LINDA'S POINT AND THE VILLAGE SITE:

A NEW LOOK AT THE CHINDADN COMPLEX AND ARCHAEOLOGICAL RECORD AT HEALY LAKE, ALASKA

A Dissertation

by

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Submitted to the Office of Graduate and Professional Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

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December 2015

Major Subject: Anthropology

ABSTRACT

Interior Alaska's Healy Lake archaeological locality contains a cultural sequence spanning 13,500 years, with some of the oldest known human occupations in Alaska. This dissertation is composed of three investigations presenting new data on the prehistoric archaeology of Linda's Point and the Village site at Healy Lake. Analyses of curated and newly excavated lithic assemblages have allowed a reassessment of culture history, and new assessments of lithic technological organization at Healy Lake and the Alaskan interior.

The first investigation presents a general report for the Linda's Point site, excavated from 2011-2013. Detailed recording has clearly separated the lowest cultural occupations, dating to 13,000-11,000 cal B.P. and associated with a thick paleosol. They contain hearths, debitage, and small triangular points similar to those seen at the Village site. Upper silt deposits contain a variety of lithic tool types among a dense scatter of debitage and bone fragments spanning a wide time range. Linda's Point appears to have been used as a habitation site throughout its history.

The second study presents a technological analysis of toolstone selection and use at Healy Lake, assessing assemblage composition, diversity, and lithic reduction streams at each site. The earliest components show strong similarities with a few differences suggesting longer-term habitation at the Village site. Assemblages show a shift in the Holocene towards primary reduction and use of lower-quality but readily-available local material, suggesting longer occupation times and reduced overall mobility. Local reduction is most prevalent at Linda's Point, indicating potential embedded local resource procurement.

The third study presents a technological analysis and description of Chindadn bifaces from early archaeological sites of interior Alaska, dating 12,000 cal B.P. and older. Convex-based bifaces are unique for informal reduction techniques and minimal evidence of use. Triangular and subtriangular bifaces show diverse reduction characteristics and low rates of hafting wear, suggestive of generalized point tips designed to conserve raw materials in Beringian climates. Concave-based bifaces show intensive flaking, haft element breakage, and abrasion, placing them outside the range of Chindadn biface technology.

DEDICATION

For Healy Lake — its people, its landscape, and its history.

ACKNOWLEDGEMENTS

This list is long, because I have a lot of gratitude to give. If I have neglected anyone, it is not because I've forgotten, but only because there are page restrictions.

Research at the Linda's Point site has been supported by the National Science Foundation under a Dissertation Improvement Grant (Award Number 1216385) and an Arctic Social Sciences Grant (Award Number 1216401), as well as a Wenner-Gren Dissertation Fieldwork Grant, and travel grants from the TAMU Department of Anthropology. Logistical support was provided through NSF by CH2MHill Polar Services. Graduate study by Angela Younie was funded by a TAMU STAR Grant and a PhD Scholarship from the Social Sciences and Humanities Research Council of Canada.

I would like to thank my committee chair, Ted Goebel, as well as my committee members, Kelly Graf, Michael Waters, David Carlson, and Anthony Filippi. As a graduate student, I was lucky to learn, conference, and excavate along with John Blong, Marion Coe, Lyndsay DiPietro, Angela Gore, Annalisa Heppner, Joshua Keene, Joshua Lynch, Jesse Tune, Casey-Wayne Riggs, Heather Smith, and many others.

This work could not have been accomplished without the efforts of multiple excavation crews and student groups. In 2012, our main excavation crew included Evelynn Combs, Lyndsay DiPietro, Angela Gore, Aaron Kinn, Leah Mann, and Melissa Mueller. Between 2011-2014, the project also benefitted from the work of numerous volunteers in the field and laboratory: Caroline Barnes, Emilie Condon-Heck, Lauren Cook, Mandy Cook, Julie Crisafulli, Sara Ford, Daniel Gonzalez, Tyler Graham, Aria

Holmes, Dongwei Niu, and Meng Zhang. Further excavation was conducted during field schools conducted in collaboration with Dr. Kelly Graf of the Department of Anthropology at Texas A&M University, and Kathryn Pendleton and Denise Wartes of the Rural Alaska Honors institute at the University of Alaska, Fairbanks. As well as being amazing colleagues, Carolyn Doe and Christine Fik played vital roles in keeping our field schools fed, educated, and safe.

