish brown (10YR 6/2) . Opacity varied as well between translucent with dark gray bands to completely opaque. The material is mildly coarse grained and has very few inclusion or noticeable cleavage plains (medium to good quality). The material has a waxy appearance and resembles material class C1. The cryptocrystalline structure of this material was consistent throughout and was clearly removed from the same objective or nodule.

Stratigraphically, C7 was recorded in the upper five levels. One flake (0.2%) was recorded in level 1, 480 (83%) were recorded in level 2, 87 (15.1%) were recorded in level 3, 9 (1.6%) were recorded in level 4, and 1 (0.2%) was recorded in level 5. Of the 578 artifacts recorded, 146 (25.3%) are complete, 98 (17%) are proximal fragments, 260 (45%) are medial fragments, 57 (9.9%) are distal fragments, and 17 (2.9%) are split flakes.

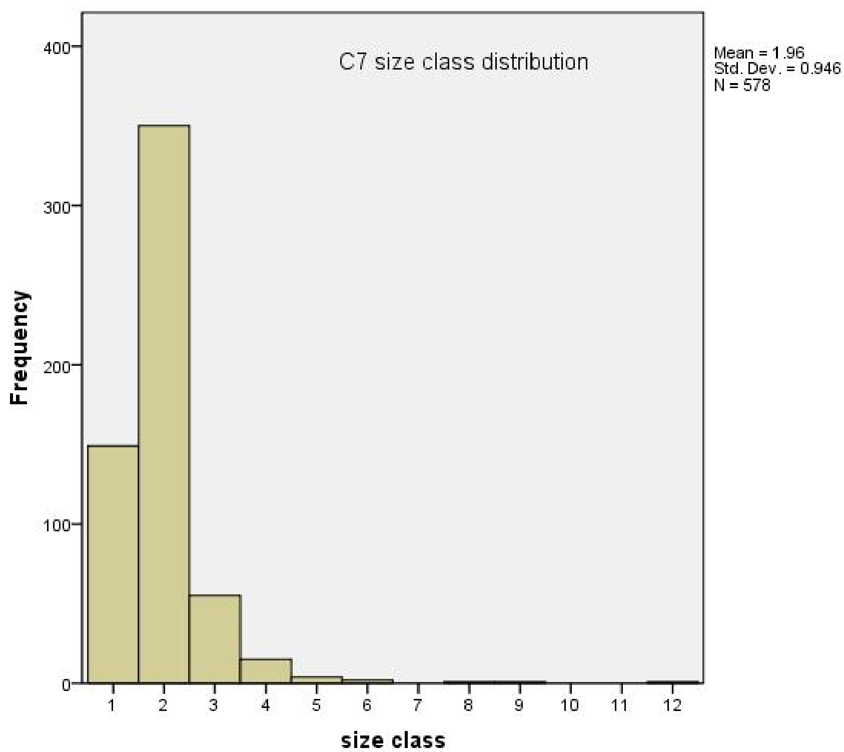

Figure 5-8. C7 size class distribution.

The median flake size for C7 is SC2 and would indicate late stage reduction (Figure 5-8), but based on the dorsal scar count, only 5 (0.9%) have greater than three dorsal scars associated with late stage bifacial reduction. Several hundred flakes and flake fragments from this material class were observed, but due to the very small size (<3mm) and means of recovery (nested sieve), they have not been included in the analysis to avoid inconsistencies. Analysis of platform preparation indicates that 60 (26.4%) are crushed, 89 (39.2%) are abraded, 43 (18.9%) are complex, and 35 (15.4%) are flat. In addition, 59.3% of the platforms have an acute angle. While none of the flakes exhibited bending, 3.1% did have lipped platforms. Shatter consisted of 7.3% of the total C7 assemblage. Taken altogether, C7 appears to represent late stage unifacial tool production and is associated with Feature 2.

C5

Material class C5 produced 2.6% (n=27) of the total lithic assemblage, all of which was recorded in Component 3 (3.3%). C5 is a light colored argillite that varies from pale yellowish brown (10YR 6/2) to light brownish gray (5YR 6/1). All of the material associated with this material class were recorded in Level 2. Of the 27 artifacts,11 (40.7%) are complete, 2 (7.4%) are proximal fragments, 12 (44.4%) are medial fragments, and 2 (7.4%) are distal fragments.

The median size class for C5 is SC2 and would indicate late stage reduction (Figure 5-9). All flakes contain fewer than three dorsal facets. Analysis of platform preparation indicates that 4 (30.8%) are crushed, probably due to the relatively soft material, while 1 (7.7%) exhibits abrasion, 6 (46.2%) are complex, and 2 (15.4%) are flat. Of flakes with platforms, 53.3% exhibit angles that approach right angles and only 1 flake had a lipped platform. Material class C5 most like represents late stage unifacial reduction.

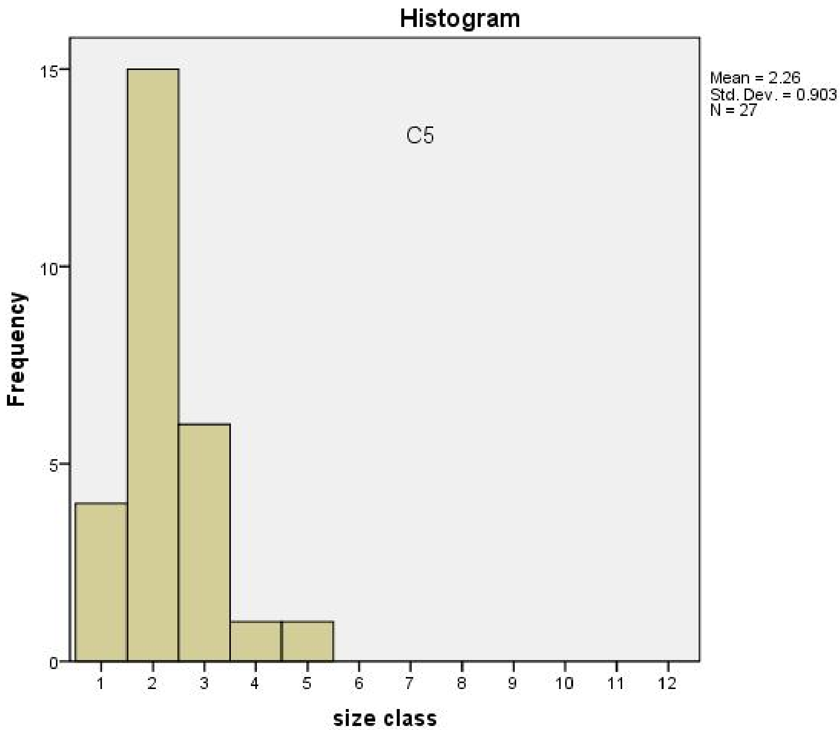

Figure 5-9. C5 size class distribution.

C3

Material class C3 accounts for 4% (n=42) of the total lithic assemblage recorded in 2012 and makes up 5% (n=41) of Component 3. The material is a medium to good quality chert or greenstone argillite that ranges in color from dark gray (N3) to olive gray (5Y 4/1). The majority of the material is located in Levels 2 and 3 in Block A (n=40) although one flake was recorded in Level 5 and another in Level 13 in Block B. This suggests a possibility that the material is directly procured for its quality, but without a larger sample, it is difficult to test this hypothesis. Of the 42 flakes, 7 (16.7%) are complete, 10 (23.8%) are proximal fragments, 19 (45.2%) are medial fragments, 5 (11.9%) are distal fragments, and 1 (2.4%) is a split flake.

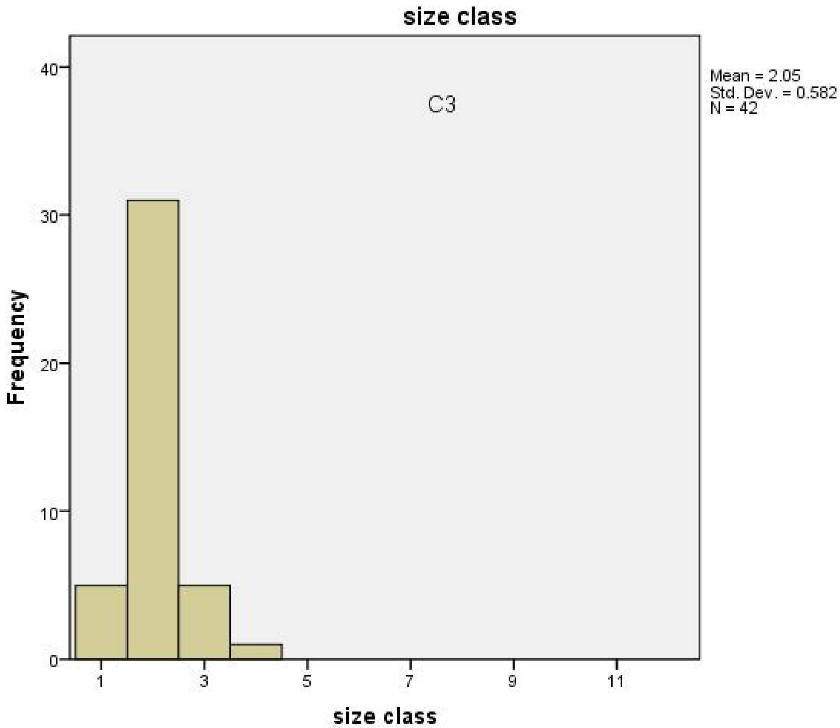

Figure 5-10. C3 size class distribution.

The median size class for C3 is SC2 and again appears to represent late stage reduction (Figure 5-10). The single flake from Level 5 was a medial flake fragment and exhibited more than three dorsal facets (SC3), while the remainder had fewer than three. Analysis of platform preparation indicated that 4 (25%) were crushed, 6 (37.5%) were abraded, and 6 (37.5%) were complex. 62.5% of the platforms were at oblique angles and 2 exhibited lipped platforms, all of which came from Component 3. While the Component 2 and Component 1 artifact sample is far too small to diagnose intent, the remainder of the Component 3 artifacts suggest a pattern of later stage unifacial reduction.

C19

Material class C19 was located entirely within Block B. C19 accounts for 2.1% (n=22) of the site assemblage and 2.3% of the Component 3 assemblage. C19 was located in Levels 2 (4.5%), 3 (36.4%), 4 (31.8%), 5 (18.2%), 6 (4.5%) and 7 (4.5%). Of the eight flakes recorded in Level 3, five were recorded as lying directly on one another and were mapped with the total station as a single point (Point ID# 867). The flakes were oriented in a horizontal position and while they did not refit, it was immediately evident that they were removed from the same objective. Based on this position and the occurrence of ten more flakes within Level 3 and 4, C19 has been confidently linked with Component 3.

C19 is a good quality chert that appears tan under field conditions and ranges from yellowish gray (5Y 7/2) to dark yellowish brown (10YR 4/2). One piece of shatter was recorded and of the remaining flakes, 6 (27.3%) are complete, 4 (18.2%) are proximal fragments, 5 (22.7%) are medial fragments, 3 (13.5%) are distal fragments, and 3 (13.5%) are spit fragments.

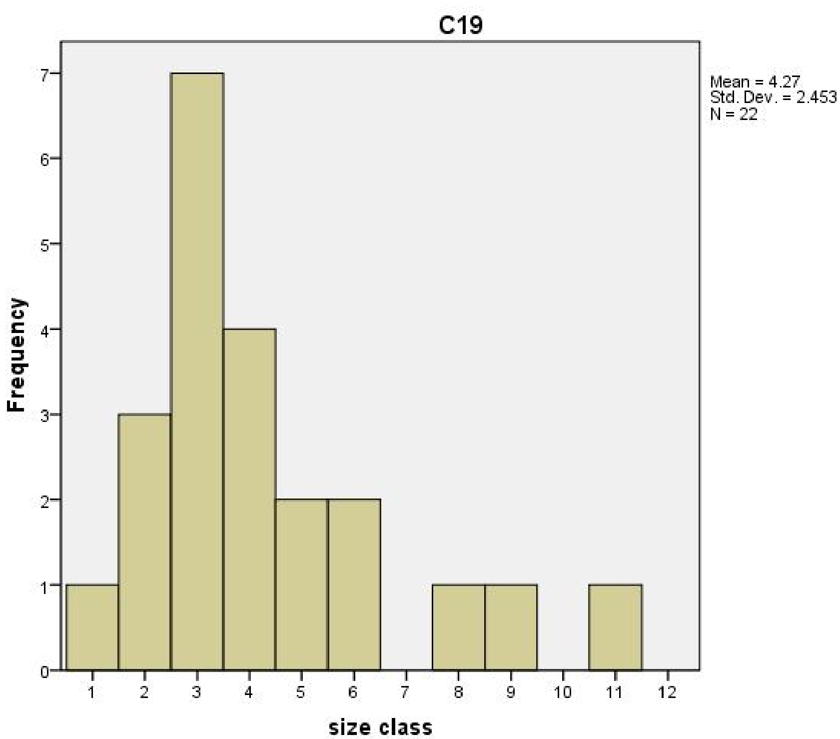

Figure 5-11. C19 size class distribution.

The median size class for C19 is between SC3 and SC4 (3.5) (Figure 5-11). The size class distribution suggests middle stage reduction, but the sample size is small. None of the flakes exhibited greater than three dorsal facets. Platform analysis indicates that 1 (9.1%) is crushed, 2 (18.2%) are abraded, 4 (36.4%) are complex, and 4 (36.4%) are flat and 54.5% exhibit platforms approaching a right angle. In addition, nine of the flakes exhibited bending along the ventral surface.

Material classes M9, M4, M7, and M5 account for 5.8% (n=60) of the all lithic materials analyzed and 7.3% of all materials recorded in Component 3 (Figure 5-12). While each material class is unique and individual sample sizes are small, they are all high quality chert, chalcedony, and argillite and as a group my provide incite as to how these materials were curated.

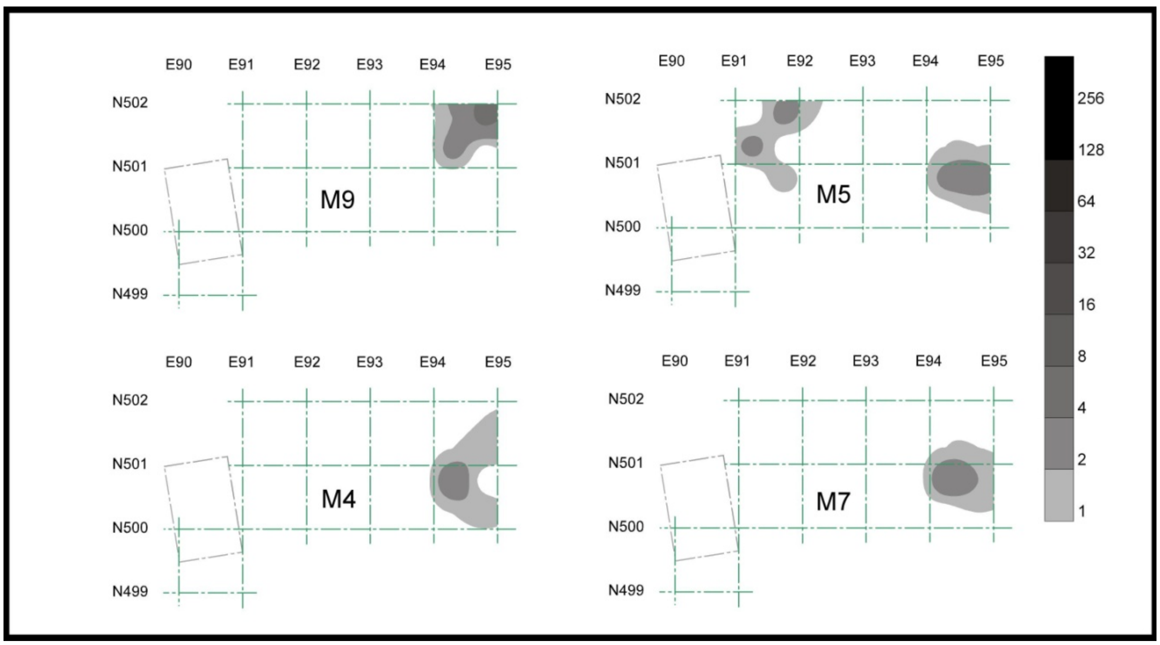

Figure 5-12. Material Classes M9, M4, M7 and M5 with major distribution in Component 3.

M5

Material class M5 produced 2.1% (n=22) of the lithic assemblage from the site, and 2.6% of the Component 3 assemblage, and particularly in Level 2 (77.3%) and Level

3 (22.7%). Under field conditions, the color is a strong brown but ranges from light brown (5YR 5/6) and moderate brown (5YR 4/4) to blackish red (5R 2/2), and is semi-translucent in appearance. The material is very good quality with few inclusions or cleavage planes. Of the twenty two artifacts associated with the material class, two are microblade fragments. Both microblade fragments were recorded in-situ.

The median size class for M5 is SC2 (Figure 5-13). Of the twenty two artifacts associated with M5, 41%% were broken and 50% were complete. Of the broken flakes, 2 (9.1%) are proximal fragments, 7 (31.8%) are medial fragments, 1 (4.5%) is a distal fragment, and 1 (4.5%) was recorded as shatter. Only 2 (9.1%) of the sample exhibited greater than three dorsal facets. Analysis of platform preparation indicates that 4 (30.8%) are abraded, 4 (30.8%) are complex, and 5 (38.5%) are flat, and 53.8% have platforms approaching right angles. Given the small sample size, late stage bifacial reduction is indicated, but based on the presence of microblade fragments, this reduction is most likely related to microblade core preparation.

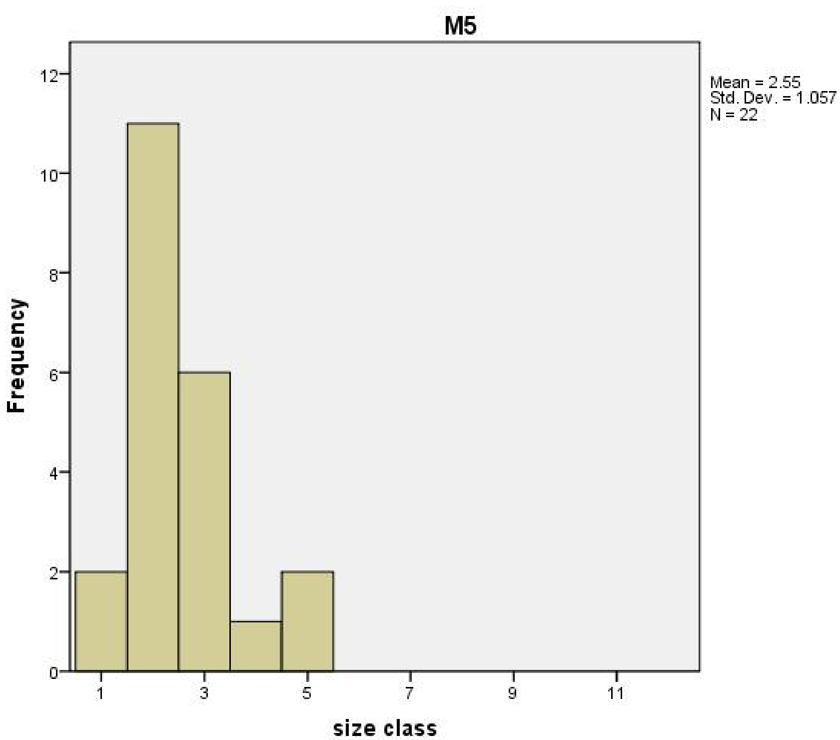

Figure 5-13. M5 size class distribution.

M4

Material class M4 produced 1.6% (n=17) of the material from the entire site and 2.1% of the Component 3 assemblage. M4 was recorded within Levels 2 (n=8), 3 (n=4), and 4 (n=4) in Block A and in Level 5 (n=1) in Block B. M4 is a high quality chalcedony that is semi-translucent and ranges in color from very light gray (N8) to dark gray (N3) with few inclusion and only one flake exhibited what may be considered a cleavage plane. This material class includes on microblade fragment that was recorded in mixed soil in Level 5 and was recovered from the screen.

The median size class for M4 is SC3 (Figure 5-14). Only the microblade fragment associated with M4 exhibits greater than 3 dorsal facets. Nine (53%) of the flakes are broken, four (23.5%) are complete, the remaining four (23.5%) are considered shatter. Of the broken flakes, three (17.6%) are proximal fragments, four (44.4%) are medial fragments, and two (22.2%) are distal fragments.

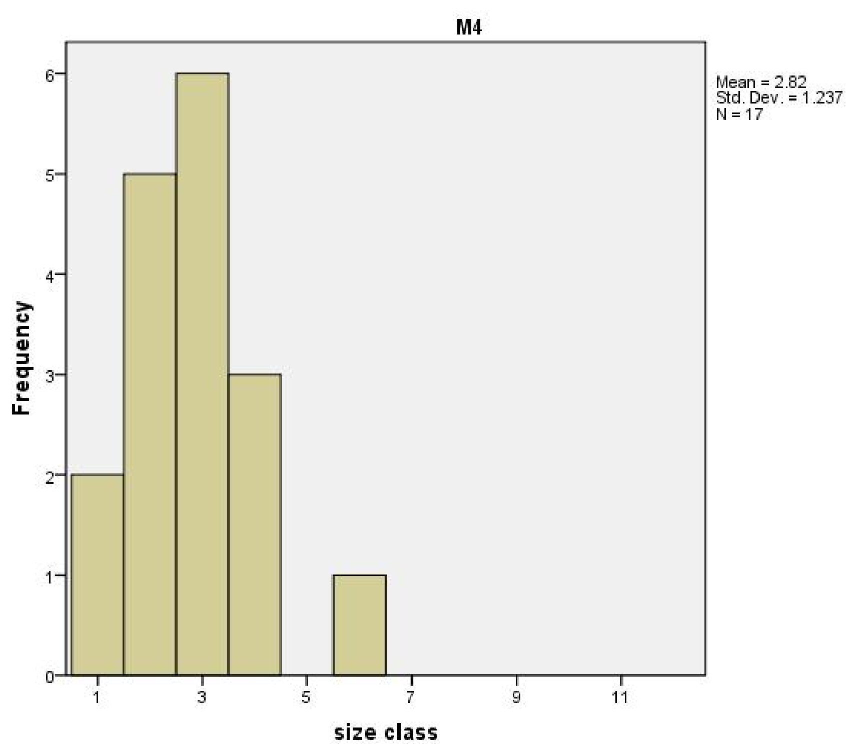

Figure 5-14. M4 size class distribution.

Of flakes exhibiting platforms, 57.1% exhibit angles approaching right. Two (28.6%) platforms are crushed, two (28.6%) are abraded, two (28.6%) are complex, and one (14.3%) is flat. Analysis of bending flakes or flakes with lipped platforms indicate that six (35.3%) of the flakes are bent, but none exhibit lipped platforms. M4 appears to represent middle to late stage unifacial reduction based on the small sample size but could just as likely be middle to late stage core reduction or core maintenance.

M7

Material class M7 produced 1.1% (n=11) the entire lithic assemblage and 1.3% of the Component 3 assemblage. All material associated with M7 was recorded in Levels 2 (72.7%) and 3 (27.3%). M7 is a very high quality chert with no noticeable inclusions or cleavage planes and produced three biface fragments that refit as a side-blade inset. The three fragments were recorded in Level 2, although continued maintenance by way of flake removal was noted on each fragment after initial breakage and is evident in uneven flake scarring on FS#014-070 and FS#013-209.

M7 produced two fragments of shatter, and while no complete flakes were recorded, 2 (33.3%) were proximal fragments, 2 were medial fragments, and 2 were distal fragments. Both proximal fragments exhibited abraded platforms with oblique angles.

The median size class for all flakes is SC2. Although the sample size is very small, flakes recorded at the site have likely been removed from the objective as a whole or after it had been broken. Many of the flake scars noted on the post breakage retouch were very small, and no material exhibiting a maximum dimension of less than 3mm was analyzed for this research. The remaining shatter may or may not be directly associated with the objective biface, but considering the general provenience of the material, it is likely associated in some way and may represent a separate objective originating from the same nodule or acquired from the same source during a single procurement event. Based on the retouch, the fine quality flake removal, and the general small size, M7 is a good representation of a highly curated tool expected when material quality is exceptional.

M9

Material class M9 also produce 1.1% (n=11) of the entire assemblage and 1.3% of the Component 3 assemblage. M9 is a relatively soft argillite that ranges in color from very pale orange (10YR 8/2) to pale yellowish brown (10YR 6/2). All for the material was recorded in Level 2 (90.9%) and Level 3 (9.1%). M9 produced 3 (27.3%) pieces of shatter and 3 (27.3%) complete flakes. The remainder of the flake count includes 2 (18.2%) proximal fragments, 3 (27.3%) medial fragments, and 1 (9.1%) split fragment.

The median size class for M9 is SC3. The single flake recorded as SC9 was a complete flake. The limited sample size indicates mixed or middle stage reduction based on the lack of cortex. One flake exhibits greater than three dorsal facets and a platform lip. Platform analysis indicates that 2 (40%) are crushed, 2 (40%) are abraded, 1 (20%) is flat, and three exhibit platforms approaching right angles.

C1

Material class C1 produced the greatest variety in debitage and is primarily located in Component 2. Fourteen of seventy six specimens were recorded in Block A including one in Level 1, seven in Level 2, and six in Level 3. All of the Block A specimens are clearly associated with Component 3. Specimens allocated to material class C1 constitute 2.9% (n=24) of the Component 3 assemblage based on major distribution by level and qualitative or descriptive flake attributes. Material class C1 attributes will be discussed further in the following section.

The median size class for C1 within Component 3 is SC3 (2.5) (Figure 5-15). Of the twenty four artifacts assigned to Component 3, five (20.8%) are complete flakes three (12.5%) are proximal fragments, eight (33.3%) are medial fragments, six (25%) are distal fragments, and two (8.3%) have been identified as shatter. Of the eight specimens with identifiable platforms, one (12%) is crushed, two (25%) are abraded, five (62.5%) are complex, and 87.5% of the platforms approach a right angle. Three of the artifacts exhibited greater than three dorsal facets. While one large flake allocated to material class C1 was recorded in Feature 1, the remaining materials are indicative of late stage unifacial reduction and is most likely associated with butchering practices.

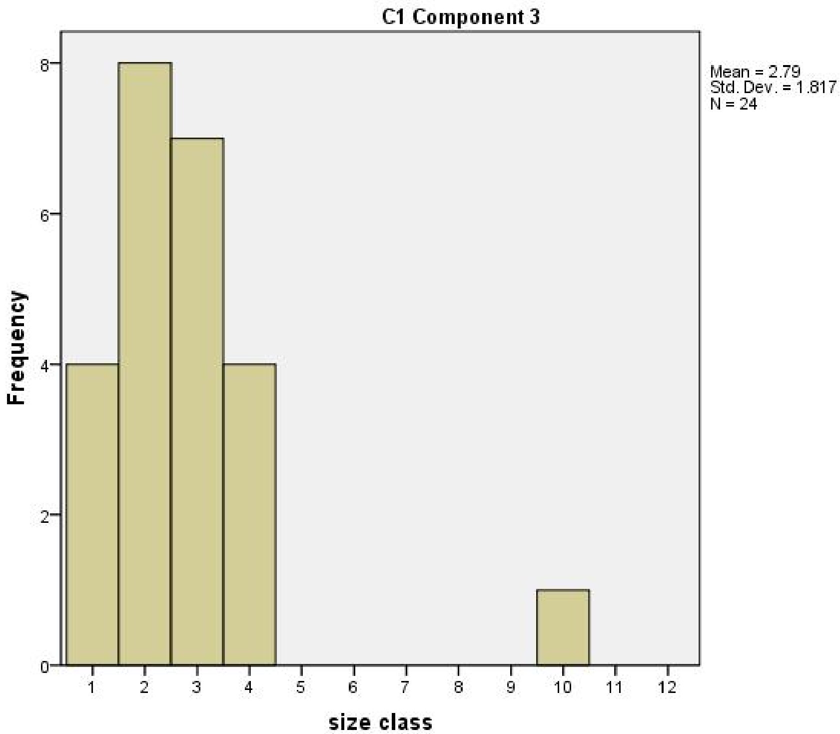

Figure 5-15. C1 size class distribution within Component 3.

The remainder of materials isolated within Component 3 contain very few specimens and aside from a brief description of the material, all metrics used are lumped by component and are listed in Table C-11 in the modified Sullivan and Rozen Typology.