John Cook helped make collections and data accessible to all by founding the Healy Lake Working Group, of which this research is a part. Charles Holmes and David Yesner kindly provided access to research collections from the University of Alaska, Anchorage. Sam Coffman, Jeff Rasic , Josh Reuther, and Scott Shirar at the UAF Museum of the North facilitated geochemical analyses and access to research collections. Robert Sattler and John Cook helped to edit early drafts of this work, and three anonymous reviewers contributed detailed comments to Chapter II.

Research at Healy Lake would not have been possible without the dedicated efforts of Tom Gillispie and Robert Sattler. Their work opened up new communications between the Healy Lake community and archaeological researchers. Tom Gillispie has acted as overall Linda's Point project manager, coauthor, and most importantly, friend. To Tom — thanks, Pard. I couldn't' have done it without you. Evelyn Combs, a Healy Lake tribal member, has also worked tirelessly to increase community involvement, promote Healy Lake archaeology, and develop continuing research in the area.

My placement in the CSFA program would never have been possible without the support and mentorship of friends and colleagues. In Alberta, Raymond Le Blanc, Robin

Woywitka, Darryl Bereziuk, Brian Rhonagan, and many more set me on the path that led to Healy Lake. The Bodo crew — Yvonne, Jonny, Angela, Tanya, Adam, and Eric — made archaeology fun and kept me both in and out of trouble. In Texas, Jared Miracle shared many discussions of philosophy, culture, research and science. In class and in the field, Heather Smith was with me every step of the way, and I couldn't be prouder to have such an accomplished and amazing friend and fellow CSFA graduate.

Thank you, Sean, for showing me how to find fun and adventure in even the most difficult challenges. And for everything else.

Thank you, Mom and Dad. I would not have had the confidence, stubbornness, or ability to start and finish a PhD program without the love and support of the most wonderful parents a person could hope for. You taught me I could do anything in life I set my mind to. Emily, I am always thinking of you.

Finally, I owe special thanks to the Mendas Chaag Athabascan Tribe at Healy Lake for welcoming me, various research teams, and multiple groups of students into their community. Over the decades, the people of Healy Lake have shared knowledge, friendship, and logistical support that have made possible much greater and more meaningful research than could have been accomplished by outside academics alone. During their lifetimes, Healy Lake elders Fred and Margaret Kirsteatter, Josephine Beaver, and Paul Kirsteatter, Sr., dedicated their work, resources, and traditional knowledge to help shape our understanding of Healy Lake history, and are the first true archaeologists of Healy Lake.

NOMENCLATURE

AOD	Alaska Obsidian Database
BIR	basal indentation ratio for bifaces
BWR	basal width ratio for bifaces
C1	Component 1
C2	Component 2
cal B.P.	calendar years before present (calibrated radiocarbon date)
CZ3	Cultural Zone 3
CZ4	Cultural Zone 4
CZ5	Cultural Zone 5
FET	Fisher’s Exact Test
HLV	Healy Lake Village Site
HRI	hafted retouch index for bifaces
LPEH	Late Pleistocene/Early Holocene
LPS	Linda’s Point Site
MCS	Micro-crystalline silicate
MWR	maximum width ratio for bifaces
TCC	Tanana Chiefs Conference

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CHAPTER I

INTRODUCTION

Interior Alaska figures prominently in the archaeology of Beringia, long interpreted to hold the key to our understanding of Native American origins and earliest prehistory. The Bering Land Bridge, open during the last glacial maximum of the late Pleistocene, was a gateway for Siberian populations to disperse into the Americas. Genetic and linguistic studies support the hypothesis of an Asian migration originating during the late glacial, when warming climates opened pathways for human expansion into Siberia and across the land bridge (Fagundes et al. 2008; Goebel et al. 2008; Gruhn 2006; Kari and Potter 2011; Kemp et al. 2007). While general archaeological continuities on both sides of the modern-day strait support the Beringian migration hypothesis, specific aspects of the Beringian archaeological record remain poorly understood, and archaeological inconsistencies within Alaska continue to complicate this otherwise well-established explanation for Native American origins.