M10

Material class C10 produced seven artifacts accounting for 0.7% of the entire lithic assemblage. All materials allocated to this class were recorded in Level 2 (71.4%) and Level 3 (28.6%). Material class C10 is dull in appearance and ranges in color from brownish gray (5YR 4/1) to pale yellowish brown (10YR 6/2) and is a medium to good quality chert with very few inclusions and resembles both material class C1 and C7.

C15

Material class C15 produced five artifacts accounting for 0.5% of the lithic assemblage. All of the material allocated to this class came from the unit in excavation

Block B and were recorded at Level 2 (20%), Level 4 (20%) and Level 5 (60%). Based on the major distribution of the material in Level 5 and upward through the column, this material class has been provisionally assigned to Component 3. All material from this class was captured using the mesh screen and was recorded by level and quadrant only.

The material is a medium to good quality translucent to opaque chert that ranges from dark yellowish brown (10YR 2/2) to pale yellowish brown (10YR 4/2). The material contains some possible banding but no other notable inclusions and has a dull appearance.

C2

Material class C2 is associated primarily with Component 3 in excavation Block A, however one flake fragment allocated to this class was recorded in association with the Component 2 hearth (Feature 6) in Block B. The material class contributed ten artifacts accounting for 1% of the assemblage. The material is a good quality chert that is opaque and dull in appearance with no notable inclusions. The color ranges from dark gray (N3) to brownish gray (5YR 4/1). Of the ten artifacts, nine are associated with Component 3 and one with Component 2, and have contributed to the overall lithic analysis based on these associations.

C21

Material class C21 accounts for a single flake fragment recorded in Level 2 of Block A. The single yellowish gray (5YR 8/1) fragment appears to be a low to medium quality chert based on the presence of inclusions such as a cleavage plane.

C28

Material class C28 produced two artifacts, one a proximal flake fragment and the other a single piece of shatter. C28 is a medium to good quality rhyolite that ranges from brownish gray (5YR 4/1) to dark yellowish gray (10YR 4/2) and exhibits a dull appearance. Both specimens were recorded within Level 2 in Block A.

C32

Material class C32 is a single quartzite flake recorded in Level 2 of Block A and was recovered from one of the flake matrices recorded within that level. The material is a medium quality pale yellowish orange (10YR 8/6) specimen similar to material class C1 and C7 with regards to the size of the crystalline structure and inclusions otherwise noted in material class C1. C32 is waxy in appearance and slightly translucent.

C4

Material class C4 also contributed a single flake fragment to the assemblage associated with Component 3. The single fragment appears to be a medial microblade fragment and is associated with materials recovered from Component 3 in Block A. The material is a high quality basalt like material that is brownish gray (5YR 4/1) and contains no identifiable inclusions. The location of this fragment in Level 2 may be indicative of some mixing that was otherwise unidentifiable, or could indicate the persistent use of microblades technology well into the late Holocene.

M11

Material class M11 produced two high quality jasper artifacts, one a medial flake fragment and the other a single piece of shatter. Both artifacts were recovered from Level two in Block A and were recorded within the same unit. While the artifacts appears red under filed conditions, they range in color from very dusky red (10R 2/2) to grayish brown (5YR 3/2).

M13

Material class M13 contributed four artifacts to the assemblage, one of which was recorded in Level 5 and the other three were recorded in-situ in Level 3. The material is most like a siliceous tuff that is typically characterized as argillite within the region. M13 is similar to M10 and M8. Materials range in color from pale yellowish brown (10YR 6/2) to moderate yellowish brown (10YR 5/4). While materials allocated to this material class are very similar and come from the same unit, it is not likely that they all originate from the same nodule, but is more likely a common material with similarities to at least four other material classes. For this reason, materials from this class recorded in Level 3 are assigned to Component 3, and the fragment from Level 5 is assigned to Component 2 for analytical purposes.

M10

Material class M10 while not found entirely within Component 3, is similar to material class M13 and M8, in that it appears to be a siliceous tuff often referred to as argillite. FS# 011-122 is a modified flake with extensive retouch along one lateral margin (Figure 6-21).

The artifacts allocated to this material class contributed 1.3% (n=14) of the entire assemblage and seven artifacts were recorded within Component 3 in Level 2 (n=4) and Level 3 (n=3) in Block A. Five artifacts allocated to this material class were recorded in Block B, three were from the mixed soil, one was recorded in-situ in a horizontal orientation in Level 6, and one more was recorded in the screen from Level 7. Based on the position of the artifact recorded in Level 6, material recorded in Block B is assigned to Component 2 for analytical purposes. Two more artifacts allocated to this material class were directly recorded within Component 1 in Level 13 and are directly associated with a buried soil horizon in Block B. One flake from Component 1 (Sc6), was complete and the second (SC10) was a distal fragment. The complete flake exhibited an abraded platform at an acute angle.

M8

Material class M8 was a single piece of shatter recorded in Level 2 in Block A. The material is very pale orange siliceous tuff with an identifiable cleavage plain.

M2

Material class M2 produced six artifacts, all of which are associated with Component 3. Of the six artifacts allocated to this material class, four were recorded in Level 2, one in Level 3, and a single small burinated scraper was recorded in Level 4. M2 is a high quality jasper with a waxy to vitreous appearance and ranges in color from pale brown (5YR 5/2) to moderate brown (5YR 3/4). The material is similar to other jaspers recorded at the site and the primary difference is the color. While the artifacts allocated to this material class appear very similar, it is possible, that they did not originate from the same objective, although it is conceivable. Based on the depth below surface, the general provenience and association with faunal remains and the upper Devil tephra, all artifacts within this material class are assigned to Component 3 for analytical purposes.

C20

Material class C20 consists of a single tuff microblade fragment that was recorded within Block A at the bottom of Level 4. The material is similar in appearance to both M10 and M13, but is softer and has a larger crystalline structure. The color is recorded as pale yellowish brown (10YR 6/2) and is the only microblade fragment recorded at the site from either the 1984 or 2012 excavation that is made from this material.

C16

Material class C16 was recorded in Levels 2 (n=3), 6 (n=1), and 7 (n=2) in Block A. C16 is a medium to good quality chert that is similar to C29 and C22 with only small differences in crystalline size and structure. The color ranges from pale yellowish brown (10YR 6/2) to brownish gray (5YR 4/1) and is semi-translucent with a waxy appearance. Artifacts in Level 2 have be assigned to Component 3, and those from Levels 6 and 7 are assigned to Component 2 for analytical purposes.

T1

Material class T1 is a low grade quartz recorded in both Component 3 (n=3) and Component 2 (n=1). It is highly unlikely that artifacts allocated to this class were removed from the same nodule although two are recognizable as complete flakes recorded in Level 4 and Level 2, one is a single piece of shatter recorded in Level 3 and another possible piece of shatter was recorded in the vicinity of Feature 6 in Level 10. It must be noted that the Level 10 specimen exhibited humic staining and may have originated in a higher context that was later redeposited due to soil mixing in Block B.. The flake recovered from Level 4 is clear quartz and is completely translucent. The second flake is light brownish gray (5YR 6/1). Both flakes exhibit identifiable cleavage plains. Both pieces of shatter are yellowish gray (5Y 8/1) but appear white under field conditions.

X1

Material class X1 contributed 0.4% (n=3) artifacts to the site assemblage but it is highly unlikely that all three were removed from the same nodule, however, two complete flakes recovered from Level 3 in Block B do appear to originate from the same nodule or objective. The artifacts allocated to this material class are the only clear examples of basalt or material containing identifiable phenocrysts recovered during the 2012 excavation.

Obsidian is the only material that can be directly sourced at Butte Lake. During both the 2012 and 1984 field seasons, at least eighteen specimens were recorded and were large enough to be sourced. Sourcing was conducted at the University of Alaska Museum of the North on a Bruker Tracer III-V no. 510 portable X-ray fluorescence (PXRF) utilizing RJS Obsid Cal 4-30-09.CFZ calibration. Eight of the eighteen were recorded during the 2012 field season and six were identifiable. In addition, the two that were two small to be positively identified were found in direct association and exhibited consistent attributes with others that could be identified.

Wiki Peak Obsidian

Obsidian sourced to Wiki Peak appears in association with both Component 2 and Component 3 in both the 1984 and 2012 excavations, however, provenience information for 1984 may indicate unclear association and one flake from the 2012 was recorded in Level 6 in Block B, which may be problematic due to soil mixing. That being stated, Wiki Peak is clearly recorded in the late Holocene occupation in Component 3 and at least two flake fragments are directly associated with a Component 2 feature recorded in 1984.

Batza Tená Obsidian

Obsidian sourced to Batza Tená is equally problematic with regards to both the 1984 and 2012 excavations although it appears isolated to the Component 3 assemblage from 1984. One complete flake was recorded in-situ in Level 2 during the 2012 season, and one proximal fragment was recovered during screening from the mixed soil in Level 7, which may or may not be associated with the Level 2 flake. Based on the very limited sample size, it would appear that Batza Tená obsidian is primarily associated with Component 3 however.

Standard K Obsidian

One other type of obsidian was identified at the site and is referred to as Standard K. While the source of Standard K is as yet unknown, both specimens were very small which may have lead to the possibility of a false positive association. Both Standard K specimens were recorded in Level 2 of Block A. If in fact, these specimens are associated with Standard K, then it would appear that greater variety in at least obsidian acquisition and use has occurred during the late Holocene.

Component 2 Lithic Analysis

The majority of materials assigned to Component 2 were recorded in or associated with the Feature 6 hearth. Table 5-5 indicates the total number of artifacts associated with Component 2 and includes the percentage by material class, component, and total for the site. Figure 5-16 and Table 5-6 provide a description of each of the tool classes recorded in Component 2.

Table 5-5. Material Classes assigned to Component 2.

Material Class	Component 2	by Material Class	Total Component	Total Site
	n	%	%	%
C1	52	68	24.5	5.0
C10	1	14	0.5	0.1
C13	1	100	0.5	0.1
C14	2	100	0.9	0.2
C16	3	50	1.4	0.3
C17	3	100	1.4	0.3
C2	1	10	0.5	0.1
C20	1	100	0.5	0.1
C22	7	100	3.3	0.7
C23	6	100	2.8	0.6
C25	8	100	3.8	0.8
C29	3	100	1.4	0.3
C9	2	100	0.9	0.2
M1	2	100	0.9	0.2
M10	5	36	2.4	0.5
M12	5	100	2.4	0.5
M3	66	100	31.1	6.3
M6	42	100	49.8	4.0
T1	1	25	0.5	0.1
WP	1	33	0.5	0.1
total	212		100.0	20.5

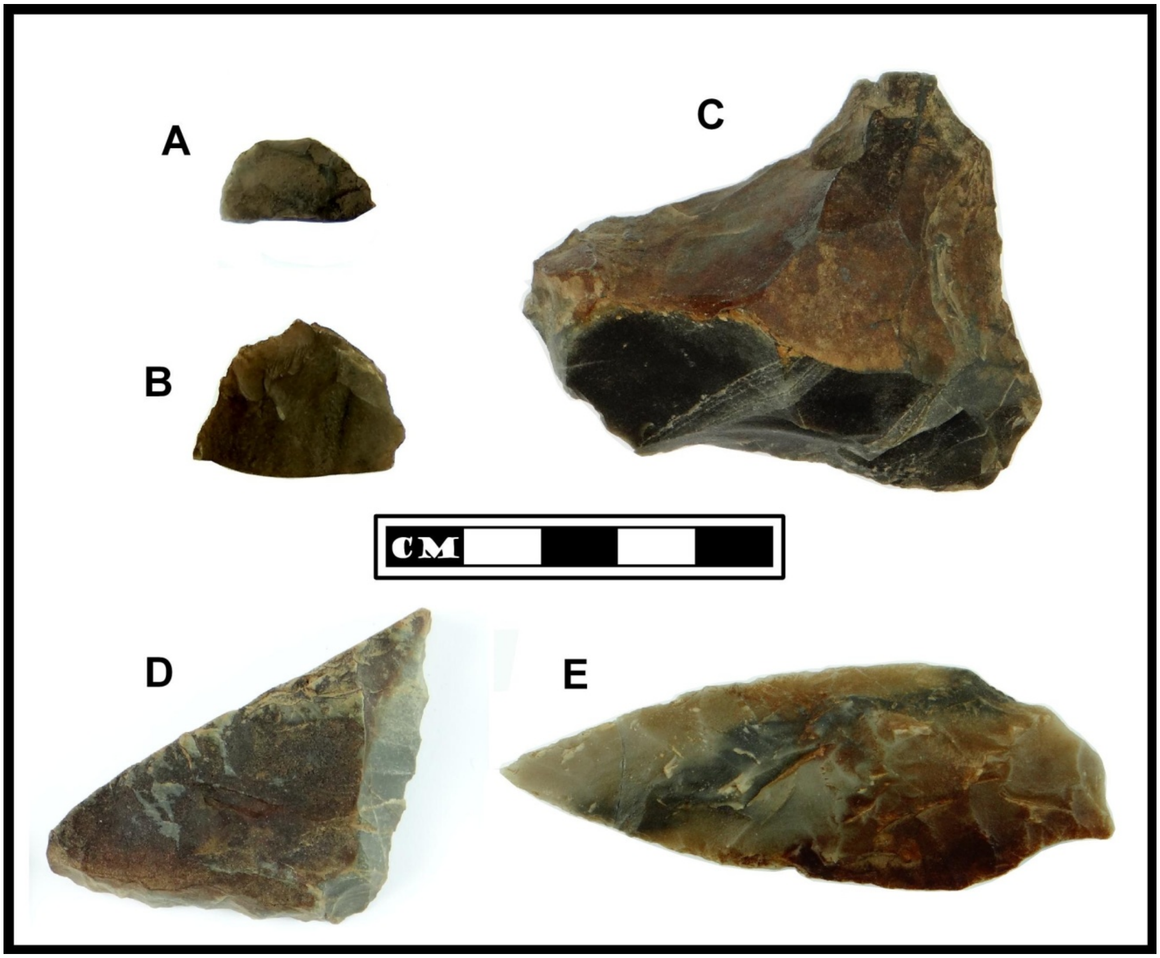

Figure 5-16. A: biface fragment; B: bifacial thinning flake; C: flake core; D: unifacial scraper; E: side-notched point.

Table 5-6. Component 2 tool classes.

	FS #	Artifact Type	Max Length (mm)	Max Width (mm)	Max Thick (mm)
Tool Classes					
A	011-256	Biface Frag.	10.7	18.7	3.9
B	011-264	Biface Frag.	26.8	22.0	6.2
C	014-170	Flake Core	66	53.4	31.9
D	013-273	Scraper	29.3	56.2	13.2
E	014-168	Projectile Point	76.8	28.1	8.6

Material classes M3, M6, and C1 contributed the major portion of the Component 2 artifacts (Figure 5-17). The Feature 6 matrices produced a total of ninety two lithic artifacts greater than 3mm in maximum dimension. Additionally, one-hundred and two specimens directly associated with material identified in Feature 6 were recorded either in-situ or were collected from the screen - in the same provenience or in the mixed soil. Feature 6 is described further in Chapter 8.

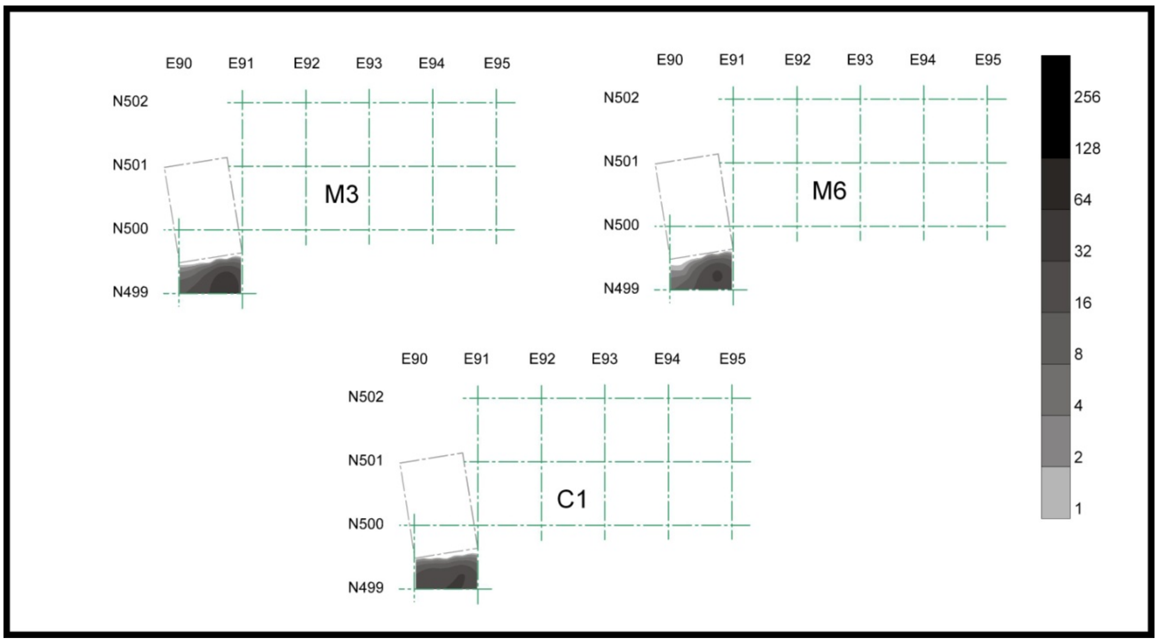

Figure 5-17. Density contour map for Material Classes M3, M6, and C1 with major distribution in Component 2.

M3

Material class M3 was recorded entirely within Block B and exhibits a porous quality characteristic of phenocrysts even though the microcrystalline structure was only visible under 40X magnification. The material ranges in color from light yellowish gray (5YR 6/1) to pale yellowish brown (10YR 6/2) and appears pink under field conditions. Material class M3 contributed to 6.3% (n=66) of the entire lithic assemblage and 31.3% of the Component 2 assemblage. All of the material allocated to this material class is associated with Component 2 with forty three specimens recorded in direct association with Feature 6 contributing to 46.7% of all materials recovered from the feature. The remainder of materials within this class were recorded in the mixed soil in Level 2 (n=6), Level 3 (n=1), Level 4 (n=5), Level 5 (n=7), Level 7 (n=2), and Level 8 (n=2) not directly within Feature 6.

The material is opaque and vitreous in appearance. Based on the color, the glassy patina, and the general texture, this material appears to have been thermally altered within the hearth feature from which the artifacts were recovered although it is unclear if the thermal alteration was intentional or post depositional. This stands in contrast to all other materials recorded within the feature, which do not exhibit thermal alteration.

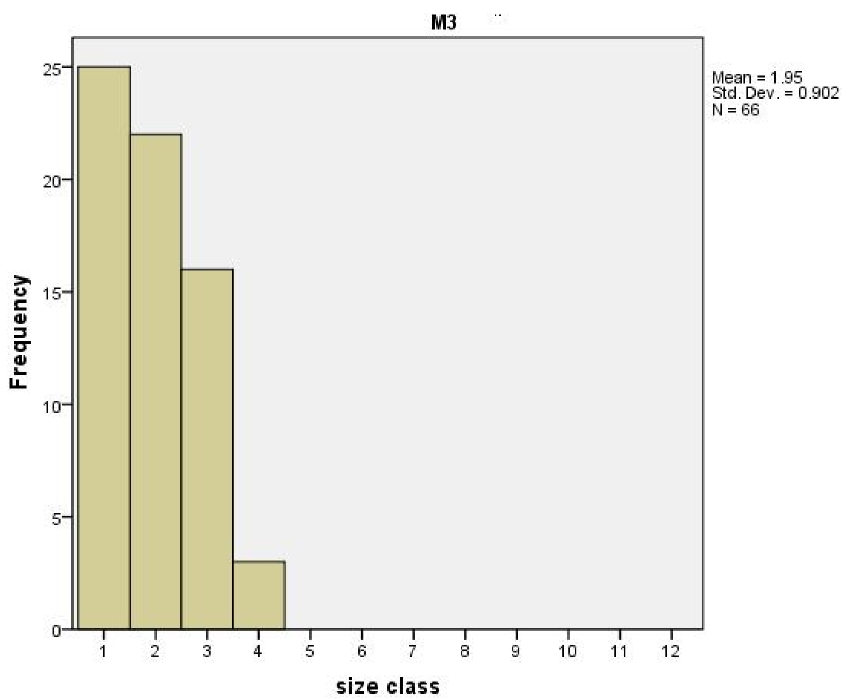

Figure 5-18. M3 size class distribution.

The median size class for M3 is SC2 and the size class distribution is indicative of late stage reduction (Figure 5-18). The dorsal scar count indicates that 1.6% of the flakes exhibited more than three facets. Of the sixty six artifacts assigned to M3, 14 (21.2%) are complete, 9 (13.6%) are proximal fragments, 30 (45.5%) are medial fragments, and

13 (19.7%) are distal fragments. Crushed platforms account for 62.5% of the materials exhibiting platforms, while 8.3% are abraded, 12.5% are complex, and 16.7% appear flat. Additionally, 60.9% of the platforms exhibit acute angles.

While flake size distribution and the lack of dorsal scars indicate late stage unifacial reduction, the high percentage of crushed platforms could indicate that a hard billet was used to detach the flakes. This position may be supported by the lack of platform lips associated with soft billet flake reduction (Andrefsky 2005). The high percentage of crushed platforms may also be indicative of a relatively soft material which can be linked to its porous quality.

While flake shape was generally qualified as linear or non-linear for this research with linear being linked to microblade technology, it was noted that flakes and flake fragments associated with material class M3 tended toward the oval to round spectrum with overall width being approximately greater than $^{2}/_{3}$ the length. This is similar to materials associated with material class C7 and C1 in particular.

M6

Material class M6 produced forty two artifacts and contributed to 4% of the lithic assemblage. M6 is directly associated with Feature 6 from which, twenty eight specimens were recorded contributing to 30.4% of the material recovered from the feature and 19.9% of all material associated with Component 2. Material class M6 is a high quality chalcedony found in Level 5 (n=2), Level 6 (n=1), Level 7 (n=8), Level 8 (n=2 not associated with Feature 6), Level 9 (n=1), and entirely within excavation Block B. The material is translucent and the microcrystalline structure was difficult to see under 40X magnification. The material appears to be white with some gray under field conditions but most closely appears light brownish gray (5YR 6/1) in a lab setting.

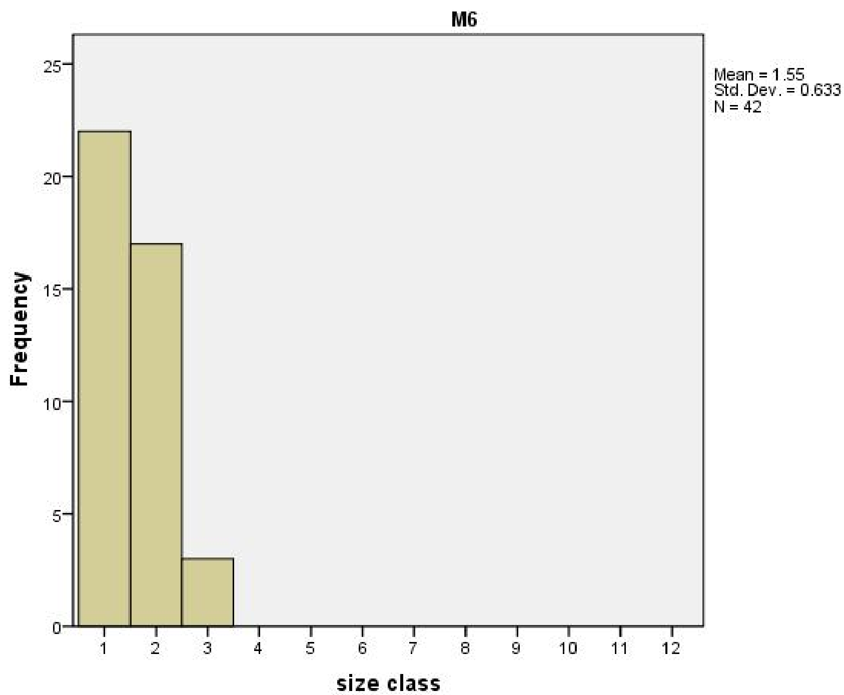

Figure 5-19. M6 size class distribution.

The median size class for M6 is SC1 (Figure 5-19). The dorsal scar count indicates that 7.1% have greater than 3 facets. Of the 42 specimens recorded, 5 (11.9%) are complete, 12 (28.6%) are proximal fragments, 21 (50%) are medial fragments, 3 (7.1%) are distal fragments, and 1 (2.4%) is a split fragment. The single flake from level 9 was recorded within the control matrix for the Feature 6 hearth matrix and was taken from the same approximate provenience. Of the materials with identifiable platforms, 6.3% are crushed, 18.8% are abraded, 62.5% are complex, 12.5% are otherwise flat, and 87.5% have platform angles approaching a right angle. M6 is clearly associated with Feature 6 and appears to be the result of late stage unifacial reduction consistent with flake size, platform angle and the lack of dorsal facets.

C1

Material class C1 is the most varied of the material classes and is unlikely the result of a single or even multiple reductions of a single objective. The material ranges in both color and opacity as well as other qualitative attributes and site distribution. Material class C1 consists of seventy seven specimens, accounting for 7.4% of the lithic material recovered from the site. While differences occur, the cryptocrystalline structure is consistent and similar to material class C7 which is associated with one reduction episode. The material has a dull or waxy appearance and small black inclusions of the same size and density occur in all of the specimens. This material was also identified in the 1984 collection making up 8% of the recorded assemblage.

Material class C1 varies in color from dark gray (N3) to pale yellowish brown (10YR 6/2) with indications of dark greenish gray (5GY 4/1), dark yellowish brown (10YR 4/2), and one medial flake fragment appearing as very pale orange (10YR 8/2). Characterization of material class C1 by component was undertaken by examining each flake by block, level, and associated feature.

Sixty three specimens were recorded in Block B. of these,even were directly associated with Feature 6 and therefore all material that could be positively correlated with the Feature 6 artifacts were assigned to Component 2 for analytical purposes. In addition to the Feature 6 specimens from Block B, two were recorded in Level 2, four were recorded in Level 3, seven were recorded in Level 4, twelve were recorded in Level 5, seventeen were recorded in Level 6, twelve were recorded in Level 7, and an additional two specimens were recorded in Level 8.

The median size class for C1 within Component 2 is SC2 (Figure 5-20). Of the Fifty two specimens assigned to Component 2, eight (15.1%) are complete, seven (13.2%) are proximal fragments, twenty six (49.1%) are medial fragments, nine (17%) are distal fragments, and 2 (3.8%) are identified as shatter. Of the fifteen specimens with identifiable platforms, three (20%) are crushed, three (20%) are abraded, five (33.3%) are complex, four (26.7%) are flat, and 66.7% of the platforms exhibit acute angles. Additionally, two flakes exhibit greater than three dorsal facets. Size class distribution and platform angle indicates mixed stage reduction, but favors late stage bifacial reduction, which may be supported by the presence of a single biface fragment recovered from Level 5 in Block B.

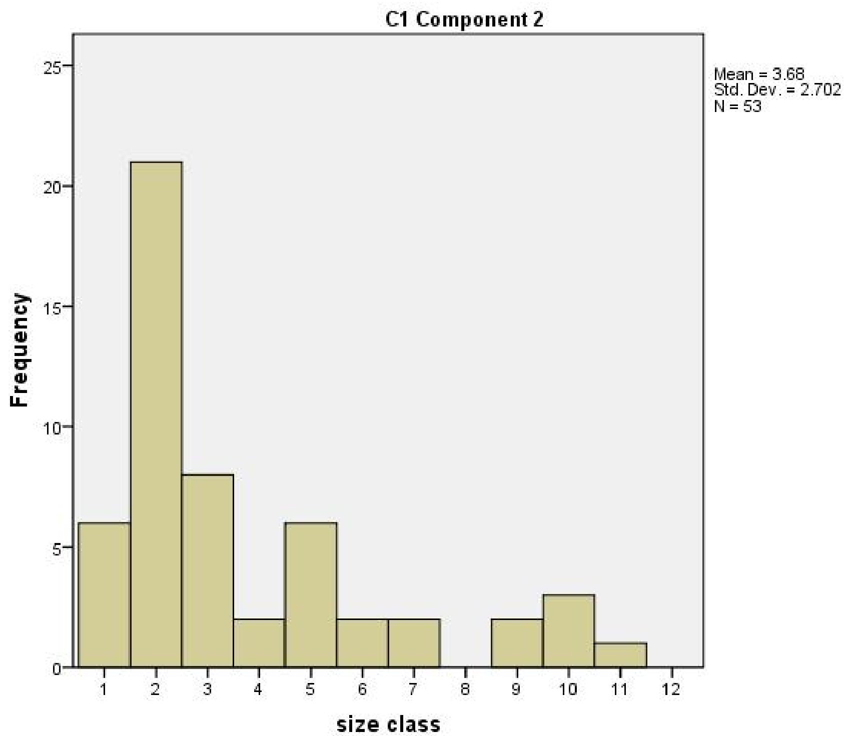

Figure 5-20. C1 size class distribution within Component 2.

C29

Material class C29 consists of three artifacts recorded within Block B, all three of which are associated with Feature 6 (Figure xx). Material class C29 is a good quality chert and ranges in color from dark yellowish brown (10YR 4/2) to grayish black (N2) and olive gray (5Y 4/1) with a combination of all colors represented with each artifact. While the color varies from artifact to artifact, the crystalline structure remains consistent and may be indicative of a common source if not a common nodule. Additionally, the material is similar in crystalline structure to material classes C1 and C16 with only slightly smaller identifiable crystals than C1.

FS#014-168 is a side-notched point that was recorded in-situ while excavating the Feature 6 matrix. FS#014-168 is 7.68cm long, 2.81cm wide and .86cm at its thickest point. The point shows bifacial and bilateral reduction with thinning and shaping on both surfaces. The point exhibits even symmetry although a portion of the base has been removed, and while the objective appears functional, the broken base may have led to discard. Approximately 50% of the artifact exhibits discoloration likely the result of humic staining within the hearth feature. The artifact was recorded in a horizontal orientation and the downward facing half is the side that exhibits the stain, while the up-facing side is clean and appears freshly deposited.

FS#014-170 was recorded outside of Feature 6 in Level 9 approximately .6cm below the side-notch point in a similar provenience. FS#014-170 is a multidirectional, bifacial flake core with approximately eighteen identifiable non-linear flake scars. This objective too exhibits humic staining on approximately 75% of its surface as well as possible primary cortex covering 5-50% (approximately 20%) of a single flat surface. The artifact was also recorded in a roughly horizontal position with a relatively flat clean surface up - and the stain surfaces down in a wedge like position.

FS#011-264 was recorded in an oblique orientation in Level 6 and within the mixed soil. The specimen is a relatively large bifacial thinning flake with extensive bifacial thinning and possible use wear along the proximal margin which exhibits an acute angle. The specimen is 2.6cm long by 2.2cm wide and is .62cm thick along the proximal margin. The specimen is characterized as a flake due to the presences of a ventral surface and multiple flake scars on the dorsal surface and appears to have been intentionally removed from an objective although its bifacial characteristics are clearly identifiable. The flake is also characterized as broken as it is missing the distal margin due to a clean break that is an oblique angle relative to the striking platform. This type of break is indicative of post depositional breakage as opposed to a steppe fracture often linked to an application of force resulting in a break parallel to the point of percussion.

C22

Material class C22 contributes .7% (n=7) of the entire assemblage and 3.3% of the Component 2 assemblage. Of the seven artifacts allocated to the material class, three were recorded directly within the Feature 6 matrix and the remaining four were recorded within Block B in the mixed soil feature in Level 3 (n=2), Level 5 (n=1) and Level 8 (n=1). Material class C22 is a medium to good quality chert with some inclusions and cleavage planes. The material ranges in color from light brownish gray (5YR 6/1) to medium dark gray (N4) and is semi translucent to opaque with a waxy to dull appearance. The C22 assemblage contains two proximal flake fragments, two medial fragments, two distal fragments and one large specimen identified as a scraper that was recorded in Level 3 and exhibits humic staining on one surface.

C23

Material class C23 contributes 0.6% (n=6) of the entire assemblage and 2.8% of the Component 2 assemblage. Of the six specimens, three were recorded within the Feature 6 matrix. C23 is a good quality translucent chert with a dull appearance and ranges in color from pale yellowish brown (10YR 6/2) to dark yellowish brown (10YR 4/2). Besides Feature 6, material allocated to this class was also recorded in Level 2 (n=3) in Block B and likely in the mixed soil. Due to the provenience in Feature 6, all materials associated with the material class are assigned to Component 2 for analytical purposes.

C25

Material class C25 is also directly associated with Feature 6 and contributes .8% (n=8) of the entire lithic assemblage and 3.8% of the Component 2 assemblage. C25 is a good quality opaque chert that ranges in color from medium dark gray (N4) to grayish black (N2) and has a dull appearance. Of the eight specimens, three were recorded in Level 9, one was recorded in Level 1, and the remaining four were recorded in the Feature six matrix associated with Level 8.

M12

Material class M12 is the final material type identified from Feature 6. M12 contributes to .5% (n=5) of the site assemblage and 2.4% of the Component 2 assemblage. Of the five specimens allocated to the material class, three were recorded within Feature 6 in Level 8, one was recorded in Level 2, and one was recorded in Level 9. M12 is a high quality jasper that is grayish brown (5YR 3/2) or dark yellowish brown 10YR 4/2) and opaque with a vitreous appearance. All materials within this class are complete flakes (n=2) of medial flake fragments (n=3), and both complete flakes exhibit crushed or complex platforms approaching a right angle. Additionally, both of the flakes exhibit lipped platforms and bending indicative of soft billet removal. This material is very hard and showed none of the chipping along the margins associated with post depositional trampling or damage from trowling or screening identified on most other materials.

C17

Material class C17 consists of just three specimens recorded entirely within Block B, in Level 2 (n=1), Level 7 (n=1), and Level 8 (n=1). C17 is a good quality translucent chalcedony that is pale yellowish brown (10YR 6/2) or light brownish gray (5Y 6/1) with dark yellowish brown (10YR 4/2) and has a waxy appearance. All specimens are flake fragments - two are medial and one is a split fragment - and range from SC3 to SC5.

M1

Material class M1 is a good quality chert that ranges from moderate red (5R 4/6) to moderate brown (5YR 4/4). Only two specimens were allocated to this material class, and both are complete flakes with complex platforms at right angles. M1 was recorded in Levels 2 and 4 in Block B.

C9

Material class C9 is a good quality chalcedony consisting of two complete flakes recorded in Levels 3 and 8 in Block B. The color is light brownish gray (5YR 6/1) to blackish red (5R 2/2). Both flakes have either complex or abraded platforms at right angles to the dorsal surface.

Component 1 Lithic Analysis

Component 1 artifacts are entirely associated with the sharp contact between an otherwise culturally sterile C1 soil horizon and the underlying glacial till (C2). The Component 1 artifacts consist of nine specimens in seven material classes (Table 5-7). Seven of the specimens were recorded in Block A, and the remaining in Block B. The Block B artifacts were all recorded in direct association with a buried soil.

Table 5-7. Component 1 artifacts by material class.

Material Class	Component 2	by Material Class	Total Component	Total Site
	n	%	%	%
C11	2	100	22.2	0.2
C26	1	100	11.1	0.1
C27	1	100	11.1	0.1
C3	1	2	11.1	0.1
C30	1	100	11.1	0.1
C31	1	100	11.1	0.1
M10	2	14	22.2	0.2
total	9		100.0	0.9

C11

Material class C11 is a medium to low quality chert with identifiable cleavage planes. Both specimens were light olive gray (5Y 5/2) in color and completely opaque. Both specimens were recorded as shatter and neither exhibited identifiable cortex.

M10

Material class M10 was recorded in Block B and is a good quality tuff. The material is opaque and has a grayish orange (10YR 7/4) to pale yellowish brown (10YR 6/2) color. One flake (SC6) was complete and the second (SC10) was a distal fragment. The complete flake exhibited an abraded platform at an acute angle. This material class has been identified in all cultural components.

C26

Material class C26 is a single grayish brown (5Y 5/2) specimen located in Block A and is a medium quality chert. The single specimen is a large (SC9) distal flake fragment with multiple cleavage planes resulting in an atypical feathered termination.

C27

Material class C27 is also represented by a single artifact recorded in Block A. The specimen is grayish brown (5YR 4/1) good quality chert with a waxy appearance. The specimen is a proximal flake fragment with an abraded platform approaching a right angle.

C3

Material class C3, while predominately recorded in Component 3, is also represented by single piece of shatter in Component 1.

C30

Material class C30 is only recorded in Component 1 and is also recorded as shatter. C30 is a medium to good quality black (N1) chert with no identifiable cortex.

C31

Material class C31 is a good quality dark greenish gray chert recorded in Block A and is represented as a single complete flake (SC16) with a crushed-acute angle platform.

1984 Cultural Components

The results from the 1984 excavation by R. C. Betts concluded that the site at Butte Lake Northeast could be divided into four cultural components. Cultural components were divided by stratigraphic position and the cultural historic approach which groups tool class by techno-typological tradition.

Component IV is associated with artifacts delegated to the historic period and include trade beads and rifle shell casings, none of which were recovered during the 2012 excavation. Component III is assigned to materials most closely associated with the Athabascan Tradition and include bone and antler points as well as copper, but also includes small scrapers and modified flakes. According to Betts (1987a:13), artifacts at or above what would be recognized as the A horizon and the contact with the AB horizon above the Hayes vent tephra, can be contextually associated with the Athabascan Tradition, which is like the Component 3 designation introduced in the 2012 research. These components are associated with the house feature and a hearth feature designated Feature 2 by Betts.

Component II is assigned to all materials beneath the Hayes vent tephra and above the underlying C1 horizon specified in this research. Based on the major tool classes originating at this level and associated with 1984 Features 1 and 11, Betts attributes this component to the Northern Archaic Tradition.

As with the 2012 excavation, Component I is considered all materials lying directly on the glacial till and separated from the Component II artifacts by 25-35cm of sterile sediments.

Many of the artifacts that could not be assigned to a cultural component were recorded in a horizon that Betts describes as tan and mottled with charcoal. All of the artifacts associated with this horizon were located in a single 1x1.5m unit, from which Block B extends south. The soil is likely a continuation of the mixed soil recorded in Block B and extends to the north.

For the purposes of this research, an attempt has been made to appropriately assign artifacts to a cultural component for comparative analysis, but several problems exist that make some direct comparison untenable. The primary difficulty begins with sampling strategies aimed at answering different questions. The 1984 strategy was undertaken to record a single house feature, but lead to the discovery of much older components, while the 2012 strategy was focused on placing these components within an ecological framework. Betts used natural stratigraphy to delineate levels or “stratigraphic units”, as well as a ¼" screen to capture artifacts from sediments. The thesis attempts to overcome the size class differential by controlling for the difference. This has been done by removing the two smallest size classes recorded (SC1 and SC2) during the 2012 excavation from the analytical tool to compare assemblages using Chi-square. As will be demonstrated in the following section, this had little effect on variation between the two assemblages. Additionally, only a few formal tools were recorded in-situ leading to ambiguous relationships between lithic debitage and stratigraphic position in many cases.

These problems have been partly overcome by the precision with which the 2012 excavation was undertaken including the added control of matrix sampling, 3-point data, and pedostratigraphic identification within 5cm levels. Based on Betts’ description of lithic debitage and stratigraphy, and evaluated within the stratigraphic framework outlined within this research, Component III and Component IV lithic artifacts have been combined into one comparative late Holocene component referred to as Component III. Component II remains all lithic debitage recorded within a similar provenience to those recorded during the 2012 excavation. Component I likewise, is associated with material located on or near the glacial till and is associated with the Component 1 artifacts recorded during 2012.

Intra and Inter Component Comparison

Statistical analysis of lithic attributes are used to address questions concerning technological organization, primary among these is production stage and inferences regarding final objectives within each component. Technological organization at the site is viewed as a selection of strategies for making, transporting, and discarding tools and material required for their manufacture and maintenance. Mobile strategies can be inferred from the types and quality of the material as well as the abundance. Bamforth (1986) hypothesizes that raw material availability conditions curation. As good quality material becomes more scarce for example, more time and energy is required to maintain a tool. Likewise, if materials required to make and use a tool are relatively plentiful, less curation is expected.

Lithic analysis of occupational components is undertaken to identify the most likely strategy utilized by the inhabitants during each occupational period based on caveats outlined earlier in the chapter regarding flake size and attributes indicative of both bifacial and unifacial tool production. This will be accomplished by comparing artifacts recorded within each occupational components with the explicit assumption that they represent a normal distribution of the component population at the site based on specific attributes (See Table B-2 for the modified Sullivan and Rosen typology and attribute tables).

Components addressed in this analysis are referred to by either Roman numeral (i.e. I, II, III) or Arabic numeral (i.e. 1, 2, 3). Both numbering protocols characterize the same occupational components, however, Roman numerals are used to describe the 1984 components and the Arabic numerals are used to describe the 2012 components.

Three competing hypothesis are examined within this research regarding lithic material recorded at the site and how size, weight, and type and percentage of cortex can provide valuable insights into mobility and raw material procurement. For example, if the site were a primary quarry, materials exhibiting a high percentage of incipient cortex would be expected. Incipient cortex is mechanically altered cortex such as stream rolled or glacially deposited materials, and since the site is located on glacial till, then it would follow that primary cortex would not be expected if the site were a quarry. Additionally, a high percentage of relatively large primary reduction flakes would also be expected.

Alternatively, the site could be tangential to a quarry where lithic raw material is directly procured and reduced further while undertaking a behavior embedded within a strategy directed toward the acquisition of other resources (e.g. a transitory or hunting camp). This could be indicated by the presence of either incipient or primary cortex.

Primary cortex would be present if the main quarry were not located within the kettle and kame environment, but perhaps higher in the frost cracked boulder fields located in the upper elevations surrounding the lake. Additionally, mixed stage reduction would be expected under this hypothesis and would include both large flakes and smaller flakes possibly associated with preform or blank production and continuing nodule reduction.

Finally, if late stage reduction were indicated, than it is possible to infer that either material is acquired from a source tangential to or within the procurement range, or is traded or otherwise acquired from some distant source not immediately accessible (within a day's walk or 20 kilometers) from the site. The latter of these could manifest as either very high quality material (indicated by both paucity and level of curation) or exotic materials such as non local obsidian. Acquisition of more common materials can be viewed as either embedded within a strategy directed toward the procurement of plant or large protein package resources, or as a resource directly acquired as part of strategy that is tangential to an ecologically suitable patch environment, such as siliceous tuff (argillite) in the Amphitheater Mountains near Tangle Lakes, or Livengood Chert from the ridge line near Livengood Dome north of Fairbanks, Alaska.

The first step in testing these hypothesis is to statistically examine the relationship, or the inter-component mean size class and weight between the 1984 and 2012 collections. Assuming that each sample is random, each sample is independent, each sample is from a normally distributed population, and that all population variance is the same, analysis of both size class and weight are undertaken to examine homogeneity.

Use of a one-way ANOVA and a Tukey post hoc test (Tables B-3) indicates significant differences between components recorded in both 1984 and 2012, however the Tukey post hoc test reveals no significant difference between Components I, II, and III with regards to size class (p=0.983). Additionally, 2012 Components 2 and 3 are significantly alike (p=0.814), as is Component 2 and Component III (p=0.116). All components except Component 1 show significant homogeneity for weight (p=0.852) (Table B-4). This is likely to the very small sample size of Component 1.

Figure 5-21 shows size class data for the middle and late Holocene occupation components and does not include the earliest component due to the small sample size of the component (n=29). Both the lack of homogeneity in size class and the significant homogeneity of weight by component indicates that differences in sampling strategy between 1984 and 2012 may have had a significant impact due to the increased number of small flakes (≤1cm or SC1 and SC2) recorded during the 2012 excavation.

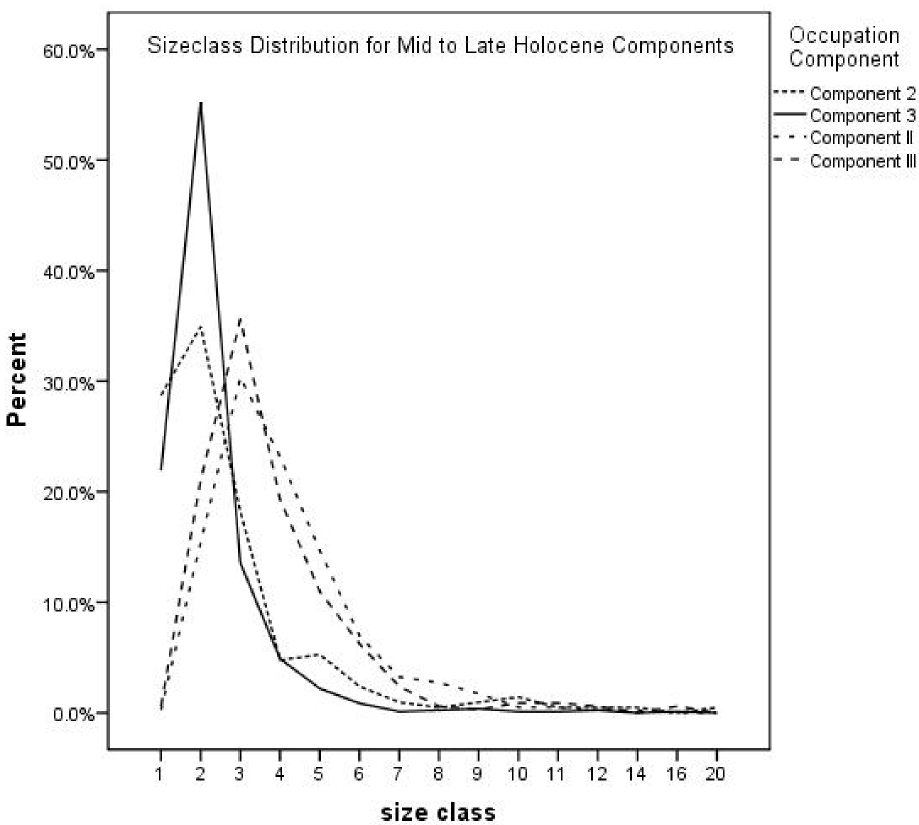

Figure 5-21. Line graph showing size class distribution for middle and late Holocene components.

To more closely examine the possibility of error due to sampling strategy, a χ^2 analysis of size class has been undertaken by controlling for differences and removing the smallest size classes recorded for the 2012 excavation from the analytical tool. While removing SC1 and SC2 produced no change in the differences exhibited in Components

III and 3 (*p*=0.00), removal of SC3 produced results suggesting homogeneity of the distribution of size classes within the component above 1.5cm in greatest dimension (*p*=0.344). Likewise, the analysis was duplicated for Components 2 and II. These components were significantly homogenous after removing flakes 2cm or smaller from the analysis (*p*=0.094). This result is indicative of either error due to sampling strategy, or it could reflect a more significant difference representing variation by activity area.

Based on the assumption that a 1cm to 2cm flake is unlikely to fall through a ¼" screen or otherwise not be detected during the normal course of the 1984 excavation, and the fact that tool classes recorded within features during each excavation are significantly different (e.g. bifaces in 2012 Component 2 and microblades in 1984 Component II; see Figure E-2) (Betts 1987a), it is reasonable to infer that intracomponet variation is the result of behavior and not sampling strategy. This is particularly evident in the upper most component which contains a house feature with central hearths for heating, an anvil with hammer stones, and a large hearth for waste disposal; clearly representing various site activities.

Analysis of Component 3 and Component 2 indicate little homogeneity regarding either size class or weight, and once again, this may be due to the sample size and the very large sample of material class C7 (n=578) considered a nearly complete individual reduction event. Upon close examination of size class distribution (Figure 5-21) in components associated with middle and late Holocene occupation, and the relative low frequency of cortex recorded on any of the artifacts (>0.01% of sample), it is however clear that all occupational components exhibit much higher frequency of late stage lithic reduction than middle stage, regardless of statistical homogeneity.

As with size class and weight, artifact attribute distribution within each component is assumed to be normal and population variance is assumed to be the same. Likewise, each sample is random and each sample is independent. However, attributes are analyzed as either dichotomous or ordinal and are ranked based on a percentage of all measured attributes within an occupational component. Exploration of attributes is conducted using a combination of pie charts to visually identify differences, and then test the hypothesis that there is no difference between component attributes with χ^2.

SRT

Using the modified SRT, Figure 5-22 breaks down the percentage of complete and broken flakes by component. Ignoring Component 1 and Component I due to small sample size, Components 3 and III were compared using χ^2 and found to be significantly different (χ^2=5.673, df=1, p=0.017). However no significant difference occur between Component 2, II, and III (χ^2=0.675, df=2, p=0.714).

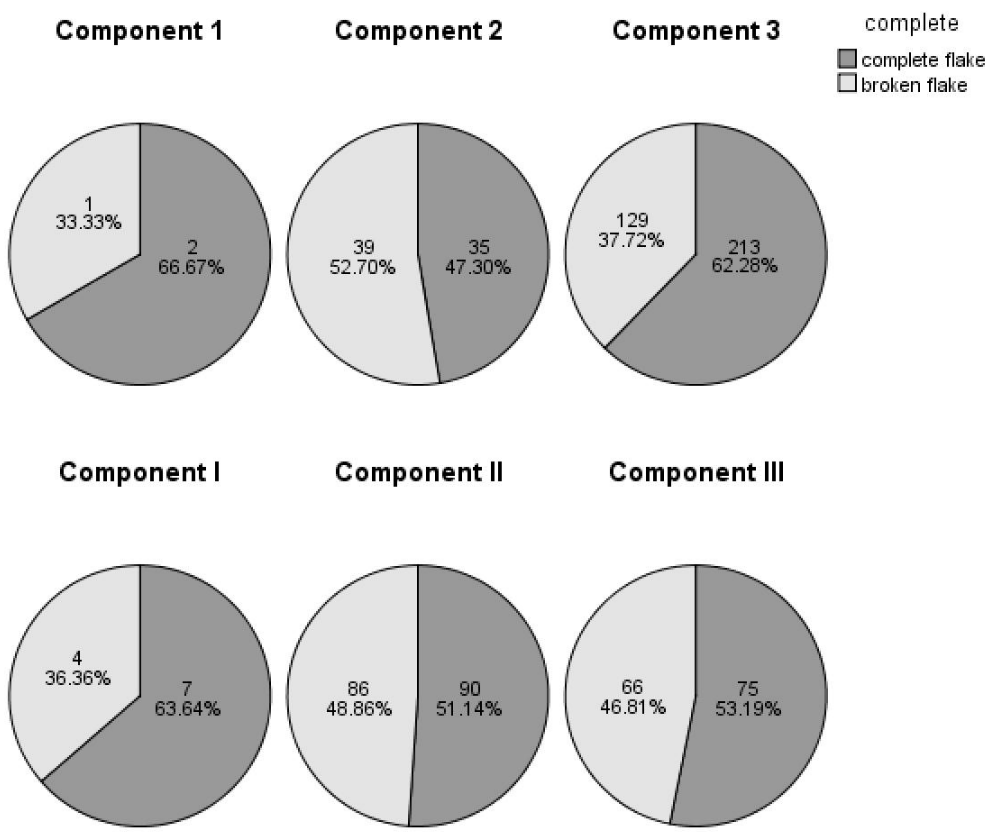

Figure 5-22. Pie chart exhibiting number of complete and broken flakes by component.

Flake Fragment

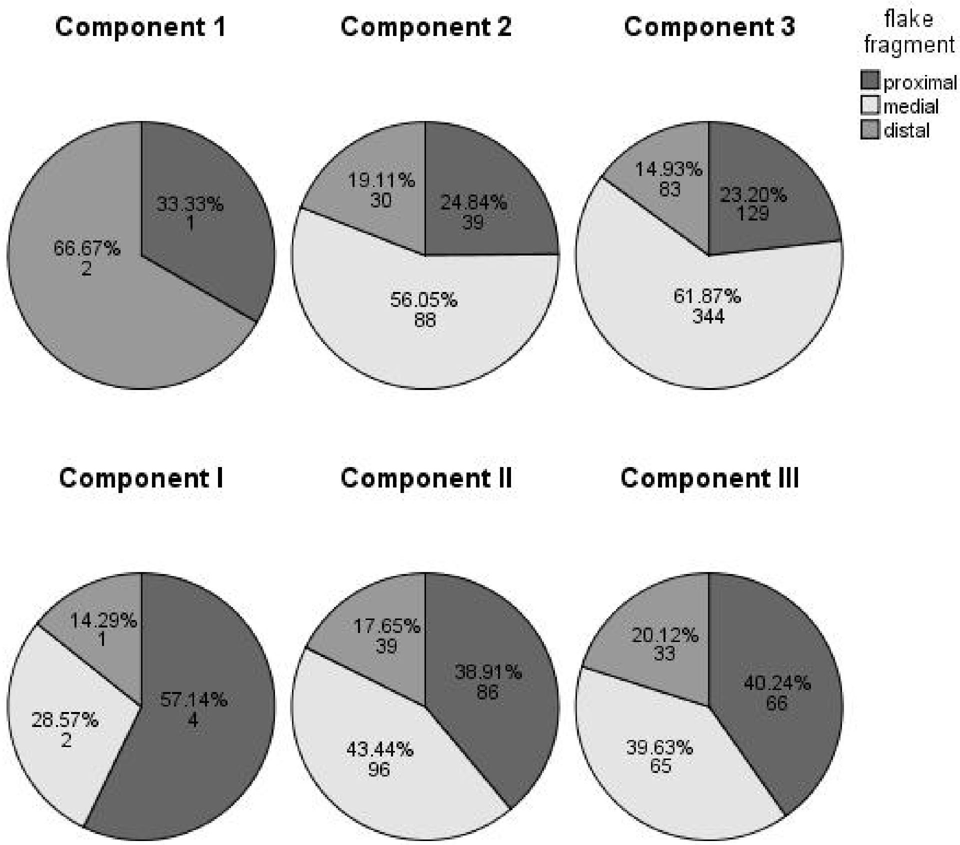

Figure 5-23. Flake fragment by Component.

Figure 5-23 is used to visualize the variation in flake fragment by occupational component. Component 2 and 3 are not significantly different (χ^2=2.174, df=2, *p*=0.337), nor is Component II and III (χ^2=.676, df=2, *p*=0.713), however Components 2 and 3 are significantly different than Components II and III (χ^2=42.056, df=6, *p*=0.000).

Platform Preparation

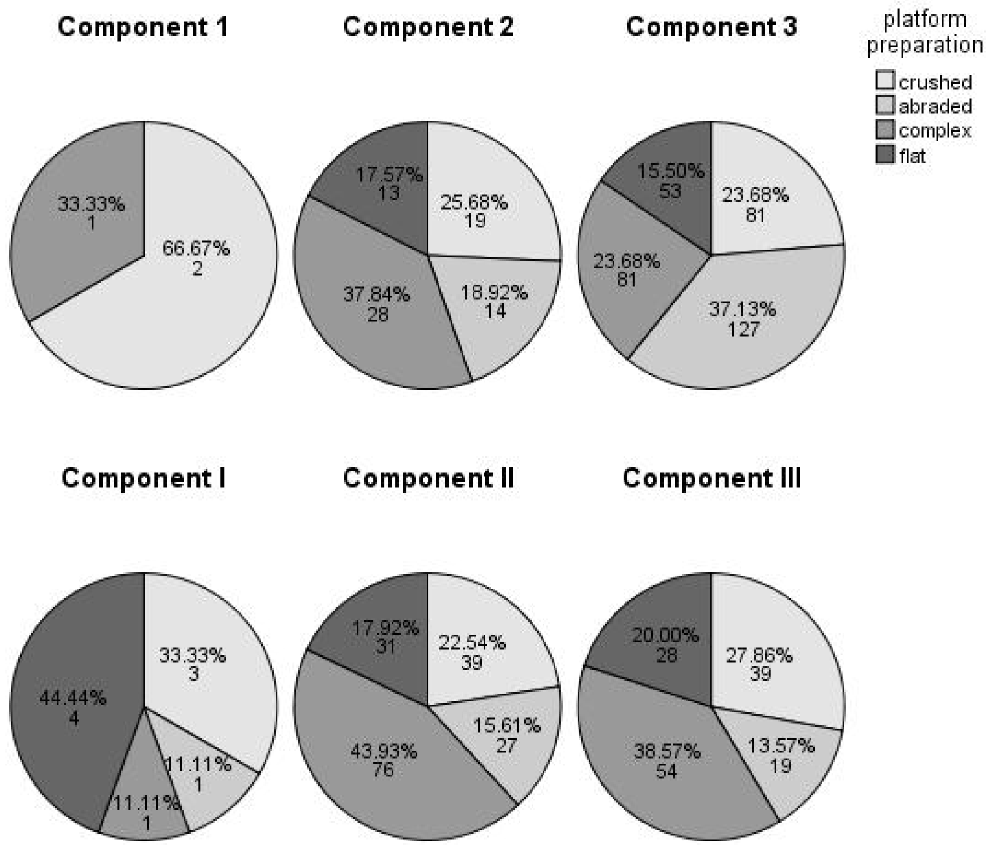

Figure 5-24. Platform preparation by Component.