One of the greatest confusions surrounds the relationship of microblade and biface technologies, and their use as cultural markers across Beringia. Microblade technology, widespread in northeast Asia between 20,000-14,000 calendar years ago (cal B.P.) (Goebel 1999; Goebel et al. 2008; Graf 2010; Ineshin and Teten'kin 2011; Mochanov and Fedoseeva 1996; Slobodin 2011), is also found in the oldest known Alaskan occupation at Swan Point dating as early as 14,000-13,700 cal B.P. (Holmes 1998, 2011), and has been proposed to be a suitable marker of early Beringian migrants.

However, early microblades are seemingly rare. Instead, basal components of most early sites in central Alaska and Kamchatka, typically dated between 13,500 and 13,000 cal B.P. are characterized by small, thin teardrop-shaped and triangular points with far fewer correlates in the Siberian archaeological record (Goebel 2011; Goebel et al. 1991; Goebel et al. 2010; Holmes 2011). Given such conflicting patterns, how can we relate late Pleistocene Alaskan archaeology to the Beringian migration hypothesis? Were microblade technologies important for early Beringian migrants, and if so, why are they an uncharacteristic part of most early assemblages?

Exhibiting a unique pattern of microblades and small triangular points assigned to a single component, the Healy Lake Village site may hold the answers to these questions. Inconsistency in the radiocarbon dates between and within excavation levels suggests that a lack of vertical control between arbitrarily defined depth units led to an artificial lumping of separate components (Dumond 2011; Hamilton and Goebel 1999; Hoffecker et al. 1993). Despite these problems, the Village site is the type-site for the Chindadn complex, defined by the presence of small projectile points, microblades, microblade cores, burins, and triangular and teardrop-shaped Chindadn bifaces (Cook 1969, 1996). While the Chindadn complex has been accepted by some as an archaeological entity (Dixon 1985; Holmes 2001, 2011; Potter 2011), it stands in contradiction to the Nenana and Denali complexes proposed to exist in the Nenana River valley. There, Chindadn bifaces are found stratigraphically separated from overlying microblade artifacts. If the stratigraphic context of the artifacts recovered from Healy

Lake Village is questionable, so then is its use to define a controversial grouping of artifacts as a single complex.

This research addresses the many questions that have surrounded Healy Lake since its original study in 1968, returning to Healy Lake to re-assess the controversial Village site assemblage, and contributing new data from the Linda's Point site for correlation and comparison.

History of Study at Healy Lake

The history of archaeological study at Healy Lake extends beyond the appearance of Euro-American academic researchers. Village resident Margaret Kirsteatter was one of the first collectors, breaking Athabascan traditions that made disturbance of ancestral items taboo in favor of the knowledge to be gained from the past (Fred Kirsteatter and Evelyn Combs, pers. comm. 2012, 2013). Along with her son, Fred Kirsteatter, she collected a variety of carved bone, obsidian tools, lanceolate points, debitage, and historic trade items, which attracted the attention of Robert McKennan, the first ethnographer to visit the area in 1962. McKennan returned to the area over the following years to conduct systematic survey. Based on local knowledge and collection, followed by survey and shovel testing with the aid of Fred Kirsteatter, McKennan's team recorded eleven prehistoric and one historic site along the edges of the lake (Cook 1969).

Figure 1. Aerial view of north shore of Healy Lake, facing northwest, with Linda's Point in the foreground, the Village site in the far background, and modern-day Healy Lake Village between them.

Figure 2. Aerial view of the point of land containing the Village site.

The Village site was the largest and most accessible of the Healy Lake sites, located on a point of land only a mile away from the modern Native village (Figures 1 and 2). Shovel tests exposed artifacts across the entire point, and between 1967-1972 John Cook directed excavations at the site under the supervision of McKennan. From over 170 five-foot square (approximately 1.5x1.5 m^2) units, these excavations produced 43,000 artifacts. To address an apparent lack of stratigraphy, Cook excavated in two-inch arbitrary levels. Excavation methods were standard for the early era of subarctic archaeology, and no metric chains or tapes were available in Fairbanks at the time. The legacy of these methods is partly responsible for our limited the ability to interpret Cook's results: sediments were not screened, detailed provenience data was only recorded for artifacts deemed diagnostic at the time, and measurement of arbitrary levels began at the top of the mineral horizon for each unit rather than from a single site datum, so that few vertical controls now exist to compare depth measurements between units.