Figure 5-24 is used to visualize the variation in platform preparation by occupational component. Components 2, II, and III exhibit no significant differences (χ^2=2.758, df=6, *p*=0.839) with regard to platform preparation. This is interpreted as late stage core or tool production. Platform preparation in Component 3 however, is significantly different that the other components (χ^2=53.184, df=9, *p*=0.000) consistent with middle stage core reduction or tool preparation.

Platform Angle

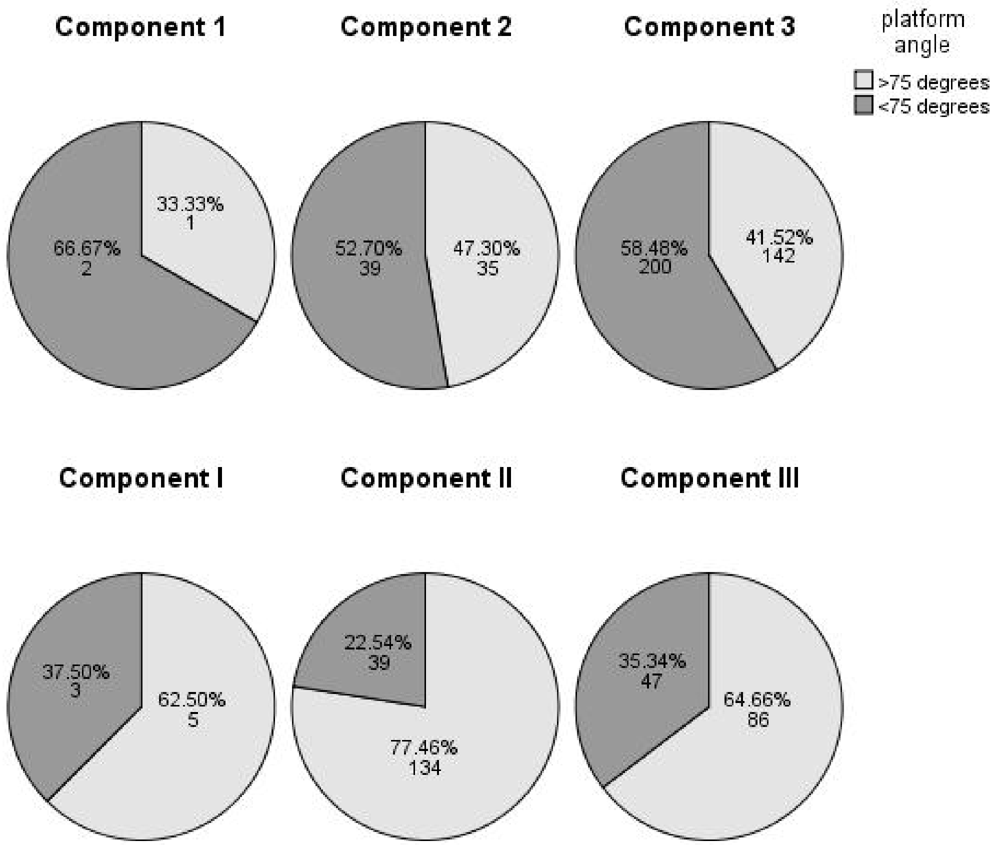

Figure 5-25. Platform angle by Component.

Figure 5-25 is used to visualize the variation in platform angle by component. Variation is not significant between Component 2 and 3 (χ^2=0.831, df=1, *p*=0.362). Component II and III do however exhibit significant variation (χ^2=6.092, df=1, *p*=0.014). Likewise, Components 2, 3, and III show significant variation (χ^2=20.561, df=2, *p*=0.000). Furthermore, this indicates that Components II and III show a greater occurrence of right angle platforms indicative of unifacial and core reduction. The relatively equal occurrence of both right and oblique platform angles in the Component 2 and 3 assemblages is indicative of late stage tool production and maintenance.

Due to the low occurrence of recognizable cortex, dorsal facets, and observable platform lips represented in either the 1984 or 2012 assemblage, components are combined and evaluated by occupational horizon. These are identified as early Holocene (Components 1 and I), middle Holocene (Components 2 and II), and late Holocene (Components 3 and III).

Cortex Percentage

Figure 5-26 and 5-27 are used to depict the percentage and type of cortex recorded on material from all components. The occurrence of cortex of any type is low and occupational components show no significant difference in percentage (χ^2=3.756, df=6, p=0.710) or type (χ^2=0.629, df=2, p=0.730). Likewise, components show no significant difference in dorsal scar counts (χ^2=1.246, df=2, p=0.536) (Figure 5-28).

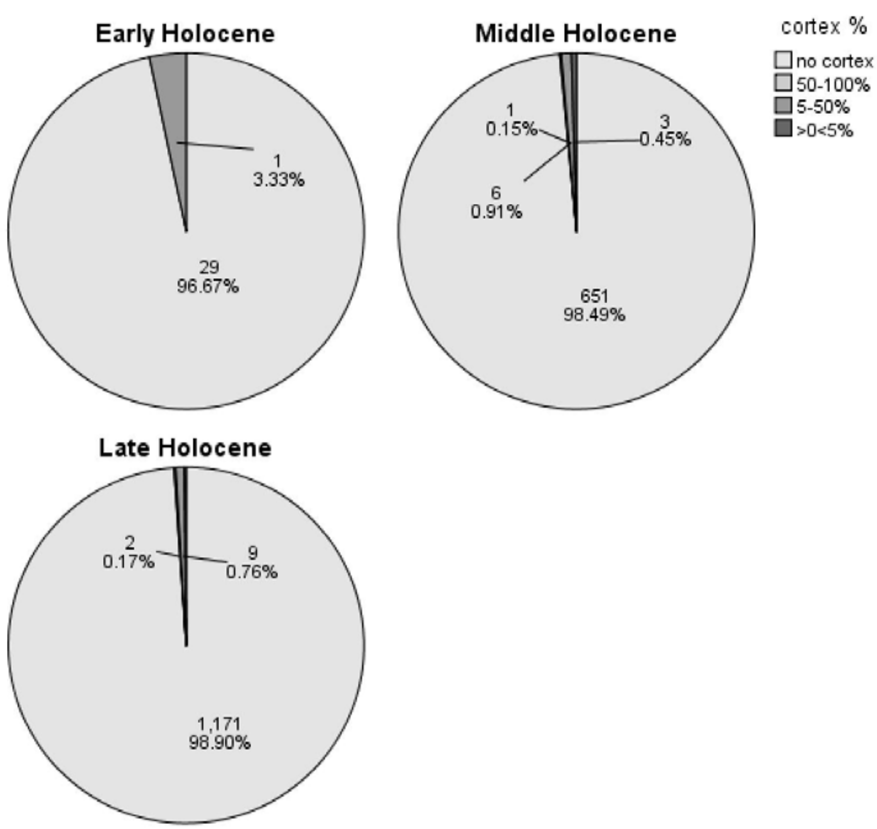

Figure 5-26. Cortex percentage by Component.

Cortex Type

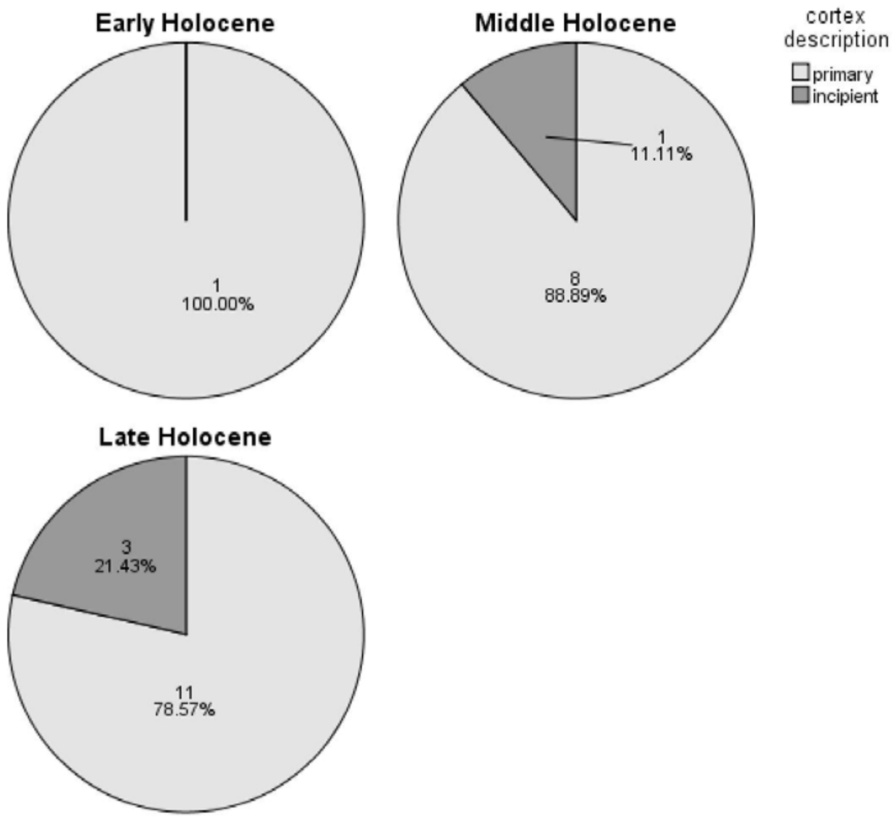

Figure 5-27. Cortex type by Component.

Dorsal Scar Count

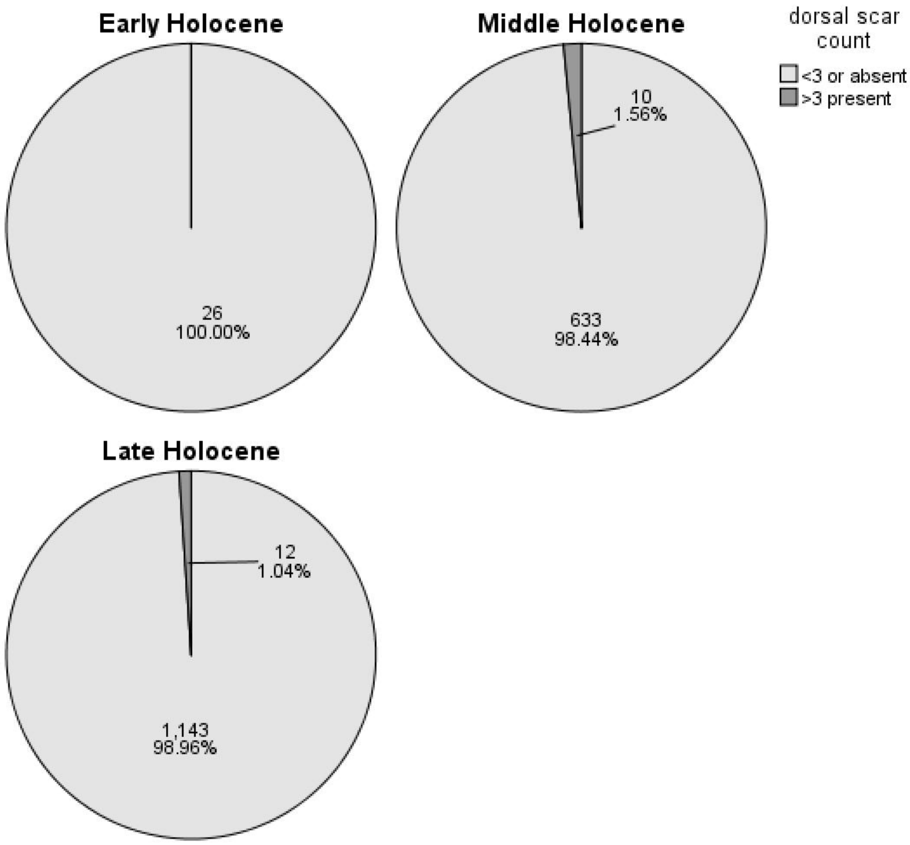

Figure 5-28. Dorsal scar count by Component.

Platform Lip

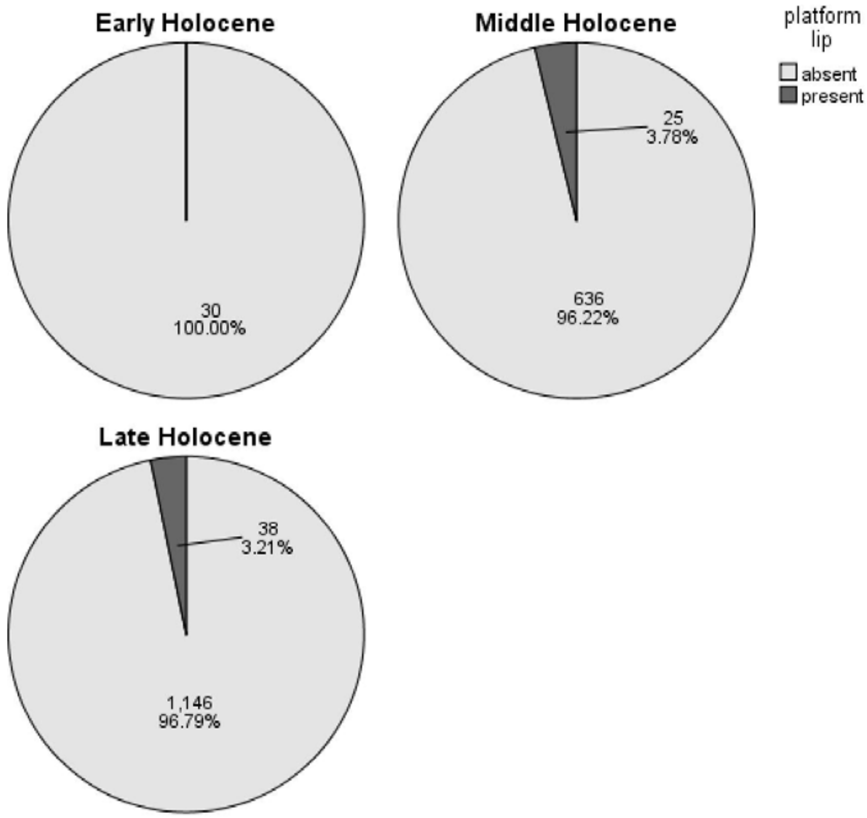

Figure 5-29. Platform lip by Component.

Finally, the occurrence of platform lip (Figure 5-29) is likewise low and the occurrence by component is not significantly different (χ^2=1.488, df=2, p=0.475) even though the early Holocene component contained no flakes with platforms exhibiting platform lips.

Discussion

Analysis has shown that variation in size class by component cannot be explained as error due to sampling strategy. Additionally, variation in complete/broken flakes, flake fragment, platform preparation and angle, cortex type and percentage, and dorsal scar counts between and within components may be indicative of differences in behavior centered on activity. This is based on the association of lithic material with documented features and technological organization. Both Component 2 and 3 varied significantly from not only each other, but also from Components II and III. As with all attributes measured in this research, variation must be viewed not only by component but by contextual association.

Variation in the number of broken flakes between Component 3 and Component III is likely due to the location of those artifacts. The majority of materials assigned to Component III are associated with the house feature (Figure 5-30) recorded by Betts in 1984 and are likely more susceptible to trampling than lithic artifacts recorded outside of the house. Note that the distribution of artifacts in the excavated portion of the house feature depicted in Figure 5-30 appear to be concentrated near the perimeters. Additionally, a majority of the materials assigned to both Components 2 and 3 were recorded in a dense concentrations collected as part of matrices, resulting in a higher number of both small flakes and flake fragments as well as a higher percentage of complete flakes.

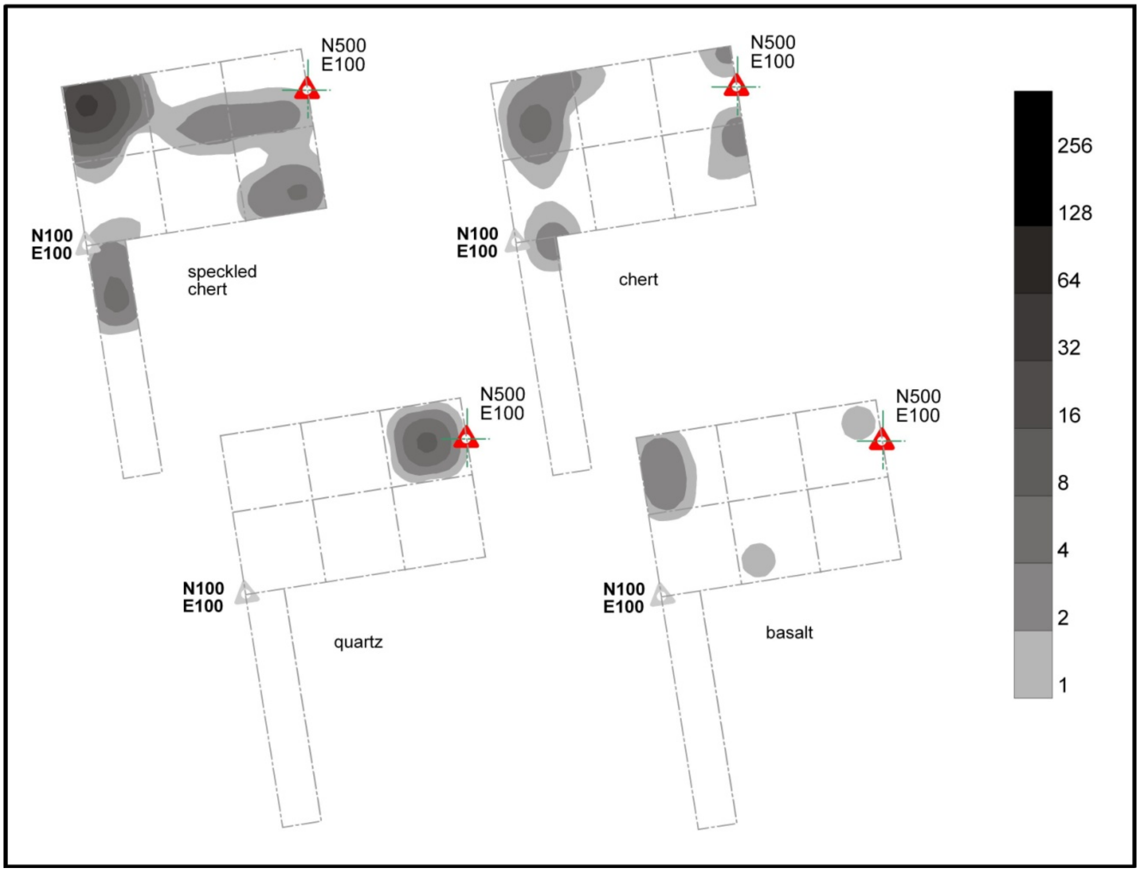

Figure 5-30. Point cloud distribution of artifacts in excavated portion of house feature by material type.

The higher relative percentage of flakes with greater than three dorsal facets in Component 2 (n=5% compared to 1.5% for component 3), as well as the relative fewer numbers of smaller flakes is likely the result of more bifacial reduction or modification indicated by the number of bifaces recorded in both 1984 and 2012 (Figure E-1). Furthermore, all of the materials recorded from the middle Holocene occupation components are associated with three small hearth features, leading to the conclusion that site use and subsistence strategy were not the same as that employed during the late Holocene.

Based on the limited sample from the lowest occupational components at Butte Lake Northeast, it is difficult to draw any conclusions regarding site use during this period. While it is possible to speculate that some cobble testing was undertaken based on the size and type of material recorded in this component, it is also clear that material similar to those found in later components and at other sites within the region, were brought to the site and deposited. This infers that the site was tangential to a strategy directed toward the acquisition of non-lithic resources weather embedded or directly procured.

The presence of forty seven material classes within a very small sample infers that adequate tool stone was abundant throughout the procurement range and only the highest quality materials were curated to any great extent. This suggests constancy where predictability is measured as constancy and contingency. This means that raw materials recorded at the site are know in certain locations throughout the year, and year to year (Colwell 1974). Furthermore, the variety of material types and the lack of bipolar flakes indicate that lithic resource depression was not a concern at the site.

Finally, while significant variation is indicated within and between occupational components, there also appears to be technological continuity in at least the middle and late Holocene components. This is especially indicated by the presence of microblades in the middle Holocene component and the lowest extent of the late Holocene component. This technological continuity is interpreted to extend beyond the manufacture of formal tool types and includes the manufacturing process itself, which varies just as much within each component as it does between components and infers that variation in activities are the ultimate factor for conditioning technological organization at the site. This includes those materials associated with microblade technology, certain unifacial scrapers, and small bifaces located within the late Holocene occupation components (See Figures E2 through E5).

While faunal materials are confined to only the late Holocene component, the following chapter will use analysis of the remains to support of refute the hypothesis that activity area conditions technological organization. This will be done by using the faunal remains to further isolate specific attributes associated with site types outlined in the ethnographic model.

Chapter Six. Faunal Analysis

Analysis of faunal remains recorded entirely within Component 3 (Figure 6-1) is undertaken for the explicit purpose of identifying site-type, behavior, and season of occupation. Specific behavior is linked to activity areas and site-type is based in part on the presence of certain fauna and skeletal elements associated with both activity area and subsistence strategies outlined in the ethnographic model. Season may be inferred from the presence of faunal elements with diagnostic characteristics. The analysis of faunal remains is an integral part of this research and uses the results of the lithics analysis and site structure to assess the ethnographic use of the site during the late Holocene occupation through pattern analysis.

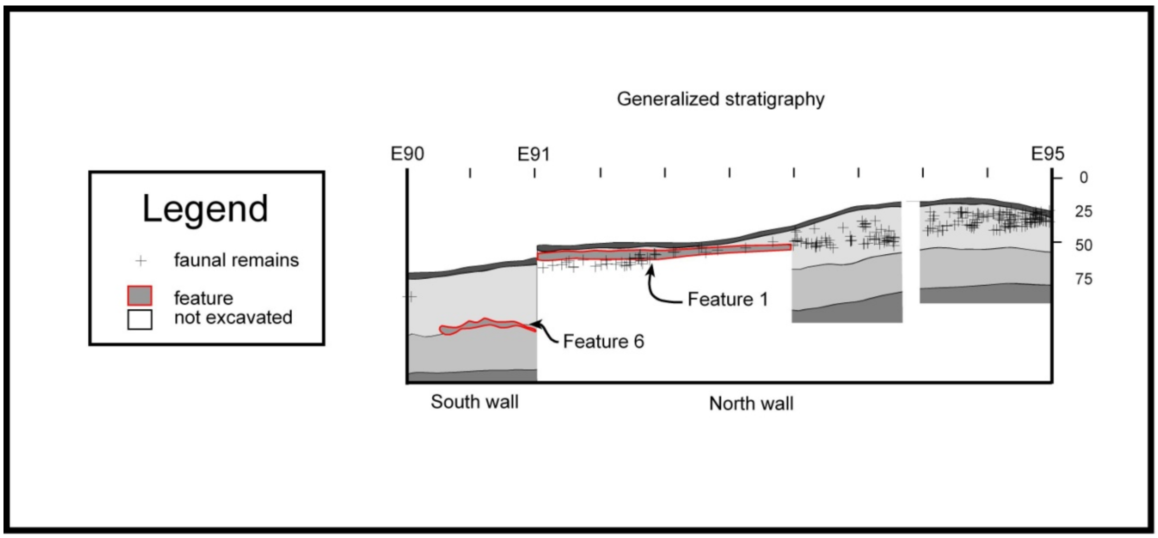

Figure 6-1. Three point distribution of faunal remains superimposed on north and south (E90 to E91) wall profile.

Methods

Faunal analysis at the site was undertaken to identify site taxon, taphonomic processes that may have affected the remains, and to elucidate behavior based on faunal remains within a framework that emphasizes the utility of the identifiable and diagnostic remains (Binford 1978b; Lyman 1994; Metcalfe and Jones 1988; Reitz and Wing 2008).

The ethnographic model for the importance of Butte Lake to the Cantwell-Denali

Band provides a precise function for the site located at the northwest corner of the lake. Based on the model, the site is expected to be a hunting camp (see Table 3-2). Hunting camps are expected to be located in upland settings and focus primarily on caribou capture and processing. The model likewise predicts that the site would have been occupied during the late summer or fall and would correspond with the fall caribou migration. The site should exhibit evidence of meat drying as well as marrow and grease processing. Since the model predicts that animals were captured in and around the lake, evidence of both high and low utility elements are expected as well as highly fragmented remains and burned/calcined bone. Evaluation of the model requires the use of primary data and derived secondary data. Primary data includes data classification and basic description and is used to infer secondary data relating to relative frequency of taxa, dietary contributions, butchering patterns, procurement strategies, and taphonomic disturbance at the site. Faunal material was recorded in-situ or by unit, level, and quadrant. Results of the faunal analysis will be compared to the results of research conducted by Skeete (2008) on several sites in the upper Susitna River drainage.

Primary data includes size, class, and taxon, as well as weight, maximum length, and maximum width of each specimen. If identifiable, side was recorded as right, left, or axial. Element identification was assigned based on the comparative collection and element portion was recorded as bone fragment. Bone fragment was recorded when applicable and included proximal, distal, diaphysis only, bone flake, and entire bone. Both presence and fusion of epiphysis was recorded. Fusion was recorded as unfused, partially fused, fused, and intermediate.

Gender, age, size, and relative health are also important, but due to the small sample size and highly fragmented nature of the assemblage, no adjustment has been made for these considerations. Unidentifiable or non-diagnostic bones have not been included in the NISP and will not be included in this analysis. The total count of all specimens recorded at the site includes approximately 0.6kg (n~1000) of highly fragmented calcined bone collected from Feature 6 and 147 unburned bone fragments recorded in association with Feature 2 that could not be identified to taxon or anatomical element. Taxon estimations are based on a comparative collection and comparative guides (Gilbert 1980; McGowan and Bengtson 1997). Diagnostic specimens were identified as *Rangifer tarandus*.

An analysis of taphonomic processes is also important for this research and is included with the primary data. Fracture outline, angle, and edge, shaft circumference and length (Villa and Mahieu 1991), and fracture regularity (Reitz and Wing 2008:158), provide strong links regarding both behavior and site taphonomy. In particular, these attributes can lead to inferences about how a bone was broken, when a bone was broken , and why a bone was broken. For example, a green (fresh) bone will typically exhibit a curved or V-shaped fracture outline with a smooth oblique, or combined right and oblique fracture edge. Trampling on the other hand, is far more likely to produce breaks on bone that is dry, thus resulting in transverse fracture outlines with jagged right angle fracture edges. Likewise, bone fragmentation, measured as both circumference and length can provide valuable insights about purpose. Highly fragmented bone can occur if bone has been processed for marrow and grease, been highly trampled, or has been subjected to animal activity (Binford 1978b; Villa et al. 2004; Villa and Mahieu 1991).

Fracture outline was recorded as transverse, curved or V-shaped, or intermediate (which includes straight but are diagonal and stepped). Fracture edge was recorded as smooth or jagged, and fracture angle was recorded as right, oblique, or right and oblique. Shaft circumference was recorded as <50%, >50% but not complete, and complete based on the greatest portion of the total circumference. Shaft length was likewise recorded as a percentage of total length and includes <25%, 25-50%, 50-75%, and >75%.

Specific taphonomic indices such as burning and weathering were also recorded. Burning was recorded by color and includes white charred, black charred, brown/buff/tan charred, grey charred. Possibly burned, not burned, reddened, and intermediate were also included in this category. Weathering includes no sign of cracking, cracking parallel to fiber structure, outermost layer of bone flaking, rough homogeneously weathered to 1.5mm, rough fibrous flaking/splintering to inner cavities, and easily breaks in situ, difficult to recognize (Behrensmeyer 1978). Other taphonomic indices include erosion, root etching, mineral deposits, gnawing, or a combination of these. Cut marks were noted on a number of the specimens recorded at the site and were consistent with the tools being used to excavate the site (e.g. trowels and root saws). While a number of specimens exhibited root etching and severe weathering, none exhibited notable animal disturbance such as gnawing. Data collected from the faunal remains regarding taphonomic observations is presented in Table C-2.

The secondary data produced for this research includes a modified general utility index (MGUI) and food utility indices (FUI) to determine a ratio of the minimum number of animal units (MAU) and the utility of those elements present at the site (Binford 1978b; Metcalfe and Jones 1988). Additionally, a meat drying index (MDI) (Binford 1978b; Friesen 2001), marrow index (MI), and grease index (WGI) (Binford 1978b) will be compared to MAU as a ratio to determine if the excavated portion of the site exhibits these types of activities.

The secondary data produced for this research includes the minimum number of elements (MNE) and the minimum number of animal units (MAU). MNE is simply the minimum number of elements recorded at the site. An element is a complete natural anatomical unit of the skeleton (i.e. femur) and can be represented as a whole bone, or portions such as the epiphysis and diaphysis, from which an element can be inferred (Lyman 1994). MNE is derived as a count of the number of specimens from a specific element and ignores side and allows for fragmentation. Because of the highly fragmented nature of the assemblage, MNE was calculated using a combination of methods. Using Bunn et al. (1986), MNE was first analyzed by determining (1) the minimum number of complete elements for each taxon, followed by (2) a count of shafts without ends, and finally, (3) a count of ends is included. Due to the paucity of complete elements recorded at the site, Klein and Cruz-Ubine’s (1984) method for determining elements based on the fraction that is represented, was modified by applying Villa and Mahieu’s (1991) scale, which has been used to determe the completeness of all identified specimens. Additionally, specimens identified to an anatomical part were examined for overlapping landmarks for the purposes of limiting inflation of MNE. While some overly abundant bones such as ribs or vertebrae can inflate a count of MNE, this does not seem to be the case at Butte Lake Northeast.

MAU is statistical calculation of the size of a sample population and aids in the interpretation of butchering and secondary transport, as well as a quantification technique for determining survivorship of elements within the archaeological record (Binford 1984). MAU is calculated by first dividing the number of individual elements recorded at the site by the number of times the elements are recorded within a complete skeleton. For example, if three proximal metacarpals are recorded and the number of elements within a complete skeleton is two, the MAU for a proximal metacarpal is 1.5. MAU is standardize on a scale of 1 to 100 as %MAU. %MAU is calculated by dividing the MAU for each element by the highest MAU for the dataset (standard) and multiplying by 100 to produce the normal scale (Binford 1978a, b, 1984; Lyman 1994; Lyman 2008; Reitz and Wing 2008).

The modified general utility index (MGUI) was developed by Binford (1978b) to rank skeletal elements in qualitative terms based on meat, marrow, fat, and grease. MGUI was developed as a means of inferring behavior with regards to differential animal transport and taphonomic processes and is designed to include riders such as low utility elements that remain attached to higher utility elements during transport. A standardized (scaled 0 to 100) version of MGUI is calculated as %MGUI for this research. FUI produces nearly identical results, but is meant to be less complex and simply scales variation in the amounts of meat, marrow, and bone grease associated with anatomical elements (Metcalfe and Jones 1988). FUI is also standardized on a scale of 1 to 100 and is presented as (S)FUI. %MGUI values for the elements recorded at Butte Lake Northeast were calculated using Table 7.1 in Lyman (1994:226) and were derived from Binford (1978b). Data values for (S)FUI are located on Table 2 in Metcalfe and Jones (1988:492). See Table C-1 for NISP, MNE, MAU, MGUI and FUI data values used in this analysis.

The meet drying index (MDI) is used to determine the likelihood that drying practices described in the ethnographic model were used at the site. This index is based on the presence of elements ranked by their association with the process. The highest ranked item include elements of the axial skeleton and ribs. A description of the technique and the resulting index was produced by Binford (1978b) and modified by Friesen (2001). Data values come from Table 2 in Friesen (2001).

The white grease index (WGI) and a marrow index (MI) are likewise used to determine the likelihood of these activities being undertaken at the site. As with the MDI, the indices are based on the presence or absence of anatomical units most associated with the process. Both indices were developed by Binford and data values are taken from Table 4.7 (WDI) and Table 1.9 (Marrow Index) (Binford 1978b). See Table C-3 for MDI, WGI, and MI data values used in this analysis.

Due to the probability that both distribution and preservation of the remains at the site are differential over time and may not accurately reflect economic decisions or behavior at the site, error in the evaluation of MGUI, FUI, MDI, WGI, and the MI are considered. For this reason, taphonomic processes will be addressed as a ratio of %survivorship over bone density of deer (deer provide the most accurate approximation when caribou has not been sufficiently analyzed) (Lyman 1994). Bone density is derived using photon absorptiometry measurements taken at various point on the anatomical elements of ungulates. Scan point data for this research was obtained from Lyman (1994:240-247) in images and Table 7.6

Bone mediated attrition requires an examination of element survivorship and a tally of observed scan points divided by the number of expected scan points for each element within a complete skeleton (Lyman 1994:239). Survivorship is calculated as a statistical ratio between the number of elements observed over the number of elements expected within a complete skeleton based on the location of an individual scan point. %survivorship is then calculated to obtain a normal scale (Table C-4).

Analysis of secondary data values is undertaken using Spearman's rank order correlation. This is done because outliers exist, and the variables may not be normally distributed. The second reason is to examine the site in relation to others in the region with a focus on obtaining data that is comparable (Skeete 2008).

Finally, estimation of seasonality is based on the tooth eruption sequences for Alaskan caribou provided by Miller (1972) and a single specimen exhibiting both deciduous and permanent teeth.

Analysis

The total weight of material analyzed was 2900.58 grams. The number of individual specimens (NISP) equals 212 and represents 64% the total weight. The minimum number of individuals (MNI) equals 5, and a corresponding minimum number of animal units (MAU) equals 4.5. For this research, NISP includes teeth, but is tallied as an articulated unit (teeth and mandible = 1 NISP). The MNI is calculated to define the smallest number of individuals represented at the site (Shotwell 1955) and was derived from the presence of five right-side distal tibia portions and five left-side mandible portions with overlapping landmarks.

Due to the fragmented nature of many of the bone and the small sample size (n=359) all identifiable elements regardless of sex, age, or health were included in this analysis. Comparison data is provided by Skeete (2008) and focuses on faunal remains and taphonomic processes associated with sites in the Upper Susitna region of the Talkeetna Mountains to the south of Butte Lake. Skeete's use of Spearman's rank order correlations between %MAU and structural density have produced reliable results similar to other studies.

Based on the primary data values presented in Table C-2, fragmentation of bones at the site is intended and not due to trampling, gnawing, or other processes. For example, fractures on 92.2% specimens exhibit either curved (67.2%) of intermediate (25%) fracture outlines, 88% exhibit oblique (64%) or right and oblique (24%) fracture angles, and 79.6% exhibit smooth fracture edges. These figures are consistent with green bone fracture associated with butchering and rendering processes.

Bone Density Mediated Attrition

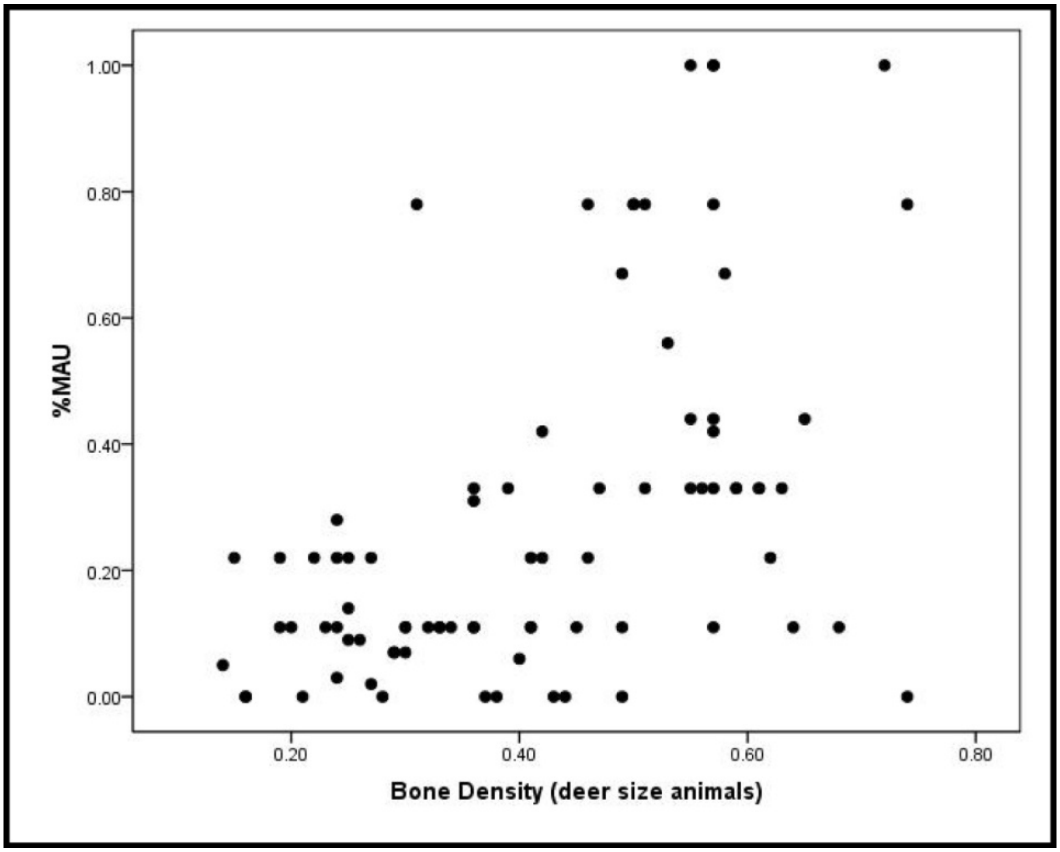

Figure 6-2. %MAU over Bone Density of deer size animals.

Based on the data values presented in Table C-4, a significant ($p<0.01$) positive correlation ($r_s=0.536$) exists between %Survivorship and Bone Density (Figure 6-2) suggesting that less dense bone is under-represented at the site as compared to more dense bone. This can be indicative of a number of processes, but based on analysis of the primary data, is most likely due to normal biodegradation of bone overtime at the site. It could also be indicative of scavenging by animals, although this seems highly unlikely due to the lack of gnawing noted on any of the remains. A third possibility is that less dense bones are being taken away from the site or destroyed by other means. Spongy bone is often used as fuel in fires to keep warm for example (Villa et al. 2004). Based on the presence of a large hearth feature (Feature 1) with numerous calcined bone, a combination of bone density mediated attrition and cultural destruction is probable.

While a detailed analysis has not been completed on the Feature 1 hearth which has been left mostly intact for future excavation, a preliminary examination of the calcined bone collected from a portion indicates a near 50/50 presence of both spongy and cortical bone indicative of waste disposal meant to keep animals away from a site, which is typical amongst Athabascan kill/butchering sites with large hearth features (Workman 1976).

As outlined in the methods section, differential transport and specific processing techniques are correlated with MAU over MGUI and SFUI, as well as MDI,WGI, and the Marrow Index.

Modified General Utility and Standard Food Utility Indices

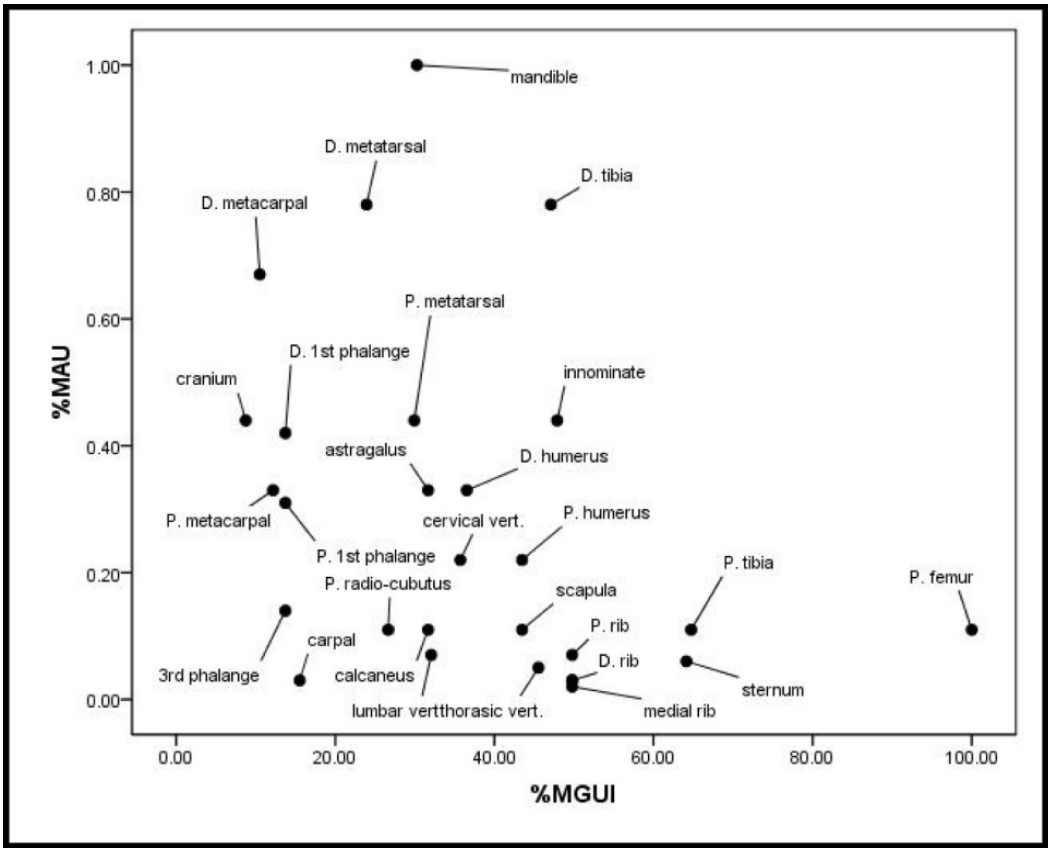

Figure 6-3. %MAU over %MGUI.

Based on secondary data values presented in Table C-1, Figures 6-3 and 6-4 represent the distribution of %MAU over %MGUI and (S)FUI respectively and exhibit results similar to those predicted by Metcalfe and Jones (1988). Both high and low utility elements are represented at the site. Spearman's correlation for %MAU over %MGUI show a significant ($p<0.01$) negative correlation (r_s= -0.516) as does %MAU over %(S)FUI (r_s= -0.527).

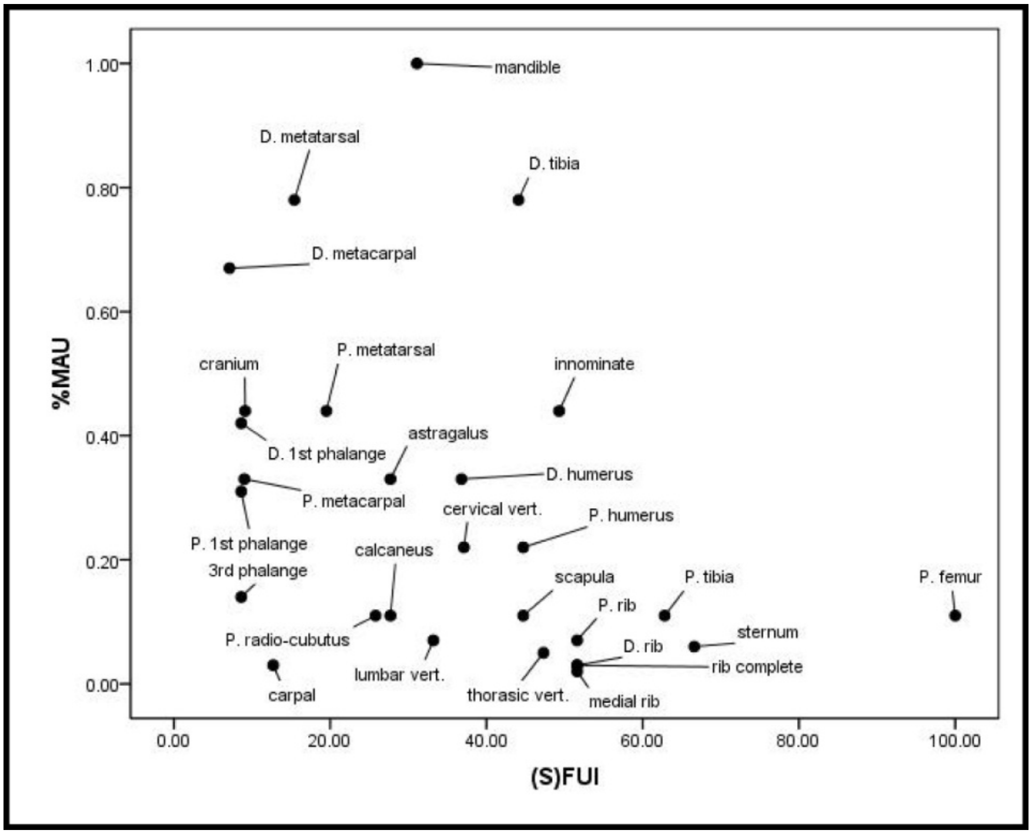

Figure 6-4. %MAU over %(S)FUI.

The relationship of MAU to the various utility based indices indicates that differential transport was not a concern and that both capture and processing were undertaken at the site. Furthermore, analysis of %Survivorship over Bone Density, suggests that the absence of many high utility elements such as ribs and scapulae may be due to bone density mediated attrition, and this could also be extended to elements such as the proximal femur which exhibits high utility and low bone density. Additionally, the highly fragmented nature of the assemblage could have lead to an under-representation due to difficulty identifying the more dense diaphysis of the femur which would have been smashed to obtain marrow.

While bone density mediated attrition could account for the lack of certain elements, an examination of the presence or absence of the elements may be linked to specific processing activities examined as the %MAU over MDI, WGI, and the Marrow Index.

Meat Drying Index

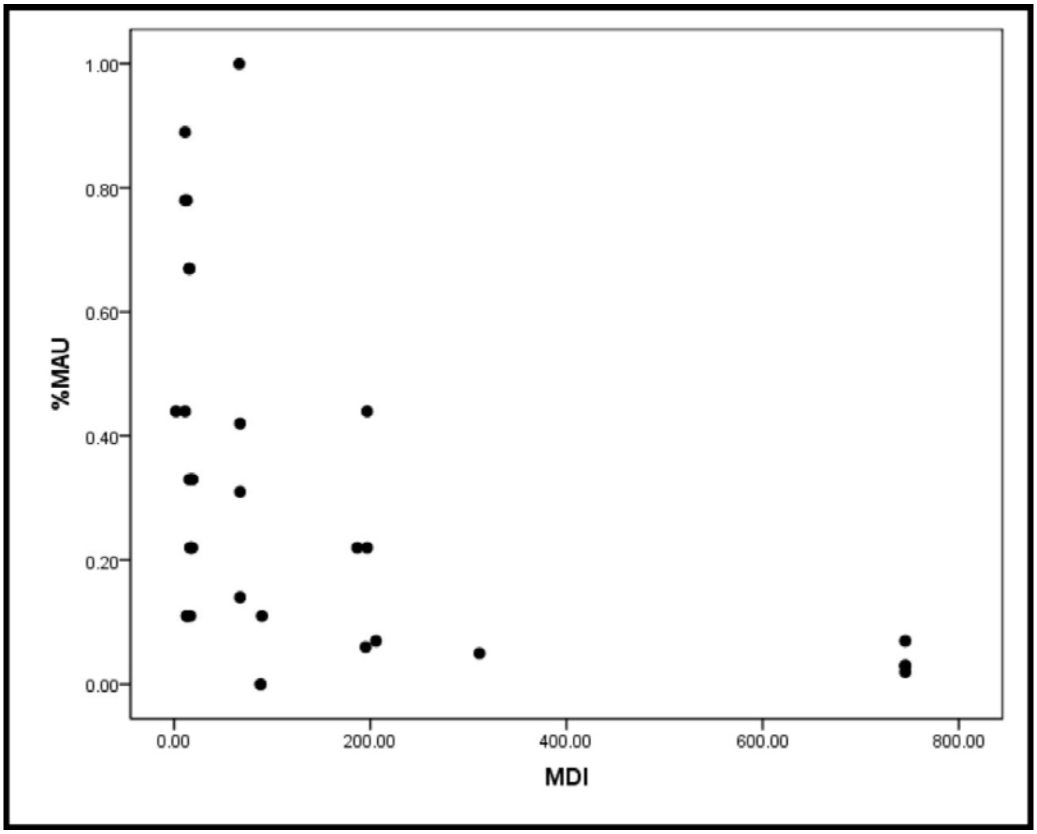

Figure 6-5. %MAU over MDI.

Based on secondary data values presented in Table C-3, %MAU over MDI is used to identify the presence of meat drying at the site, and more specifically, within the excavation. Figure 6-5 shows a graph representing this relationship. A significant ($p<0.01$) negative correlation (r_s= -0.665) between %MAU and MDI indicates that meat drying was not undertaken within the area excavated during the 2012 field season. However, the presence of both high and low utility items and the low occurrence of elements of the axial skeleton associated with meat drying may indicate that meat drying was tangential to the excavated portion of the site, which may have been the focus of other activities.

White Grease Index

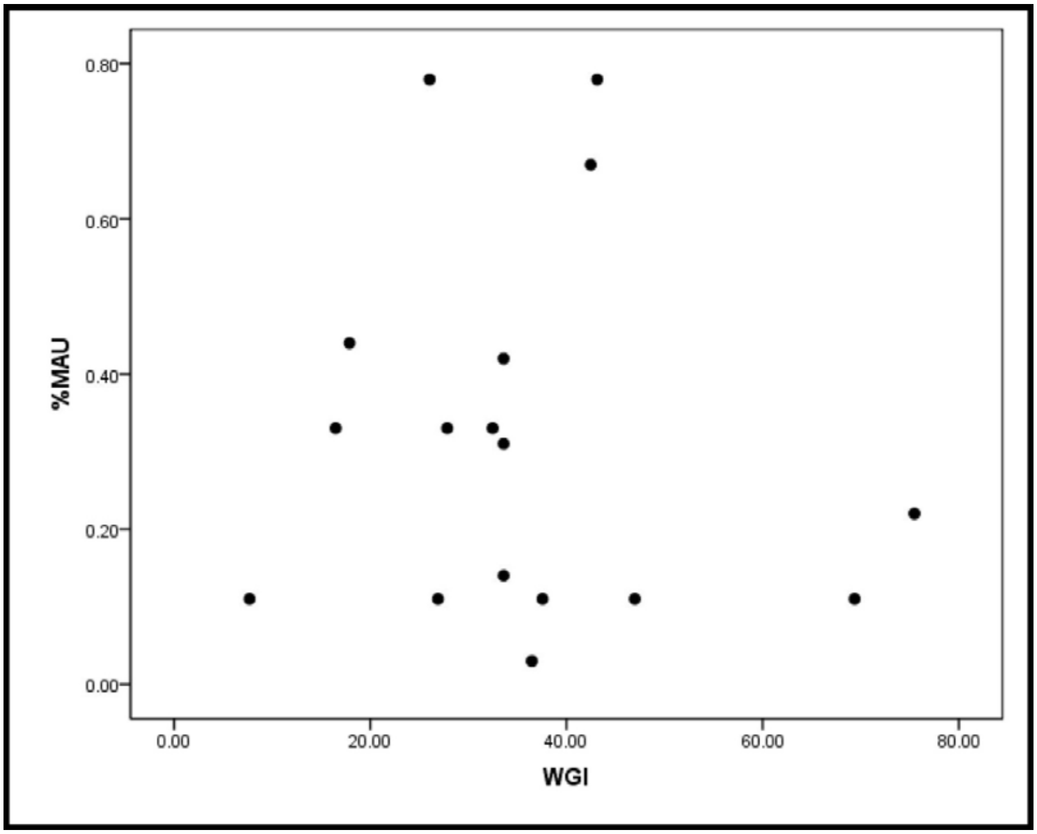

Figure 6-6. %MAU over WGI.

Based on secondary data values presented in Table C-3, %MAU over WGI is used to identify the presence of absence of elements associated with grease rendering at the site. Figure 6-6 shows a graph representing this relationship. An insignificant ($p=0.478$) negative correlation (r_s= -0.185) between %MAU and WGI indicates that while elements associated with grease processing are present, they tend to be those with a low grease index. Additionally, there does not appear to be a clear pattern to indicate that grease processing was being undertaken, however, this inference is limited to the area excavated during the 2012 field season.

Marrow Index

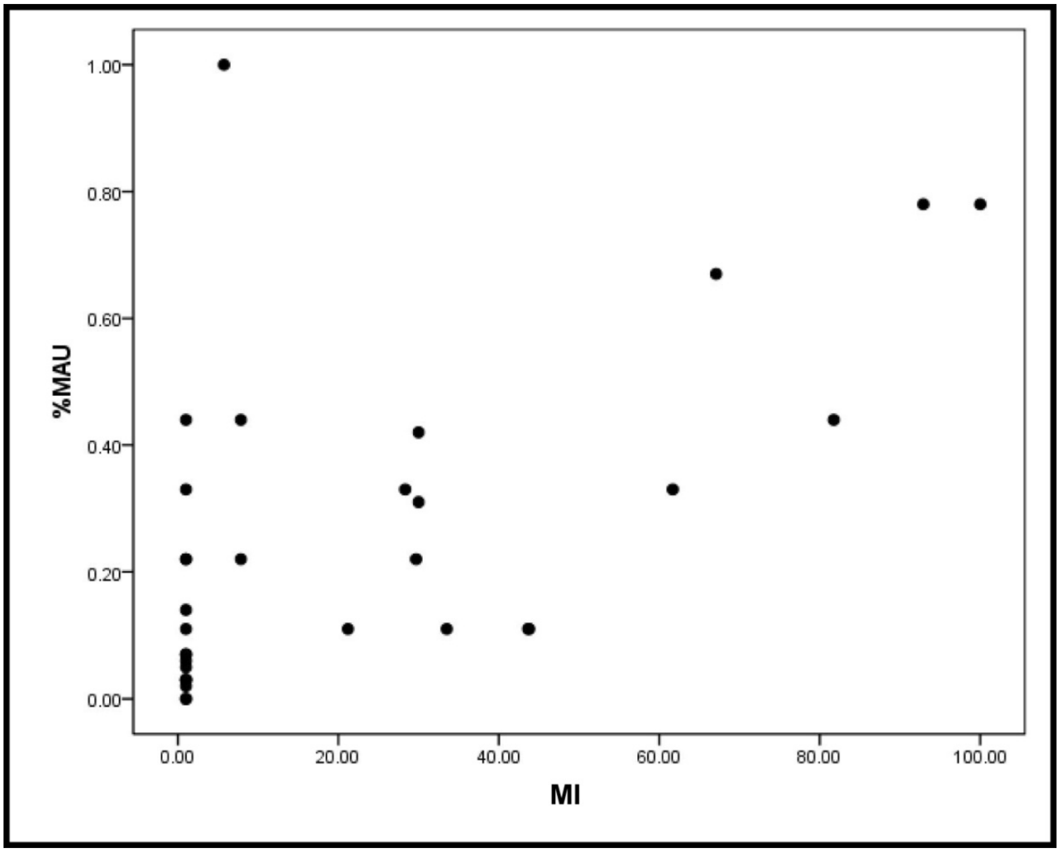

Figure 6-7. %MAU over MI.

Finally, based on the data values provided in Table C-3, %MAU over the MI is used to examine the presence or absence of elements associated with bone marrow processing. Figure 6-7 shows this relationship. A significant ($p<0.01$) positive correlation ($r_s= 0.625$) strongly suggests that the area excavated during the 2012 field season was primarily used for bone marrow processing. This is supported by the presence of an anvil stone recorded in Feature 2. The presence of low utility 1st and 2nd phalanges, often associated with resource stress, along with high utility upper and lower limb elements is indicative of long term processing in preparation for winter storage. Note the intact bone fragment present in the 1st phalange in Figure 6-8, which exhibits a second fragment on the opposite side where the bone was smashed between two stones to presumably obtain the marrow.

Figure 6-8. Refit 1st phalange.

Seasonality

The seasonal use of the site is more problematic. Based on the presence of a single right side juvenile caribou mandible (Figure 6-9), the occupation of the site is estimated to have occurred during the fall caribou migration, which is consistent with the ethnographic record. This estimate is based on the expectation that caribou calving occurs during late April or early May and depends on annual climate conditions. In the single mandible, the 2nd molar appears to have completely erupted, and according to Miller (1972:611) this occurs at 15 months. Likewise, the 4th premolar is expected to begin erupting at 21 months, however, there is no indication that eruption of this tooth has begun. This leads to the conclusion that the animal was captured at between 15 and

21 months of age. This limits the capture of the animal to the months of July through December conservatively, and since there is little indication that the area was suitable for winter occupation based on the lack of firewood, or features ethnographically associated with winter encampments, it is logical to conclude a late summer/autumn capture.

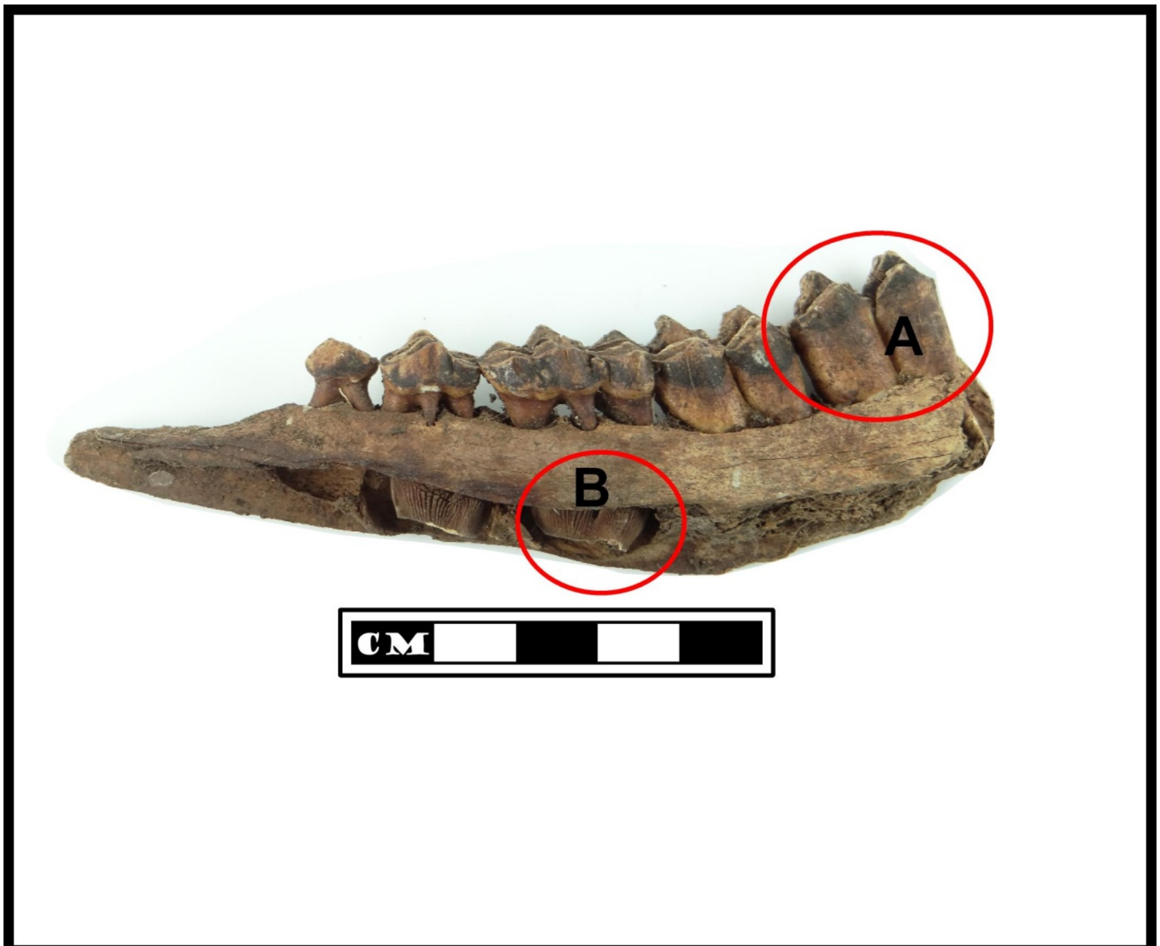

Figure 6-9. (A) 2nd molar, (B) 4th premolar.

Discussion

Comparing the results of the faunal analysis at Butte Lake Northeast with the results of Skeete's (2008) analysis of eleven sites in the nearby Talkeetna Mountains, Butte Lake Northeast appears to be unique in both the indication of specific processing activity and the lack of elements associated with other activities. While differential transport is not indicated, suggesting that both capture and processing of animals was undertaken at the site, specific indications of activity areas can be inferred from both the presence and absence of elements associated with those activities. For example, it appears that Feature 2 is directly associated with marrow processing as indicated by the association of specific elements, however, the absence of elements specifically associated with both drying and grease production are far more indicative of activity areas removed from Feature 2 rather than completely absent from the site altogether.

This conclusion leads to the inference that the late occupation of the site was used in a manner consistent with the ethnographic record and that the site was a long term hunting camp where specific activities associated with meat, grease, and marrow processing were undertaken at separate discrete loci.

While faunal analysis of the late occupation at Butte Lake (Component 3) appears to be consistent with expectations provided by the ethnographic model, early components did not exhibit fauna of any type and comparative analysis must rely completely on the lithic analysis and site structure to determine how climate change during the Holocene might have affected site occupation and use. However, the analysis of faunal remains and the resulting conclusions add considerable strength to the ethnographic model for examining site type within the framework outlined in this thesis and will be examined in the following chapter.

Chapter Seven. Interpretations, Discussion, and Conclusions

The following chapter will focus on site interpretation by applying analysis of site structure, lithic materials, and faunal remains to the Ethnographic model and the Climate model. This is undertaken for the purpose of examining the reliability of these models to address variation in site type as a product of cause and effect in a middle range theoretical approach. Site interpretation however, cannot be undertaken without considering other sites within the region. Each of these sites exhibits similar characteristics and may include geographic region, exploitation of caribou, and occupational components that are approximately contemporaneous to those recorded at Butte Lake. More importantly, each of the sites is representative of movement on the landscape and site specific behavior during the seasonal round as outlined within the Ethnographic model, and each provides clues as to how climate has affected ecology over the course of the Holocene. Therefore, a discussion of these sites and how their interpretations might illuminate the occupation and use of the site at Butte Lake will follow a discussion of both the ethnographic and the climate models.

Ethnographic Model Discussion

This research has been undertaken with the expectation that people inhabiting the site at the northeast end of Butte Lake are doing so to obtain resources in a manner that promotes optimal fitness. The ethnographic model predicts that people that inhabited the site during the late Holocene were exploiting the fall caribou migration by driving caribou into the lake where they were dispatched. The caribou would then have been removed to the northeast corner of the lake where processing was undertaken to obtain economic value from the resource by means of meat, grease, and marrow processing. The model predicts that while these processing methods would have occurred on the kame or adjacent eskers around the lake, camps would have been set up near the inlet stream primarily to keep out of the wind due to the lack of firewood present in the area.

The ethnographic model also predicts that the site would have been occupied for long periods of time by several families, and that processing of animals for both caloric and material benefit would have been an ongoing concern. From these expectations, it would not be unreasonable for the inhabitants to separate activities areas. While this is expected with regards to dwellings and processing areas, individual processing areas can also be expected based on the assumption that humans are likely to optimize the use of space and efficiently make use of time during a limited seasonal procurement of the resources.

Based on the Ethnographic model, the late Holocene occupation of the site is expected to be a hunting camp. The site is located in an upland setting near a lake. The site was likely inhabited during the fall, however spring and summer occupation cannot be ruled out. Lithic analysis indicates late stage reduction most associated with unifacial tool production and maintenance, and artifacts include highly curated and expedient tool kits. Fire cracked rock and large hearth features are also present. Faunal remains include high and low utility elements that are highly fragmented and burned/calcined or unburned. Both cache-pits and a house feature are present at the site (Betts 1987a), but due to the lack of evidence suggesting a permanent or semi-permanent structure, it is possible that the house depression was excavated for the purposes of erecting a temporary skin dwelling. While no drying racks were recorded at the site, the faunal remains suggest that elements associated with drying have been removed from the excavated portion of the site which is primarily oriented toward marrow processing, and that drying activities, and therefore remains of drying racks may be located elsewhere at the site.

The late Holocene occupation at Butte Lake meet all the criteria for a seasonal hunting camp, that is part of a residential strategy oriented toward the exploitation of seasonally abundant resources. The middle Holocene occupations are unlike the late Holocene occupations and appear to be associated with a logistical approach to obtaining resources by means of encounter in an area with a known resource base.

The middle Holocene occupations at Butte Lake are consistent with the transitory/overnight site type. The site is located on high ground and may represent a multi-season occupation. This is due to the variation in artifacts recorded within the middle Holocene component, which includes two hearth features that contained microblade fragments but no bifacial projectiles (Betts 1987a), and one hearth that contained a side notched point but no microblades. Lithic analysis of the component artifacts indicates late stage reduction that may tend more toward bifacial tool production, and both processing tools and hunting tools were recorded. No bones or structures are associated with the middle Holocene occupation. All three hearths associated with the middle Holocene occupation also appear to be small, multi-use hearths possibly for cooking and generating warmth.

The lowest component contains no recognizable features and very few artifacts. Because of the lack of archaeology associated with the early Holocene component, it is not possible to use the Ethnographic model to examine the component, however, it is clear that resources important to promoting optimal fitness were available at or near the site and must have been directly associated with or tangential to caloric resources based on the presence of material culture recorded at the site.

While substantial differences occur between the various occupational components, several similarities also stand out with regards to lithic resources based on the variety of material types recorded at the site. Many of the materials were recorded in all components, and still more are located within individual components. This suggests both familiarity with the location of directly procured resources and an abundance of resources allowing for embedded procurement during the normal seasonal round.

The differences in occupational components may be the most interesting aspect of the site at Butte Lake. If the resource base is held constant, or both caloric and raw material resources are stable within the limits defined by the ethnographic past, than it is expected that the means of acquisition and the use of site type would also remain consistent. Differences in any of these variables could be associated with cultural differences for example, but assuming that these differences are negligible, climate change should provide a link between site type and resource availability.

Climate Model Discussion

The Holocene paleoclimate is marked by oscillations in temperature and effective moisture. This thesis uses a climate model to establish scale for evaluating change within and between occupational components at the site over the extent of the Holocene. Figure 7-1 presents both a summary of the paleoclimate model and the cultural chronology of the site based on provisionally dated sediments, radiocarbon assays from Feature 1 and Feature 6, and the delineation of occupational components based on cultural material including lithic detritus and faunal remains. The resulting model of site occupation correlates climate variables with site occupation and appears to clearly show the significant impact that climate has on site occupation during the Holocene.

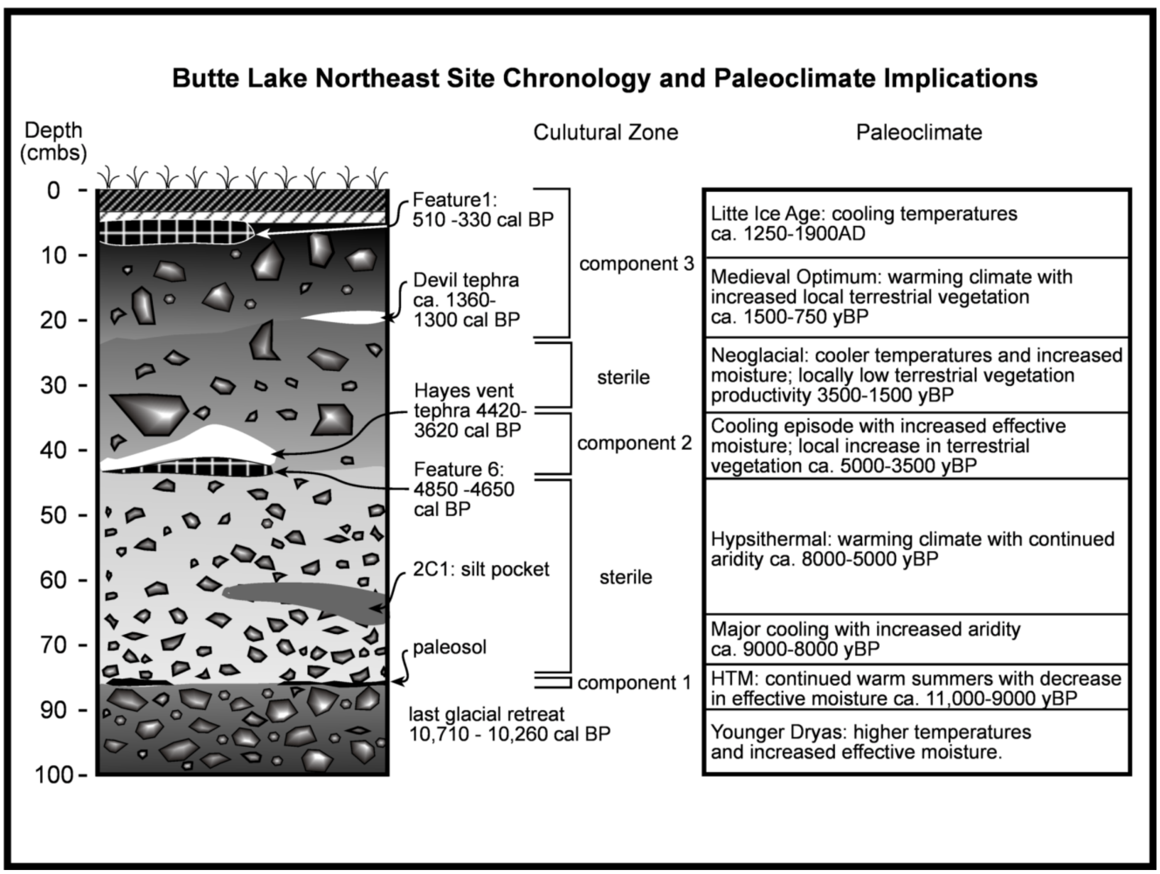

Figure 7-1. Occupation chronology and its relation to the Holocene paleoclimate.

Based on this model, it appears that initial occupation of the site occurred shortly after the last glacial retreat during a period marked by increased effective moisture and higher temperatures. It also appears that the onset of much more arid conditions during the early Holocene made site occupation untenable due to the lack caloric returns associated with desertification. While this hiatus may be tied to a decrease in temperatures during the younger Younger Dryas, it continues well into the early Hypsithermal which is markedly warmer. When viewing both temperature and moisture as a constraint on economic viability of the patch environment, only a decrease in effective moisture remains constant during this hiatus.

The model also shows that middle Holocene occupation coincides with an increase in effective moisture that is inferred from the record of terrestrial vegetation within the region. The increase in effective moisture occurs between ca. 5000 and 3500 yBP. While a cultural hiatus follows the middle Holocene occupation during a period of continually high relative precipitation, it appears that climate conditions may have hindered the development of suitable terrestrial biomes during a period marked by glacial advance in the region.

The most recent occupational component also correlates well with the onset of the Medieval Optimum and relative precipitation that has persisted from 1500 yBP to present. Over all, the model makes it abundantly clear that temperature at the site is secondary to effective moisture, and thus it is likely that occupation of the site during this period was directed toward the acquisition of fauna which rely on productive terrestrial vegetation. This conclusion is consistent with the location of artifacts in the stratigraphic column and the formation of organic soil horizons located immediately above the glacial till and above the culturally sterile C1 horizon.

It is important to note that the middle and late Holocene occupations of the site do not appear to be equal, meaning that there appears to be a substantial increase in patch productivity during the late Holocene associated with the use of storage, the construction of a house feature (noted in 1984 excavation), and an increased reliance on seasonally predictable and abundant resources. This may be the result of the small sample area at the site, but is more likely indicative of substantial variation in habitat between these periods. Likewise, it is important to note that the earliest occupation of Component 3, differs from both the Component 2 occupation and the record of Component 3 occupation directly overlying the material and more closely associated with the 510-330 cal BP date recorded from Feature 1.

Intersite Comparisons and Conclusions

Site Summary

Component 1 exhibits few clues regarding human occupation during the early Holocene and includes lithic debitage and a buried soil. While the sample size is small, lithic material analysis suggest that early inhabitants were arriving at the site with a fully formed tool kit suggesting pursuit of resources other than tool stone. However this does not rule out the possibility that they were also testing cobbles at or near the site for quality as well. Assuming that humans are operating in an optimal fashion that maximizes returns while minimizing the risk of variation in returns, then it is likely that Component 1 is associated with a productive patch environment, whether tangential to the lake environment, or directly related to the lake itself. There is also little to suggest that the early visitors to the site were residentially mobile as the record does not indicate occupation of the site at all. Based on the lack of features and the scattered artifacts, the site appears to be oriented toward logistic mobility where the site is accessed during resource pursuit from a nearby camp (Binford 1978b).

Component 1 also seems to be related to occupations of the same period at Tangle Lakes. This is based not only on the time period, but also on the presence of siliceous tuff (argillite) flakes with a likely source in the Amphitheater Mountains in the Tangle Lakes region. This material is found in all components at Butte Lake and is a common raw material used for tool stone production at Tangle Lakes.

The Component 2 occupation is entirely associated with the end of the Hypsithermal and the onset of the Neoglacial. The apparent cultural hiatus from the site lasting approximately 3500 to 1300 cal BP, may be the result of catastrophic ash fall associated with the Hayes vent tephra, but is most likely the result of declining economic returns related to the onset of the Neoglacial. This is inferred from multiple lines of evidence including the presence of occupational components possibly within or directly above the Hayes vent tephra at Duck Embryo Lake (TLM-022) and Jay Creek Mineral Lick (TLM-143) south of Butte Lake near the Susitna River (Dixon et al. 1985). Additionally, evidence from Butte Lake shows that occupation was not adversely hindered by the Devil tephra for any substantial period of time. Likewise, reoccupation at Ta 'Tla Mun on Tatlmain Lake in central Yukon occurred in a relatively short period after the White River tephra fall (Thomas 2003), and certainly did not hinder reoccupation for the time period represented by the hiatus between Component 2 and Component 3 at Butte Lake. However, all of the sites located with the upper Susitna region do exhibit the same possible hiatus that spans approximately 2000 years.

Component 3 clearly represents a late Holocene hunting camp, located where game was predictable and abundant, and initial occupation corresponds with both the end of the Neoglacial and the Devil tephra. The site also appears to represent an autumn hunting camp based on the caribou dentition. The presence of faunal remains in the upper portion of Component 3, both large and small hearth features (central hearths recorded in the house during the1984 excavation), cache features, and a house feature, suggest a residential strategy that takes advantage of the resources located at or near the site as part of a seasonal round. This is supported by the variety of lithic materials that were procured as part of an embedded strategy where tool stone is acquired as it is encountered. This is not to say that some materials were not directly procured, but it does suggests that those that were, such as siliceous tuff from the Clearwater or Amphitheater Mountains for example (Glen et al. 2011; Stout 1976), were procured tangential to the seasonal round. This also suggest that variety in material type may be indicative of late summer/fall occupation consistent with the ethnohistoric accounts of site use, as late winter/spring encampments would exhibit lithic materials that were more often directly procured resulting in less variation in material type.

For example, the variety of materials in a relatively small area stands in contrast to two contemporaneous sites on Paxson Lake (Ketz 1982). Both the Knoll and Point sites on Paxson lake lack variability in lithic artifacts but exhibit many of the same site attributes associated with the late occupation at Butte Lake including numerous faunal remains, house features, and cache pits. While the sites exhibited similar artifacts with regards to bone tools, beads, and copper, stone tools for butchering or hide scraping are consistently made on rounded boulder spalls likely collected from the rocky shoreline of Paxson Lake (Ketz 1982). Since the two sites on Paxson Lake have been linked to the spring caribou migration (Yesner 1980), it is probable that movement from winter encampments to spring hunting grounds does not provide adequate time or access to lithic resources to exhibit substantial diversity in lithic raw materials.

Native copper was recorded during both excavations at Butte Lake, however, the 2012 excavation produced the only complete projectile point. The 1984 copper artifacts were recorded in the house feature and were similar to other rolled or “cone” samples recorded and the Ringling Site (Shinkwin 1977; Workman 1976). The copper point (Figure D-7) recorded during 2012 is consistent with others recorded at multiple sites including Dakah De'nin' s Village (Shinkwin 1979) and suggests continuity in metal working technology.

Discussion

Component 3 represents a major shift in the economic resource base at the site that may also be reflected regionally. This shift is inferred by differences between the occupations of Component 2 and Component 3 indicating either variety in cultural adaptation, or differences in resource base related to productivity of terrestrial biomes. While it is currently impossible to rule out differences in how cultures utilized resources during one period or another, this research assumes continuity in technological organization and optimal foraging, and is guided by the ethnographic model.

Based on Dixon et al. (1985), these differences are reflected throughout the upper Susitna River region and include several multi-component sites including the for mentioned Jay Creek Mineral Lick, Tsusena Creek, and the Borrow C site. Each of the multi-component sites exhibits two occupational components, each associated with a regional tephra. The lower components are typically below or immediately above a lower tephra associated with the Hayes vent tephra and unusually include only lithic detritus and occasionally small hearth features, although fauna is present at a small number of sites such as Jay Creek Mineral Lick. The upper components are typically associated with the provisionally identified Devil tephra and more often exhibit faunal remains with fewer lithic and more organic artifacts. Analysis of faunal remains and associated material culture have indicated that site types during the later occupations range from kill/processing sites, to transitory/overnight sites, and hunting camps (Skeete 2008), while designation of lower components is more problematic due to the lack of, or poor provenience of faunal remains. This is likewise true of Component 2 at Butte Lake and may suggest a strategy that differed greatly from that exhibited during the late Holocene occupation, however, a closer examination of the Ratekin site near Swampbuggy Lake, which is associated with middle Holocene occupation based on the number of side notched points and fragments, may contradict this inference.

Both the Ratekin site and Hosley Ridge site represent a strategy of large ungulate pursuit and capture, and are likely associated with caribou hunting (Skarland and Keim 1958). While faunal remains have not been recorded at the sites, observations by Skarland and Keim (1958) suggest disadvantaging tactics similar to those exhibited at Butte Lake during the late Holocene, inferring that long term hunting accompanied by processing would have been an ongoing concern near the recorded site.

Component 2 at Butte Lake is as different from the two sites near Swampbuggy Lake as the Tsusena Creek site and Borrow C site (Dixon et al. 1985; Skeete 2008) are from Component 3 at Butte Lake, and yet each shares a culturally contemporaneous association, albeit different strategically. Both the Tsusena Creek and Borrow C sites are late Holocene kill/lookout sites or transitory/overnight camps (Skeete 2008) similar to the middle Holocene Component 2 occupation at Butte Lake. The fact that the middle Holocene Ratekin site is more like the late Holocene Component 3 at Butte Lake brings up a very important question regarding the role that Butte Lake played in the importance of the middle Holocene seasonal round. Based on this inference, it is worthwhile to consider how landscape changes and how those changes may be reflected by sites recorded within the region.

Evidence from Swampbuggy and Nutella Lakes indicate that the lakes have only existed on the landscape for the past 6000 to 7000 years (Rohr 2001). Therefore, it is possible that Butte Lake is even younger and may not have reached current lake levels until the end of the Neoglacial. Without the advantage the lake provided for late Holocene hunters, there would have been no conceivable reason to locate long term residential camps on the lake to capture and process game. During the middle Holocene, it is likely Swampbuggy Lake may have served as a hunting camp, while Butte Lake would have served as a transitory hunting ground accessed as part of a logistical strategy. While this question and the potential implications may provide an avenue for future research at Butte Lake, it can only be answered through lake core analysis. In lieu of such analysis however, it is clear that a major shift does occur during the late Holocene, and while this shift shows continual continuity within the upper portion of Component 3, the earliest occupation of the component may provide the most valuable insight to how the region is reoccupied after a long cultural hiatus, as well as how ecological response to the Medieval Optimum may have shaped regional population dynamics and trade.

Summary of Medieval Optimum

The earliest occupation of Component 3 is based on artifact superposition and the proximity with the provisionally identified Devil tephra, and includes microblade technology, iron, and highly curated tools. The presence of microblades recorded in the lowest extent of the component suggest a cultural continuum that spans the introduction of the bow and arrow weapon system. Additionally, their presence during this time may also be indicative of longer periods of cold near the end of the Neoglacial necessitating material conservation and risk minimizing by using more durable organic tools. It is just as likely however, that this may be indicative of spring acquisition or late winter/early spring encounters in the upland environment and may be associated with pioneering occupation and mapping of resources.

The presence of Batza Tená obsidian, which originates from a source several hundred kilometers to the northwest on the Koyukon River and is absent in older contexts, in addition to a small highly curated scraper, an Ipiutak style lateral side blade, and an iron bit strongly suggest a possible Eskimo (Norton/Ipiutak) affiliation. Similar cultural materials have been recorded within contexts at other lake side sites including Hahanudan (RkIk-5) dating to between 1300 and 990 cal BP (Clark 1977), and Lake Minchumina (MMK-4) dating to between 1290 and 800 cal BP (Holmes 1986). Most notable of all is the presence of iron which is recorded in Old Bering Sea culture sites and found on both sides of the Bering Strait ca 1500 - 1800 cal BP (Chard 1960; Collins 1937; Levin and Segeyev 1964) as well as in Ipiutak contexts ca. 1550 cal BP (Bandi 1969; Larsen and Rainey 1948; Rainey 1971).

While this affiliation does not necessarily equate to Eskimo settlement of the region during the Medieval Optimum, it at least strongly suggests extensive trade networks with cultures bearing these materials or culturally diagnostic artifacts. However, an early resettlement of the uplands by coastal Eskimo populations following the retreat of the Neoglacial advances along the coastal Gulf of Alaska via the Copper or Susitna River, or by Ipiutak/Norton populations via the Tanana River (by way of the Yukon River), or Kuskokwim River, cannot be ruled out either. Additionally, microblades recorded in the same context suggest a late Northern Archaic component. This is similar to components recorded at MMK-4 at Lake Minchumina within the same time frame. While this is likely indicative of regional cultural continuity coupled with extensive trade, it could just as likely be evidence that multiple cultures had occupied the site over a relatively short period of time. This should not be considered unusual, as multi-band occupation was common during the ethnographic period at Butte Lake and included occasional Tanana and possibly Dená ina incursions into the ethnographic western Ahtna territory, which in turn was likely Tanana territory prior to the ethnographic period (Betts 1985; Greiser et al. 1985; Kari 2010).

Future Directions

While it seems clear that site occupation is related to climate change, and that oscillations in temperature and moisture have produced various outcomes on the landscape, future research at the site could be oriented toward identifying the complexities of site organization during long term hunting bouts. By testing for activity based loci within the upper component, greater evidence of site use during the middle and early Holocene could illuminate how differences reflect resource scheduling during these periods and how or whether these strategies were in fact affected by climate as proposed in this thesis.

Presently only a small percentage of the site at Butte Lake has been tested. The site which includes the remainder of the kame, the area along the inlet stream, and the peninsula immediately to the west of the kame, are likely to represent only a small portion of the activity represented near the north end of the lake which includes multiple kames and eskers. In my opinion, Butte Lake and other sites in the region with notable deposition and clear stratigraphy provide the potential to answer some of the most difficult questions regarding why people inhabit a particular area and how physiographic and terrestrial biome variation can lead to population movement and pioneering of landscapes, as well as extensive trade and diffusion of ideas throughout the Holocene. However, it is also my opinion that this requires careful and well planned excavation of components with a focus on middle range theoretical implications within a framework of human behavioral ecology.

References

Ager, T. A.
1983 Holocene vegetational history of Alaska. In *Late Quaternary Environments of the United States*, edited by H. E. Wright, pp. 128-141. vol. 2. 2 vols. University of Minnesota Press, Minneapolis.

Ahler, S. A.
1989 Mass Analysis of Flaking Debris: Studying the Forest Rather Than the Tree. *Archeological Papers of the American Anthropological Association* 1(1):85-118.

Allen, H. T.
1887 *Report of an Expedition to the Copper, Tananá, and Kóyukuk Rivers, in the Territory of Alaska, in the Year 1885," for the Purpose of Obtaining All Information which Will be Valuable and Important, Especially to the Military Branch of the Government."*. US Government Printing Office.

Amick, D. S., R. P. Mauldin and S. A. Tomka
1988 An Evaluation of Debitage Produced by Experimental Bifacial Core Reduction of a Georgetown Chert Nodule. *Lithic Technology* 17(1):26-36.

Anderson, D. D.
1968 A Stone Age campsite at the gateway to America. *Scientific American* 218(6):24-33.

Andrefsky, W.
2005 *Lithics: Macroscopic Approaches to Analysis*. 2nd ed. Cambidge University Press, New York.

Andrefsky, W.
2008 The Analysis of Stone Tool Procurement, Production, and Maintenance. *Journal of Archaeological Research* 17(1):65-103.

Andrefsky, W. J.
1994 Raw-Material Availability and the Organization of Technology. *American Antiquity* 59(1):21-34.

Arndt, K. L.
1977 The Structure of Cache Pits at GUL-077, a Late Prehistoric Archaeological Site Near Gulkana, Alaska. M.A., Univeristy of Alaska Fairbanks.

Bamforth, D. B.
1986 Technological Efficiency and Tool Curation. *American Antiquity* 51(1):38-50.

Bamforth, D. B. and P. Bleed
1997 Technology, Flaked Stone Technology, and Risk. *Archeological Papers of the American Anthropological Association* 7(1):109-139.

Bandi, H. G.
1969 *Eskiomo Prehistoy*. University of Alaska Press, Fairbanks.

Barclay, D. J., G. C. Wiles and P. E. Calkin
2009 Holocene glacier fluctuations in Alaska. *Quaternary Science Reviews* 28(21-22):2034-2048.

Baumler, M. F. and C. E. Downum
1989 Between Micro and Macro: A Study in the Interpretation of Small-Sized Lithic Debitage. . In *Experiments in Lithic Technology*, edited by D. S. Amick and R. P. Mauldin, pp. 101-116. BAR, Oxford.

Beck, C., Amanda K. Taylor, George T. Jones, Cynthia M. Fadem, Caitlyn R. Cook, and Sara A. Millward
2002 Rocks are heavy: transport costs and paleoarchaic quarry behyavior in the Great Basin. *Anthropological Archaeology* 21:481-507.

Begét, J. E., R. D. Reger, D. Pinney, T. Gillispie and K. Campbell
1991 Correlation of the Holocene Jarvis Creek, Tangle Lakes, Cantwell, and Hayes Tephras in South-Central and Central Alaska. *Quaternary Research* 35(2):174-189.

Behrensmeyer, A. K.
1978 Taphonomic and Ecologic Information from Bone Weathering. *Paleobiology* 4(2):150-162.

Belovsky, G. E.
1987 Hunter-Gatherer Foraging: A Linear Programming Approach. *Journal of Anthropological Archaeology* 6:29-76.

Belovsky, G. E.
1988 An Optimal Foraging-Based Model of Hunter-Gatherer Population Dynamics. *Journal of Anthropological Archaeology* 7:329-372.

Bettinger, R. L.
2009 *Hunter-Gatherer Foraging: Five Simple Models*. Eliot Werner Publications, Inc., Clinton Corners, New York.

Betts, R. C.
1985 Western Ahtna Ethnohistory of the Butte Lake Region. University of Alaska Fairbanks.

Betts, R. C.
1987a Archaeological Investigations at Butte Lake, Alaska: A Report to the University of Alaska Museum Geist Fund. M.A., Department of Anthropology, University of Alaska Fairbanks, Fairbanks, Alaska.

Betts, R. C.
1987b A Late Denali Microblade-Notched Point component at Butte Lake on the Upper Susitna River, Alaska. Paper presented at the 14th Annual Alaska Anthropological Association, Anchorage, AK.

Bigelow, N. H., L. B. Brubaker, M. E. Edwards, S. P. Harrison, C. Prentice, P. M. Anderson, A. A. Andreev, P. J. Bartlein, T. R. Christensen, W. Cramer, J. O. Kaplan, A. V. Lozhkin, N. V. Matveyeva, D. F. Murray, A. D. McGuire, V. Y. Razzhivin, J. C. Ritchie, B. Smith, D. A. Walker, K. Gajewski, V. Wolf, B. H. Holmqvist, Y. Igarashi, K. Kremenetskii, A. Paus, M. F. J. Pisaric and V. S. Volkova
2003 Climate change and Arctic ecosystems: 1. Vegetation changes north of 55°N between the last glacial maximum, mid-Holocene, and present. *Journal of Geophysical Research* 108(D19):1-25.

Bigelow, N. H. and W. R. Powers
2001 CLIMATE, VEGETATION, AND ARCHAEOLOGY 14,000 TO 9000 CAL YR B.P. IN CENTRAL ALASKA. *Arctic Anthropology* 38(2):171.

Binford, L. R.
1967 Smudge Pits and Hide Smoking: The Use of Analogy in Archaeological Reasoning *American Antiquity* 32(1):1-12.

Binford, L. R.
1978a Dimensional Analysis of Behavior and Site Structure: Learning from an Eskimo Hunting Stand. *American Antiquity* 43(3):330-361.

Binford, L. R.
1978b *Nunamiut Ethrnoarchaelogy*. Academic Press, New York.

Binford, L. R.
1979 Organization and Formation Processes: Looking at Curated Technologies. *Journal of Anthropological Research* 35(3):255-273.

Binford, L. R.
1980 Willow Smoke and Dogs' Tails: Hunter-Gatherer Settlement Systems and Archaeological Site Formation. *American Antiquity* 45(1):4-20.

Binford, L. R.
1984 *Faunal Remains from Klasies River Mouth*. Academic Press, Orlando.

Bleed, P.
1986 The Optimal Design of Hunting Weapons: Maintainability or Reliability. *American Antiquity* 51(4):737-747.

Bobe, R., A. K. Behrensmeyer and R. E. Chapman
2002 Faunal change, environmental variability and late Pliocene hominin evolution. *Journal of Human Evolution* 42(4):475-497.

Bousman, C. B.
1993 Hunter-Gatherer Adaptations, Economic Risk and Tool Design. *Lithic Technology* 18(1&2):59-86.

Bousman, C. B.
2005 Coping with risk: Later stone age technological strategies at Blydefontein Rock Shelter, South Africa. *Journal of Anthropological Archaeology* 24(3):193-226.

Bowers, P. M., R. Bonnichsen and D. M. Hoch
1983 Flake Dispersal Experiments: Noncultural Transformation of the Archaeological Record. *American Antiquity* 48(3):553-572.

Bright, J., A. Ugan and L. Hunsaker
2002 The Effect of Handling Time on Subsistence Technology. *World Archaeology* 34(1):164-181.

Brown, C.
2005 *Caribou Management Report of Survey-Inventory Activities: 1 July 2002 - 30 June 2004*. State of Alaska. Copies available from W-33-1 and W-33-2.

Bunn, H. T., E. M. Kroll, S. H. Ambrose, A. K. Behrensmeyer, L. R. Binford, R. J. Blumenschine, R. G. Klein, H. M. McHenry, C. J. O'Brien and J. J. Wymer
1986 Systematic Butchery by Plio/Pleistocene Hominids at Olduvai Gorge, Tanzania [and Comments and Reply]. *Current Anthropology* 27(5):431-452.

Calkin, P. E., G. C. Wiles and D. J. Barclay
2001 Holocene coastal glaciation of Alaska. *Quaternary Science Reviews* 20:449-461.

Cashdan, E. A.
1985 Coping with Risk: Reciprocity Among the Basarwa of Northern Botswana. *Man* 20(3):454-474.

Chard, C. S.
1960 First Iron Artifact from the Old Bering Sea Culture. *Anthropological Papers of the University of Alaska* 9(1):57.

Charnov, E. L., G. H. Orians and K. Hyatt
1976 Ecological implications of resource depression. *The American Naturalist* 110(972):247-259.

Clark, D. W.
1977 *Hahanudan Lake: An Ipiutak-Related Occupation or Western Interior Alaska*. Archaeological Survey of Canada, Paper No. 71. National Museums of Canada, Ottowa.

Collins, H. B.
1937 Archaeology of St. Lawrence Island, Alaska. *Smithsonian Miscellaneous Collections* 91(1).

Colwell, R. K.
1974 Predictability, Constancy, and Contingency of Periodic Phenomena. *Ecology* 55(5):1148-1153.

Cook, J.
1969 Early Prehistory of Healy Lake, Alaska, Department of Anthropology, University of Wisconsin.

Cook, J. P.
1995 Characterization and distribution of obsidian in Alaska. *Arctic Anthropology* 32(1):92.

Damas, D.
1972 Central Eskimo Systems of Food Sharing. *Ethnology* 11(3):220-240.

de Laguna, F. and C. McClellan
1981 Ahtna. In *Handbook of North American Indians: Vol. 6, Subarctic*, edited by J. Helm, pp. 641-663. vol. 6. Smithsonian Institution, Washington D.C.

Dixon, E. J.
1985 Cultural Chronology of Central Interior Alaska. *Arctic Anthropology* 22(1):47-66.

Dixon, E. J., W. F. Manley and C. M. Lee
2005 The Emerging Archaeology of Glaciers and Ice Patches: Examples from Alaska's Wrangell-St. Elias National Park and Preserve. *American Antiquity* 70(1):129-143.

Dixon, E. J., G. S. Smith, W. J. Andrfsky, B. Saleeby and C. J. Utermohle
1985 *Susitna Hydroelectric Project: Cultural Resource Investigations 1979-1985*. Report to the Alaska Power Authority, University of Alaska Museum.

Dumond, D. E.
1980 The Archeology of Alaska and the Peopling of America. *Science* 209(4460):984-991.

Ellis, C. J.
1997 *Factors Influencing the Use of Stone Projectile tips.* . Projectile Technology. Plenum, New York.

Elston, R. G. and P. J. Brantingham
2002 Microlithic Technology in Northern Asia: A Risk-Minimizing Strategy of the Late Paleolithic and Early Holocene. *Archeological Papers of the American Anthropological Association* 12(1):103-116.

Enloe, J. G.
2006 Geological Processes and Site Structure: Assessingt Integrity at a Late Paleolithic Open-Air Site in Northern France. *Geoarchaeology: An International Journal* 21(6):523-540.

Esdale, J. A.
2008 A Current Synthesis of the Northern Archaic. *Arctic Anthropology* 45(2):3-38.

Esdale, J. A.
2009 Lithic Production Sequences and Toolkit Variability: examples from the Middle Holocene, Northwest Alaska. Dissertation, Department of Anthropology, Brown University, Providence, RI.

Farnell, R., P. G. Hare, E. Blake, V. Bowyer, C. Schweger, S. Greer and R. Gotthardt
2004 Multidisciplinary Investigations of Alpine Ice Patches in Southwest Yukon, Canada: Paleoenvironmental and Paleobiological Investigations. *Arctic* 57(3):247-259.

Fretwell, S. D. and H. L. J. Lucas
1969 On Territorial Behavior and Other Factors Influencing Habitat Distribution in Birds.

Friesen, T. M.
2001 A Zooarchaeological Signature for Meat Storage: Re-Thinking the Drying Utility Index. *American Antiquity* 66(2):315-331.

Frison, G. C.
1968 A Functional Analysis of Certain Chipped Stone Tools. *American Antiquity* 33(2):149-155.

Gilbert, B. M.
1980 *Mammalian Osteology*. The Missouri Archaeological Society, Laramie, Wyoming.

Gillespie, T. E.
1992 *Final Report: Archaeological Data Recovery and Evaluation: Landmark Gap Trail, Alaska*. GDM, Inc.

Gilreath, A. J.
1983 Bifacial Debitage and Sampling at a Small Lithic Scatter: An Experimental Study, Department of Anthropology, University of Washington, Seattle.

Glen, J. M. G., J. M. Schmidt and G. G. Connard
2011 Three-dimensional model of an ultramafic feeder system to the Nikolai Greenstone mafic large igneos province, central Alaska Range. *Geochemistry Geophysics Geosystems* 12(6):1-24.

Greiser, T. W., S. T. Greiser, G. H. Bacon, T. A. Foor, P. R. Kari, J. Kari, D. H. Gallacher and J. M. Caywood
1985 *Susitna Hydroelectic Project Phase 1 Report: Background Research and Predictive Model for Cultural Resources Located Along the Susitna Hydroelectric Project's Linear Features*. Harza-Ebesco Susitna Joint Venture.

Hadleigh-West, F.
1967 The Donnelly Ridge Site and the Definition of an Early Core and Blade Complex in Central Alaska. *American Antiquity* 32(3):360-382.

Hadleigh-West, F.
1975 Dating the Denali Complex. . *Arctic Antropology* 12(1):76-81.

Hadleigh-West, F. (editor)
1996 *American Beginnings: The Prehistory and Palaeoecolgy of Beringia.* University of Chicago Press, Chicago.

Hanson, D. K.
2008 Archaeological Investigations in the 1990s at the Ringling Site, GUL-077, Near Gulkana, Alaska. *Alaska Journal of Anthroplogy* 6(1&2):109-130.

Hare, P. G., S. Greer, R. Gotthardt, R. Farnell, V. Bowyer, C. Schweger and D. Strand
2004 Ethnographic and Archaeological Investigations of Alpine Ice Patches in Southwest Yukon, Canada. *Arctic* 57(3):260-272.

Heusser, C.
1995 Late-Quaternary vegetation response to climatic-glacial forcing in North Pacific America. *Physical Geography* 16(2):118-149.

Hilton, M. R.
2003 Quantifying Postdepositional Redistribution of the Archaeological Record Produced by Freeze–Thaw and Other Mechanisms: An Experimental Approach. *Journal of Archaeological Method and Theory* 10(3):165-202.

Hoek, W. and J. Bos
2007 Early Holocene climate oscillations—causes and consequences. *Quaternary Science Reviews* 26(15-16):1901-1906.

Holmes, C. E.
1986 *Lake Minchumina Prehistory: An Archeological Analysis.* Alaska Anthropological Association Monograph Series #2. Alaska Anthropological Association, Anchorage, AK.

Holmes, C. E. (editor)
1996 *Broken Mammoth*. The University of Chicago Press, Chicago and London.

Holmes, C. E.
2001 Tanana River Valley Archaeology Circa 14,000 to 9000 B.P. *Arctic Anthroplogy* 38(2):154-170.

Holmes, C. E.
2008 Swan Point: technology of the Beringian period in Alaska. Paper presented at the 73rd Annual Meeting of the Society for American Archaeology, Vancouver, B.C. Canada.

Holmes, C. E.
2008 The Taiga Period: Holocene Archaeology of the Northern Boreal Forest, Alaska. *Alaska Journal of Anthroplogy* 6(1):69-81.

Ingbar, E. E., M. L. Larson and B. Bradley
1989 A Nontypological Approach to Debitage Analysis. In *Experiments in Lithic Technology*, edited by D. S. Amick and R. P. Mauldin, pp. 117-136. BAR, Oxford.

Ingold, T.
2000 The optimal forager and economic man. In *The Perception of the Environment: Essays on livelihood, dwelling and skill*. Routledge, London and New York.

Kari, J.
2008 *Ahtna Place Names: 2nd edition revised*. 2nd ed.

Kari, J.
2010 *Ahtna Travel Narratives: A Demonstration of Shared Geographic Knoledge among Alaska Athabascans*. Alaska Native Language Center, University of Alaska Fairbanks, Fairbanks, Alaska.

Kari, J. M.
1990 *Ahtna Athabaskan dictionary*. Alaska Native Language Center, University of Alaska Fairbanks, Fairbanks.

Kaufman, D.
2004 Holocene thermal maximum in the western Arctic (0–180°W). *Quaternary Science Reviews* 23(5-6):529-560.

Kelly, R. L.
1988 The Three Sides of a Biface. *American Antiquity* 53(4):717-734.

Kelly, R. L. and L. C. Todd
1988 Coming into the Country: Early Paleoindian Hunting and Mobility. *American Antiquity* 53(2):231-244.

Ketz, J. A.
1982 Paxson Lake: Two Nineteenth Century Ahtna Sites in the Copper River Basin, Alaska, Department of Anthropology, University of Alaska Fairbanks, Fairbanks, Alaska.

Klein, R. G. and K. Cruz-Uribe
1984 *The analysis of animal bones from archeological sites.* University of Chicago Press, Chicago.

Klitgaard-Kristensen, D., H. P. Sejrup, H. Haflidason, S. Johnsen and M. Spurk
1998 A Regional 8200 cal yr BP Cooling Event in Northwest Europe, Induced by Final Stages of the Laurentide Ice-sheet Deglaciation. *Journal of Quaternary Science* 13:165-169.

Knecht, H.
1993 *Early Upper Paleolithic Approaches to Bone and Antler Projectile Technology*. Hunting and animal Exploitation in the Later Paleolithic and Mesolithic of Eurasia. Arcaheological Papers of the American Anthropolocial Association. American Anthropological Association, Arlington, Va.

Knecht, H.
1997 *Projectile Points of Bone, Antler, and Stone: Experimental Exploratins of Manufacture and Use*. Projectile Technology. Plenum, New York.

Kuhn, S. L.
1994 A Formal Approach to the Design and Assembly of Mobile Toolkits. *American Antiquity* 59(3):426-442.

Laporte, L. F. and A. L. Zihlman
1983 Plates, climate and hominoid evolution. *South Africa Journal of Science* 79.3:96-108.

Larsen, H. and F. Rainey
1948 Ipiutak and the Arctic Whale Hunting Culture. *Anthropological Papers of the American Musium of Natural History* 42.

Levin, M. G. and D. A. Segeyev
1964 *The Penetration of Iron into the Arctic.* The Archaeology and Geomorphology of Northern Asia: Selected Works. University of Toronto Press, Toronto.

Lloyd, A. H.
2005 Ecological Histories from Alaskan Tree Lines Provide Insight into Future Change. *Ecology* 86(7):1687-1695.

Lyman, R. L.
1994 *Vertebrate Taphonomy*. Cambridge University Press, Cambridge.

Lyman, R. L.
2008 *Quantitative Paleozoology*. Cambridge Manuals in Archaeology. Cambridge University Press New York.

MacArthur, R. H. and E. R. Pianka
1966 On Optimal Use of a Patchy Environment. *The American Naturalist* 100(916):603-609.

Magne, M. and D. Pokotylo
1981 A Pilot Study in Bifacial Lithic Reduction Sequences. *Lithic Technology* 10:34-47.

Magne, M. P. R.
1985 *Lithics and livelihood: Stone tool technologies of central and southern interior British Columbia.* National Museum of Man Mercury Series, Archaeological Survey of Canada Paper No. 133.

Mason, O. K. and J. E. Begét
1991 Late Holocene Flood History of the Tanana River, Alaska, U.S.A. *Arctic and Alpine Research* 23(4):392-403.

Mason, O. K. and N. H. Bigelow
2008 The Crucible of Early to Mid-Holocene Climate in Northern Alaska: Does Northern Archaic Represent the People of the Spreading Forest? *Arctic Anthroplogy* 45(2):39-70.

Mason, O. K., P. M. Bowers and D. M. Hopkins
2001 The early Holocene Milankovitch thermal maximum and humans: adverse conditions for the Denali complex of eastern Berigia. *Quaternary Science Reviews* 20:525-548.

Mauldin, R. P. and D. S. Amick
1989 *Investigating Patterning in debitage from Experimental Bifacial Core Reduction*. Experiments in Lithic Technology. BAR International Series 528, Oxford.

Mayr, E.
1982 The place of bilogy in the sciences and its conceptual stucture. In *The Growth of Biological Thought*, edited by E. Mayr. The Belknap Press of Harvard University Press, Cambridge, Massachesetts and London, England.

McGowan, S. and D. M. Bengtson
1997 *Rangifer tarandus Skeleton Lab Manual*. University of Alaska, Fairbanks, Alaska.

Metcalfe, D. and K. T. Jones
1988 A Reconsideration of Animal Body-Part Utility Indices. *American Antiquity* 53(3):486-504.

Miller, F. L.
1972 Eruption and Attrition of Mandibular Teeth in Barren-Ground Caribou. *The Journal of Wildlife Management* 36(2):606-612.

Mobley, C. M.
1982 The Landmark Gap Trail Site, Tangle Lakes, Alaska: Another Perspective on the Amphitheater Mountain Complex. *Arctic Anthropology* 19(1):81-102.

Nelson, R. K.
1986 *Hunters of the Northern Forest*. 2nd ed. The University of Chicago Press, Chicago and London.

North, A. C. o. S. N.
2005 North American Stratigraphic Code. In *AAPG Bulletin*, pp. 1547-1591. vol. 89.

Parker, G. A. and J. M. Smith
1990 Optimality theory in evolutionary biology. *Nature* 348:27-33.

Phillips, P. and G. R. Willey
1953 Method and Theory in American Archeology: An Operational Basis for Culture-Historical Integration. *American Antiquity* 55(5):615-633.

Potter, B. A.
1997 A First Approximation of the Ahtna Region Archaeology. M.A., Department of Anthroplogy, University of Alaska Fairbanks, Fairbanks, Alaska.

Potter, B. A.
2005 Site Structure and Organization in Central Alaska. Archaeological investigatins at Gerstle River. Dissertation, Department of Anthropology, University of Alaska Fairbanks, Fairbanks, Alaska.

Potter, B. A.
2008a Exploratory models of intersite variability in mid to late Holocene central Alaska. *Arctic* 61(4):407-425.

Potter, B. A.
2008b A First Approximation of Holocene Inter-Assemblage Variability in Central Alaska. *Arctic Anthroplogy* 45(1):89-113.

Potter, B. A.
2008c Radiocarbon Chronology of Central Alaska: Technological Continuity and Economic Change. *Radiocarbon* 50(2):181-204.

Potter, B. A.
2011 *Late Pleistocene and Early Holocene Assemblage Variability in Central Alaska*. From the Yenisei to the Yukon: Interpreting lithic Assemblage Variability in Late Pleistocene/Early Holocene Beringia. Texas A&M Universtiy Press, College Station, TX.

Potter, B. A., J. D. Irish, J. D. Reuther, C. Gelvin-Reymiller and V. T. Holliday
2011 A Terminal Pleistocene Child Cemation and Residential Structure from Eastern Beringia. *Science* 331:1058-1062

Potts, R.
1996 *Humanity's Descent: The Consequences of Ecological Instability*. . William Morrow and Co Inc, New York.

Potts, R.
1998 Environmental Hypotheses of hominin evolution. *American Journal of Physical Anthropology* 107:93-136.

Powers, R., R. D. Guthrie and J. F. Hoffecker
1983 *Dry Creek: Archaeology and Paleoecology of the Late Pleistocene Alaskan Hunting Camp.* National Park Service.

Prentiss, W. C.
1998 The Reliability and Validity of a Lithic Debitage Typology: Implications for Archaeological Interpretation. *American Antiquity* 63(4):635-650.

Rainey, F.
1971 *The Ipiutak Culture: Excavations at Point Hope*, *Alaska*. Module 8: Mccaleb Module in Anthroplogy. Addison Wesley Publications.

Real, L. and T. Caraco
1986 Risk and Foraging in Stochastic Environments. *Annual Review of Ecology and Systematics* 17(ArticleType: research-article / Full publication date: 1986 / Copyright © 1986 Annual Reviews):371-390.

Reckord, H.
1983 Where the Raven Stood. *Anthropology and Historic Preservation Cooperative Park Studies Unit of Alaska*, *Fairbanks* Occasional Paper No. 35.

Reger, R. D. and T. K. Bundtzen
1990 *Multiple Glaciation and Gold-Placer Formatin, Valdez Creek Valley, Western Clearwater Mountains, Alaska*. State of Alaska.

Reger, R. D., D. A. S. P. Stevens and D. N. Solie
2008 *Surficial Geology of the Alaska Highway Corridor, Delta Junction to Dot Lake, Alaska*. State of Alaska Department of Natural Resources.

Reimer, P. J., M. G. L. Baillie, E. Bard, A. Bayliss, J. W. Beck, P. G. Blackwll, C. E. Buck, G. S. Burr, R. L. Edwards, M. Friedrich, P. M. Grootes, T. P. Guilderson, I. Hajdas, T. J. Heaton, A. G. Hogg, K. A. Hughen, K. F. Kaiser, B. Kromer, G. McCormac, S. Manning, C. B. Ramsey, R. W. Reimer, D. A. Richards, J. R. Southon, S. Talamo, C. S. M. Turney, J. van der Plicht and C. E. Weyhenmeyer
2009 IntCal09 and Marine09 Radiocarbon Age Calibration Curves, 0-50,000 years cal BP. *Radiocarbon* 51(4):1111-1150.

Reitz, E. J. and E. S. Wing
2008 *Zooarchaeology*. 2nd ed ed. Cambridge Manuals in Archaeology. Cambridge University Press, New York.

Reuther, J. D. and S. C. Gerlach
2005 Testing the "Dicarb Problem": A Case Study from North Alaska. *Radiocarbon* 47(3):359-366.

Ridges, M.
2006 Scale and Its Effects on Understanding Regional Behavioural Systems: An Australian Case Study. In *Confronting Scale in Archaeology: Issues of Theory and Practice*, edited by G. Lock and B. L. Molyneaux, pp. 145-161. Springer, New York.

Riehle, J. R., P. M. Bowers and T. A. Ager
1990 The Hayes Tephra Deposits, an Upper Holocene Marker Horizon in South-Central Alaska. *Quaternary Research* 33:276-290.

Rohr, M.
2001 Paleoenvironmental Changes at Treeline in Central Alaska: A 6,500 Year Long Pollen and Stable Isotope Record. Masters Thesis, College of Science, Engineering and Mathematics, University of Alaska Fairbanks, Fairbanks, Alaska.

Rots, V., L. Pirnay, P. Pirson and O. Baudoux
2006 Blind tests shed light on possibilities and limitations for identifying stone tool prehension and hafting. *Journal of Archaeological Science* 33(7):935-952.

Rozen, K. C. and A. P. I. Sullivan
1989 Measurement, Method, and Meaning in Lithic Analysis: Problems with Amich and Mauldin's Middle Range Approach. *American Antiquity* 54:169-174.

Schoeneberger, P. J., D. A. Wysocki, E. C. Benham and W. D. Broderson
2002 *Field Book for Describing and Sampling Soils* 2. United States Department of Agriculture, Washington D.C.

Schoener, T. W.
1974 The Compression Hypothesis and Temporal Resource Partitioning. *Proceedings of the National Academy of Sciences* 71(10):4169-4172.

Schwanke, R.
2011 *Game Management Unit 13: Nelchina Caribou Herd*. Alaska Department of Fish and Game.

Sheets, P. D. and G. R. Muto
1972 Pressure blades and total cutting edge: an experiment in lithic technology. *Science* 175(4022):632-634.

Sheppard, W. L., A. F. Steffian, D. P. Staley and N. H. Bigelow
1991 *Late Holocene Occupations at the Terrace Site Tok, Alaska*. Arctic Environmental Information and Data Center University of Alaska Anchorage.

Shinkwin, A. D.
1977 *The "archaeological visibility" of northern Athapaskans in the Tanana River area, central Alaska: a disussion.* The Athapaskan Question. University of Calgary Archaeolgical Asslciation, Calgary.

Shinkwin, A. D.
1979 *Dakah De'nin's Billage and the Dixthada Site: A Contribution to Northern Athapaskan Prehistory*. Archaeological Survey of Canada, Mercury Series, Paper No. 91. National Museum of Man, Ottawa.

Shott, M. J.
1986 Technological Organization and Settlement Mobility: An Ethnographic Examination. *Journal of Anthropological Research* 42(1):15-51.

Shott, M. J.
1994 Size and form in the analysis of flake debris: Review and recent approaches. *Journal of Archaeological Method and Theory* 1(1):69-110.

Shotwell, J. A.
1955 An approach to the paleoecology of mammals. *Ecology* 36(2):327-337.

Shulski, M. and G. Wendler
2007 *The Climate of Alaska*. Universtiy of Alaska Press, Fairbanks, Alaska.

Sih, A.
1980 Optimal Foraging: Partial Consumption of Prey. *The American Naturalist* 116(2):281-290.

Simeone, W. E.
2006 *Some Ethnographic and Historical Information on the Use of Large Land Mammals in the Copper River Basin*. Wrangell-St. Elias National Park and Preserve.

Skarland, I. and C. J. Keim
1958 Archaeological Discoveries on the Denali Highway, Alaska. *Anthropological Papers of the University of Alaska* 6(2):79-88.

Skeete, L. K.
2008 An Analysis of Faunal Remains from the Susitna Hydroelectirc Project. M.A. , University of Alaska Fairbanks, Fairbanks, Alaska.

Smith, E. A.
1992a Human behavioral ecology: I. *Evolutionary Anthropology: Issues, News, and Reviews* 1(1):20-25.

Smith, E. A.
1992b Human behavioral ecology: II. *Evolutionary Anthropology: Issues, News, and Reviews* 1(2):50-55.

Smith, J. M.
1978 Optimization Theory in Evolution. *Annual Review of Ecology and Systematics* 9(ArticleType: research-article / Full publication date: 1978 / Copyright © 1978 Annual Reviews):31-56.

Stahle, D. W. and J. E. Dunn
1982 An Analysis and Application of the Size Distribution of Waste Flakes from the Manufacture of Bifacial Stone Tools. *World Archaeology* 14(1):84-97.

Stanley, S. M.
1992 An Ecological Theory for the Origin of Homo. *Paleobiology* 18(3):237-257.

Stiner, M. C., N. D. Munro and T. A. Surovell
2000 The Tortoise and the Hare. *Current Anthropology* 41(1):39-73.

Stout, J. H.
1976 *Geology of the Eureka Creek Area, East-Central Alaska Range*. Alaska Division of Geological and Geophusical Surveys.

Sullivan, A. P., III and K. C. Rozen
1985 Debitage Analysis and Archaeological Interpretation. *American Antiquity* 50(4):755-779.

Surovell, T. A.
2003 The Behavioral Ecology of Folsom Lithic Technology. Dissertation, Department of Anthropology, The University of Arizona.

Thomas, C. D.
2003 Ta 'Tla Mun: An Archaeolgical Examination of the Technology, Subsistence Economy and Trade at Tatlmain Lake, Central Yukon, Department of Anthroplogy, University of Alberta, Edmonton, Alberta.

Tomka, S. A.
1989 *Differentiating Lithic Reduction Techniques: An Experimental Approach.* Experiments in Lithic Technology. BAR Oxford.

Torrence, R. (editor)
1989 *Time, energy and stone tools*. Cambridge University Press, Cambridge, London, Newyork.

Trauth, M. H., M. A. Maslin, A. Deino and M. R. Strecker
2005 Late cenozoic moisture history of East Africa. *Science* 309(5743):2051-2053.

Tucker, G., N. M. Gasparini, S. T. Lancaster and R. L. Bras
1999 *Modeling Floodplain Dynamics and Stratigraphy: Implications for Geoarchaeology*. Massachusetts Institute of Technology.

Ugan, A., J. Bright and A. Rogers
2003 When is technology worth the trouble? *journal of Archaeological Science* 30:1315-1329.

Vanderhoek, R., R. M. Tedor and J. D. McMahan
2007 Cultural Materials Recovered from Ice Patches in the Denali Highway Region, Central Alaska, 2003-2005. *Alaska Journal of Anthroplogy* 5(2):185-200.

Vanderhoek, R., B. T. Wygal, R. M. Tedor and C. E. Holmes
2007 Survey and Monitoring of Ice Patches in the Denali Highway Region, Central Alaska, 2003-2005. *Alaska Journal of Anthroplogy* 5(2):67-86.

Villa, P., J.-C. Castel, C. Beaubal, V. Bourdillat and P. Goldberg
2004 Human and carnivore sites in the European Middle and Upper Paleolithic: Similarities and defferences in bone modification and fragmentation. *Revue de Paléobiolgie* 23(2):705-730.

Villa, P. and E. Mahieu
1991 Breakage patterns of human long bones. *Journal of Human Evolution* 21(1):27-48.

Vrba, E.
1995 On the connections between paleoclimate and evolution. *Paleoclimate and evolution, with emphasis on human origins*:24-45.

Waguespack, N. M., T. A. Surovell, A. Denoyer, A. Dallow, A. Savage, J. Hyneman and D. Tapster
2009 Making a point: wood- versus stone-tipped projectiles. *Antiquity* 83(321):786-800.

Wahrhaftig, C.
1960 *The Physiographic Provinces of Alaska*. U. S. Geological Survey.

Whittaker, R. H.
1975 *Communities and ecosystems*. Macmillan, New York.

Willey, G. and P. Phillips
1958 *Method and Theory in Archaeology*. University of Chicago Press, Chicago.

Winterhalder, B.
1986 Diet choice, risk, and food sharing in a stochastic environment. *Journal of Anthropological Archaeology* 5(4):369-392.

Winterhalder, B. and P. Leslie
2002 Risk-sensitive fertility: The variance compensation hypothesis. *Evolution and Human Behavior* 23(1):59-82.

Winterhalder, B., F. Lu and B. Tucker
1999 Risk-Sensitive Adaptive Tactics: Models and Evidence From Subsistence Studies in Biology and Anthropology. *Journal of Archaeological Research* 7(4):301-347.

Wobst, H. M.
2006 Artifacts as Social Interference: The Politics of Spatial Scale. In *Confronting Scale in Archaeology: Issues of Theory and Practice*, edited by G. lock and B. L. Molyneaux, pp. 55-64. Springer, New York.

Workman, W. B.
1972 The cultural significance of volcanic ash which fell in the Upper Yukon Basin about 1400 years ago. . Paper presented at the International Conference on the Prehistory and Paleoecology of teh Western American Arctic and Subarctic, Calgary.

Workman, W. B.
1976 *Archaeological investigations at GUL-077, a prehistoric Site Near Gulkana, Alaska.* Alaska Methodist University.

Workman, W. B.
1977 *Ahtna archaeology: a preliminary statement.* . The Athabaskan question.

Wyckoff, D. G., J. L. Hofman and J. G. Enloe
1992 *Refitting and Protohistorica Knapping Behavior: The Lowrance Example*. Piecing Together the Past: Applications of Refitting Studies in Archaeology. BAR International Series, Oxford.

Wynn, J. G.
2004 Influence of Plio-Pleistocene aridification on human evolution: Evidence from paleosols of the Turkana Basin, Kenya. *American Journal of Physical Anthropology* 123(2):106-118.

Yesner, D. R.
1980 Caribou Exploitation in Interior Alaska: Paleoecolgy at Paxson Lake. *Anthropological Papers of the University of Alaska* 19(2):15-31.

Yesner, D. R.
1989 Moose hunters of the boreal forest? A re-examination of subsistence patterns in the western subarctic. *Arctic* 42(2):97-108.

Yesner, D. R.
2001 Human dispersal into interior Alaska: antecedent conditions, mode of colonization, and adaptations. *Quaternary Science Reviews* 20:315-327.

Appendix A. Site Structure and Chronology.

Table A-1. Last glacial retreat from study area from Reger and Bundtzen 1990: table 4 page 14.

Sample	Material dated	^{14}C age yr BP (Laboratory No.)	Calibrated age (IntCal09)(2σ cal BP)
Upper Watana Creek valley	wood in frozen lacustrine silt and clay	9395 ± 200 (GX-8035)	cal BP 11200 - 10223
Upper Deadman Creek valley	peat in fine-grained ice-disintegration deposits	9920 ± 265 (GX-8062)	cal BP 12387 - 10665
small lake south of Snodgrass Lake	Frozen basal peaty organic silt overlying ice-disintegration deposits in palsa	9195 ± 150 (GX-14438)	cal BP 10773 - 9910
Upper Boulder Creek	Frozen basal peat overlying fluvial sand in palsa	9035 ± 335 (GX-14437)	cal BP 11157 - 9444
Cantwell Creek valley	Frozen basal woody organic silt overlying till in palsa	9260 ± 150 (GX-14446)	cal BP 11075 - 10157
*Denali Highway near Mclaren River Bridge	Lowest exposed frozen peat in palsa	10565 ± 225 (GX-2049)	cal BP 12944 - 11624
Pooled average		**9317 ± 85**	**cal BP 10710 - 10260**

Test statistic T = 6.844361, χ2 = 9.49, df = 4; *not included in pooled average as it lies significantly outside of the mean distribution.

Table A-2. Devil tephra chronology based on Dixon 1985, Figure 2 page 52.

Sample	context	^{14}C age yr BP	95.4% (2σ) cal age ranges	Calibration citation
DIC-2244	not included			
Beta 7692	above Devil tephra	840 ± 60	cal BP 674 -908	Reimer et al. 2009
Beta 7693	above Devil tephra	1060 ± 70	cal BP 796 - 1170	
Beta 7845	above Devil tephra	1260 ± 80	cal BP 983 - 1305	
Pooled mean for estimation	**above Devil tephra**	**1013 ± 40**	**cal BP 796 - 1051**	
Beta 10785	below Devil tephra	1240 ± 60	cal BP 1010 - 1290	
Beta 10125	below Devil tephra	1530 ± 80	cal BP 1293 - 1596	
Beta 9898	below Devil tephra	1670 ± 50	cal BP 1417 - 1702	
Beta 10791	below Devil tephra	1770 ± 190	cal BP 1304 - 2123	
Beta 9892	below Devil tephra	1880 ± 50	cal BP 1705 - 1930	
Pooled mean for estimation	**below Devil tephra**	**1672 ± 28**	**cal BP 1415 - 1597**	
Pooled mean for estimation	**total**	**1425 ± 23**	**cal BP 1293 - 1357**	

Table A-3. Soil descriptions and metrics

FS#	description	MUNSELL	COLOR	% 6.35mm	% 1.68mm	% 1.18mm	% FINE	TOTAL	NOTE	LEVEL
003-021	CB	10YR3/3	DARK BROWN	0.041	0.119	0.103	0.736	1.000	upper C HOZ	7
003-020	C	5Y2.5/2	BLACK	0.125	0.310	0.194	0.371	1.000	glacial till	10
003-019	B	7.5YR2.5/3	VERY DARK BROWN	0.047	0.153	0.125	0.675	1.000	B HOZ	4
003-018	A	5YR2.5/2	DARK REDDISH BROWN	0.022	0.124	0.137	0.717	1.000	AB HOZ	2
003-006	FS003-006	5YR2.5/2	DARK REDDISH BROWN	0.156	0.246	0.130	0.468	1.000	Bb HOZ/buried soil	9
003-004	LEVEL 6	10YR3/2	VERY DARK GRAYISH BROWN	0.008	0.082	0.063	0.848	1.000	control sample for Feature 6	6
003-016	FEA6	7.5YR2.5/1	BLACK	0.000	0.063	0.022	0.915	1.000	hearth matrix	8
011-266	TEPHRA	10YR4/4	DARK YELLOWISH BROWN	0.000	0.000	0.000	1.000	1.000	TEPHRA	7
011-216	FEA1	10YR2/1	BLACK	0.018	0.098	0.051	0.833	1.000	FRACTION SKEWED BY HIGH % OF BURNED AND CALCINED BONE IN 1.68MM FRACTION, MUCH LOWER FRACTIONS OF COLLUVIUM THAN % IMPLIES.	3
014-001	FLAKE MATRIX	10YR3/2	VERY DARK GRAYISH BROWN	0.100	0.060	0.036	0.804	1.000	Feature 2	2
014-073	FLAKE MATRIX	10YR3/2	VERY DARK GRAYISH BROWN	0.029	0.067	0.050	0.854	1.000	Feature 2	2
014-090	LEVEL 3	5YR3/2	DARK REDDISH BROWN	0.074	0.099	0.033	0.795	1.000	AB HOZ	3
014-108	FEA2b	5YR2.5/1	BLACK	0.071	0.080	0.060	0.790	1.000	Feature 2	3
014-128	sum of 014-[illegible]	10YR2/1	BLACK	0.067	0.156	0.117	0.659	1.000	B HOZ	3
014-129	FEA2a	10YR2/1	BLACK	0.015	0.046	0.074	0.866	1.000	Feature 2	3
014-131	ASH	10YR4/3	DARK BROWN	0.010	0.041	0.030	0.919	1.000	POSSIBLE TEPHRA	3
014-163	CONTROL FOR FEA6	7.5YR3/3	VERY DARK BROWN	0.002	0.008	0.003	0.986	1.000	POSSIBLE TEPHRA	8
014-167	FEA6	7.5YR2.5/1	BLACK	0.000	0.057	0.050	0.892	1.000	Feature 6	8
014-175	BURIED SOIL	2.5Y3/2	VERY DARK GRAYISH BROWN	0.139	0.179	0.139	0.544	1.000	Bb HOZ	12
003-029	AEOLIAN SILT	5Y4/2	OLIVE GRAY	0.014	0.088	0.037	0.861	1.000	silt pocket in C HOZ	10

Appendix B. Lithic Analysis.

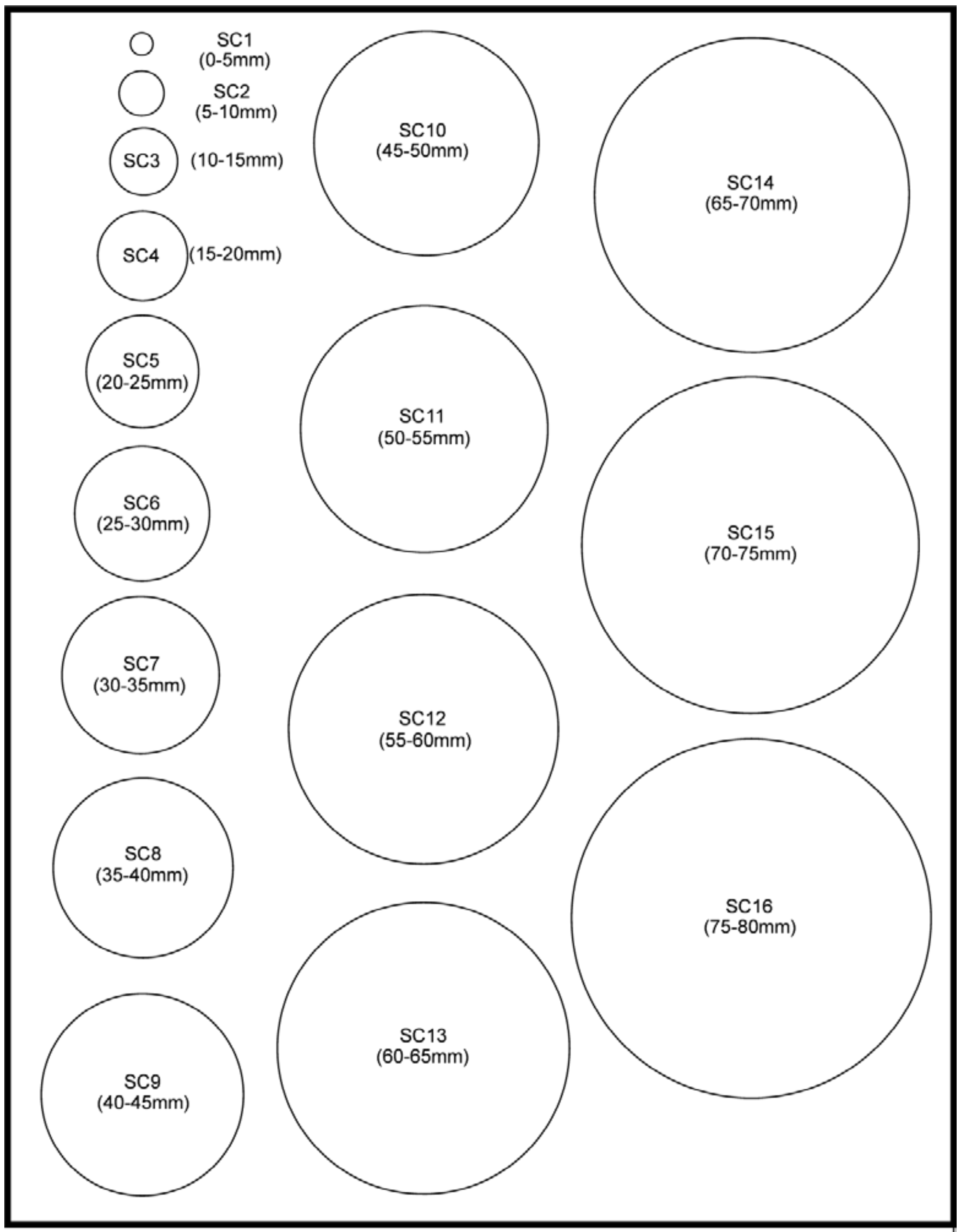

Figure B-1. Size class chart used for analysis. Not to scale.

Table B-1. Modified Sullivan and Rozen Typology and flake attributes.

Modified Sullivan and Rozen Typology (Sullivan and Rozen 1985)												
	Comp 1		Comp 2		Comp 3		Comp I		Comp II		Comp III	
	n	%	n	%	n	%	n	%	n	%	n	%
Completeness												
complete	2	40.00%	35	18.04%	213	26.86%	7	50.00%	90	28.94%	75	31.25%
broken	3	60.00%	159	81.96%	580	73.14%	7	50.00%	221	71.06%	165	68.75%
Flake Fragment												
proximal	1	33.33%	39	24.84%	129	23.20%	4	57.14%	86	40.24%	66	40.24%
medial	0	0.00%	88	56.05%	344	61.87%	2	28.57%	96	43.44%	65	39.63%
distal	2	66.67%	30	19.11%	83	14.93%	1	14.29%	39	17.65%	33	20.12%
Platform Preparation												
crushed	2	66.67%	19	25.68%	81	23.68%	3	33.33%	39	22.54%	39	27.86%
abraded	0	0.00%	14	18.92%	127	37.13%	1	11.11%	27	15.61%	19	13.57%
complex	1	33.33%	28	37.84%	81	23.68%	1	11.11%	76	43.93%	54	38.57%
flat	0	0.00%	13	17.57%	53	15.50%	4	44.44%	31	17.92%	28	20.00%
Platform Angle												
>75°	1	33.33%	35	47.30%	142	41.52%	5	62.50%	134	77.46%	86	64.66%
<75°	2	66.67%	39	52.70%	200	58.48%	3	37.50%	39	22.54%	47	35.34%
Shatter (no discernible ventral surface)												
absent	5	55.60%	195	92.00%	794	96.60%	14	66.70%	320	71.30%	258	71.30%
present	4	44.40%	17	8.00%	28	3.40%	7	33.30%	129	28.70%	104	28.70%
% Cortex												
50-100%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	1	0.22%	2	0.55%
5-50%	1	11.11%	0	0.00%	2	0.24%	0	0.00%	6	1.34%	7	1.93%
>0 & <5%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	3	0.67%	2	0.55%
0	8	88.89%	212	100.00%	820	99.76%	21	100.00%	439	97.77%	351	96.96%
Cortex Type												
primary	1	100.00%	0	0.00%	2	100.00%	0	0.00%	8	88.89%	9	75.00%
incipient	0	0.00%	0	0.00%	0	0.00%	0	0.00%	1	11.11%	3	25.00%
Platform Lip												
absent	9	100.00%	204	96.23%	797	96.96%	21	100.00%	432	96.21%	349	96.41%
present	0	0.00%	8	3.77%	25	3.04%	0	0.00%	17	3.79%	13	3.59%
Total	9	100.00%	212	100.00%	820	100.00%	21	100.00%	449	100.00%	362	100.00%

Table B-2. One-way ANOVA and Tukey post hoc analysis of size class variance.

ANOVA

size class

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1379.323	5	275.865	88.299	.000
Within Groups	5595.468	1791	3.124		
Total	6974.791	1796			

Post Hoc Tests Homogeneous Subsets

size class

Tukey HSD[a,b]

2012 Component	N	Subset for alpha = 0.05			
		1	2	3	4
Component 3	820	2.22			
Component 2	209	2.74	2.74		
Component III	337		3.78	3.78	
Component I	19			4.00	
Component II	402			4.07	
Component 1	10				7.30
Sig.		.814	.116	.983	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 36.565.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

Table B-3. One-way ANOVA and Tukey post hoc analysis of weight variance.

ANOVA

weight

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1496.614	5	299.323	11.253	.000
Within Groups	47879.501	1800	26.600		
Total	49376.115	1805			

Post Hoc Tests Homogeneous Subsets

weight

Tukey HSD[a,b]

2012 Component	N	Subset for alpha = 0.05	
		1	2
Component 3	822	.2390	
Component I	19	.8342	
Component II	403	1.1933	
Component III	340	1.3023	
Component 2	212	1.6477	
Component 1	10		10.5430
Sig.		.852	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 36.588.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

Appendix C. Faunal Analysis.

Table C-1. Secondary data values for NISP, MNE, MAU, FUI, and MGUI.

Anatomical Part	NISP	MNE	MAU	%MAU	(S)FUI	%MGUI
Axial skeleton						
cranium	12	4	2.00	0.44	9.10	8.74
maxilla	2	2	1.00	0.22	N/A	N/A
mandible	9	9	4.50	1.00	*31.1	*30.26
premolars (isolated)	5		0.00	0.00	N/A	N/A
molars (isolated)	6		0.00	0.00	N/A	N/A
incisors (isolated)	8		0.00	0.00	N/A	N/A
hyoid	0	0	0.00	0.00	N/A	N/A
atlas	0	0	0.00	0.00	N/A	N/A
axis	0	0	0.00	0.00	N/A	N/A
cervical vert.	4	4	1.00	0.22	37.10	35.71
thoracic vert.	3	3	0.23	0.05	47.30	45.53
lumbar vert.	2	2	0.33	0.07	33.20	32.05
caudal vert.	1	1	1.00	0.22	0.00	0.00
innominate	4	4	2.00	0.44	49.30	47.89
sacrum	0	1	1.00	0.22	0.00	0.00
rib complete	3	3	0.12	0.03	51.60	49.77
P. rib	8	8	0.31	0.07	51.60	49.77
D. rib	3	3	0.12	0.03	51.60	49.77
medial rib	35	2	0.08	0.02	51.60	49.77
sternum	1	1	0.25	0.06	66.60	64.13
Fore limb						
scapula	1	1	0.50	0.11	44.70	43.47
humerus shaft	5	3	1.50	0.33	N/A	N/A
P. humerus	2	2	1.00	0.22	44.70	43.47
D. humerus	3	3	1.50	0.33	36.80	36.52
radio-cubutus shaft	2	2	1.00	0.22	N/A	N/A
P. radio-cubutus	1	1	0.50	0.11	25.80	26.64
carpal	1	1	0.13	0.03	12.70	15.53
metacarpal shaft	9	6	3.00	0.67	N/A	N/A
P. metacarpal	3	3	1.50	0.33	9.00	12.18
D. metacarpal	6	6	3.00	0.67	7.10	10.50

Continued on next page

Anatomical Part	NISP	MNE	MAU	%MAU	(S)FUI	%MGUI
Hind limb						
femur shaft	4	2	1.00	0.22	N/A	N/A
P. femur	1	1	0.50	0.11	100.00	100.00
P. tibia	1	1	0.50	0.11	62.80	64.73
D. tibia	7	7	3.50	0.78	44.10	47.09
astragalus	3	3	1.50	0.33	27.70	31.66
calcaneus	1	1	0.50	0.11	27.70	31.66
metatarsal shaft	11	8	4.00	0.89	N/A	N/A
P. metatarsal	4	4	2.00	0.44	19.50	29.93
D. metatarsal	7	7	3.50	0.78	15.40	23.93
sesamoid	3	3	0.38	0.08	0.00	0.00
P. 1st phalange	11	11	1.38	0.31	8.60	13.72
D. 1st phalange	15	15	1.88	0.42	8.60	13.72
3rd phalange	5	5	0.63	0.14	8.60	13.72
total NISP	**212**					
unknown	147					
Total Specimens	359					

* Assumes that tongue is present.

Table C-2. Meat drying, white grease, and bone marrow data values.

Anatomical Part	%MAU	MDI	WGI	MARROW INDEX
Axial skeleton				
cranium	0.44	1.90		1.00
maxilla	0.22			1.00
mandible	1.00	66.40		5.74
premolars (isolated)	0.00			
molars (isolated)	0.00			
incisors (isolated)	0.00			
hyoid	0.00			
atlas	0.00	88.20		1.00
axis	0.00	88.20		1.00
cervical vert.	0.22	186.70		1.00
thoracic vert.	0.05	311.30		1.00
lumbar vert.	0.07	205.80		1.00
caudal vert.	0.22			1.00
innominate	0.44	196.80		7.85
sacrum	0.22	196.80		7.85
rib complete	0.03	745.40		1.00
P. rib	0.07	745.40		1.00
D. rib	0.03	745.40		1.00
medial rib	0.02	745.40		1.00
sternum	0.06	195.2		1.00
Fore limb				
scapula	0.11	89.50	7.69	1.00
humerus shaft	0.33	18.50		
P. humerus	0.22	18.50	75.46	29.69
D. humerus	0.33	18.50	27.84	28.33
radio-cubutus shaft	0.22	16.40		
P. radio-cubutus	0.11	16.40	37.56	43.64
carpal	0.03		36.47	1.00
metacarpal shaft	0.67	15.50		
P. metacarpal	0.33	15.50	16.47	61.68
D. metacarpal	0.67	15.50	42.47	67.08

Continued on next page

Anatomical Part	%MAU	MDI	WGI	MARROW INDEX
Hind limb				
femur shaft	0.22	17.00		
P. femur	0.11	13.00	26.90	33.51
P. tibia	0.11	13.00	69.37	43.78
D. tibia	0.78	13.00	26.05	92.90
astragalus	0.33		32.47	1.00
calcaneus	0.11		49.96	21.19
metatarsal shaft	0.89	11.20		
P. metatarsal	0.44	11.20	17.88	81.74
D. metatarsal	0.78	11.20	43.13	100.00
sesamoid	0.08			
P. 1st phalange	0.31	67.30	33.59	30.00
D. 1st phalange	0.42	67.30	33.59	30.00
3rd phalange	0.14	67.30	33.59	1.00

Table C-3. Bone density data values.

scan point	Bone Density	observed	expected	%SURVIVORSHIP	elements
DN1	0.55	3	10	0.30	2
DN2	0.57	3	10	0.30	2
DN3	0.55	9	10	0.90	2
DN4	0.57	9	10	0.90	2
DN5	0.57	9	10	0.90	2
DN6	0.31	7	10	0.70	2
DN7	0.36	3	10	0.30	2
DN8	0.61	3	10	0.30	2
CE1	0.19	4	20	0.20	4
CE2	0.15	4	20	0.20	4
TH1	0.24	2	65	0.03	14
TH2	0.27	1	65	0.02	14
LU1	0.29	2	30	0.07	6
LU2	0.30	2	30	0.07	6
LU3	0.29	2	30	0.07	6
IL1	0.20	1	10	0.10	2
IL2	0.49	0	10	0.00	2
AC1	0.27	2	10	0.20	2
PU1	0.46	2	10	0.20	2
PU2	0.24	1	10	0.10	2
IS1	0.41	2	10	0.20	2
IS2	0.16	0	10	0.00	2
SC1	0.19	1	5	0.20	2
SC2	0.16	0	5	0.00	2
RI1	0.26	11	130	0.08	28
RI2	0.25	11	130	0.08	28
RI3	0.40	8	130	0.06	28
RI4	0.24	35	130	0.27	28
RI5	0.14	6	130	0.05	28
ST1	0.22	1	5	0.20	1
SP1	0.36	1	10	0.10	2
SP2	0.49	1	10	0.10	2
SP3	0.23	1	10	0.10	2

Continued on next page

scan point	Bone Density	observed	expected	%SURVIVORSHIP	elements
SP4	0.34	1	10	0.10	2
SP5	0.21	0	10	0.00	2
HU1	0.24	2	10	0.20	2
HU2	0.25	2	10	0.20	2
HU3	0.53	5	10	0.50	2
HU4	0.63	3	10	0.30	2
HU5	0.39	3	10	0.30	2
RA1	0.42	2	10	0.20	2
RA2	0.62	2	10	0.20	2
RA3	0.68	1	10	0.10	2
RA4	0.38	0	10	0.00	2
RA5	0.43	0	10	0.00	2
UL1	0.30	1	10	0.10	2
UL2	0.45	1	10	0.10	2
UL3	0.44	0	10	0.00	2
MC1	0.56	3	10	0.30	2
MC2	0.59	3	10	0.30	2
MC3	0.72	9	10	0.90	2
MC4	0.58	6	10	0.60	2
MC5	0.49	6	10	0.60	2
MC6	0.51	3	10	0.30	2
FE1	0.41	1	10	0.10	2
FE2	0.36	1	10	0.10	2
FE3	0.33	1	10	0.10	2
FE4	0.57	4	10	0.40	2
FE5	0.37	0	10	0.00	2
FE6	0.28	0	10	0.00	2
TI1	0.30	1	10	0.10	2
TI2	0.32	1	10	0.10	2
TI3	0.74	0	10	0.00	2
TI4	0.51	7	10	0.70	2
TI5	0.50	7	10	0.70	2
AS1	0.47	3	10	0.30	2
AS2	0.59	3	10	0.30	2
AS3	0.61	3	10	0.30	2

Continued on next page

scan point	Bone Density	observed	expected	%SURVIVORSHIP	elements
CA1	0.41	1	10	0.10	2
CA2	0.64	1	10	0.10	2
CA3	0.57	1	10	0.10	2
CA4	0.33	1	10	0.10	2
MR1	0.55	4	10	0.40	2
MR2	0.65	4	10	0.40	2
MR3	0.74	7	10	0.70	2
MR4	0.57	7	10	0.70	2
MR5	0.46	7	10	0.70	2
MR6	0.50	7	10	0.70	2
P11	0.36	11	40	0.28	8
P12	0.42	15	40	0.38	8
P13	0.57	15	40	0.38	8
P31	0.25	5	40	0.13	8

Appendix D. Lithic Plates

Figure D-1. Component II bifacial artifacts. Artifacts are not directly associated with any particular feature.

Figure D-2. Component 2 bifacial artifacts associated with Feature 6.

Figure D-3. Microblades recorded at Butte. Bottom row collected during 2012 excavation, all others were recorded in 1984 excavation and are associated with hearth features recorded in Component II.

Figure D-4. Unifacially modified flakes and scrapers. Bottom row was recorded during 2012 excavation, all others were recorded in 1984.

Figure D-5. Late Holocene Component bifaces. Bottom two from 2012 excavation.

Figure D-6. Tchi-thos recorded during the 1984 and 2012 (A: FS# 010-076) excavations.

Figure D-7. (A) copper projectile point and (B) iron bit recorded in Component 3.