Much important data collected during the Village site excavation was not used in analysis, and has never been reported. The archaeologists were extremely attentive to detail, and recorded stratigraphic associations, drew profiles, floor maps, feature maps, and artifact sketches, and recorded voluminous qualitative notes. Unfortunately, data collection was not standardized, and field notes occasionally varied widely between units and excavators. Despite some limitations, great interpretive potential remains, as-yet unpublished. Cook supervised the collection of feature matrices, soil samples, and geological specimens, ensured the proper identification of dated charcoal, archived all materials for future research, and conducted flotation analysis for floral remains. He presented a detailed description of the first year's excavation results in his dissertation (Cook 1969), which he expanded over the next few decades in unpublished conference paper presentations. He published small papers providing a site overview, selected artifact descriptions, and an ethnohistoric study (Cook 1968, 1989, 1996, 2011); however, as yet a full excavation report and analysis of the entire site assemblage has not been presented or published.

Cook's dissertation outlines four stages at the Village site, each attributed to a group of arbitrary levels generally associated to the stratigraphic profile, and based on a modified seriation approach: levels with similar ranges of artifacts were grouped together, not as single occupations or moments in time, but as representing repeated occupation during periods of stability in cultural development (Table 1). The greater number of levels in the lowest cultural grouping was attributed to a higher rate of deposition at the end of the Donnelly glaciation.

Following further excavation and intensive laboratory analyses, Cook presented a slight refinement of the data at a series of conferences (Cook 1972, 1980; Cook et al. 1971; Cook and McKennan 1970; McKennan and Cook 1970) as well as a single publication (Cook 1975). Major changes included the identification of teardrop and triangular points as a typological entity, and the redefinition of the earliest cultural horizon as the Chindadn Complex (Table 2). The final published works on the Village site to date are sumarize the historic (Cook 1989) and prehistoric (Cook 1996) assemblages, providing the only site-wide summaries in existence.

Table 1. Cultural Sequence at Healy Lake Village Proposed by John Cook (1969).

Cultural Designation	Level	No. Dates	Range (^{14}C years B.P.)	Artifacts
Athapaskan	1-2	2	810-1440	Convex-based stemmed points, notched points, microblades, Campus core rejuvenation, burins
Tuktu	3	-	-	Convex-based stemmed points, notched points, lack of burins. Microblades are wide with selectivity of medial fragments
Quartzite Horizon	4-5	1	8810-9110	Large, blocky quartzite scrapers and bifaces, endscrapers, lack of microblades
Early Horizon	6-9	1	10,920-11,220	Narrow microblades, blade-like-flakes, generalized bifaces, low amounts of obsidian and high proportions of yellow agate

Table 2. Revised Cultural Sequence at Healy Lake Village Proposed by John Cook (1996).

Cultural Designation	Level	No. Dates	Range (^{14}C years B.P.)	Soil Association	Artifacts
Athapaskan	1–3	13	380–4460	Reddish B2 Horizon	Proto-Athabascan to modern Athabascan cultures: microblades, Campus cores, notched and lanceolate points, notched transverse burins, burin spalls
Transitional	4–5	4	2150–8960	Loess	Few; representative of an in-situ transition to Athabascan cultural systems
Chindadn	6–10	17	8210–11,410	Red to purple paleosol and coarse sand below	Thin triangular- and teardrop-shaped points, lanceolate bipoints, blade and microblade technology. Increased number of hearths and high frequency of bird and small mammal bone compared to upper levels

A major theme of Cook's interpretation was the in-situ development of Athabascan culture over time. The interwoven "motifs" of burin and microblade technology, at Healy Lake and elsewhere in the Alaskan interior, were interpreted to represent a cultural continuity through time since the earliest occupations (Cook 1975), despite other major technological changes, and potential occupational hiatuses indicated by radiocarbon dating. Furthermore, Cook's Chindadn Complex conflicts with many of the other classification schemes presented for Alaska's early prehistory. Chindadn points are not generally interpreted to extend as late as 9500 cal B.P., nor are they thought to be associated with lanceolate projectile points. The Healy Lake site has been cited as potential evidence that these trends are more fluid than previously interpreted (Holmes 2001; Potter 2008b), but has more often been dismissed due to the presence of chronological ambiguities (Bever 2001; Dilley 1998:248; Dixon 1985; Hamilton and Goebel 1999; Holmes 2001; Pontti 1990).

Over the last five years, a land transfer near Healy Lake Village has spurred renewed archaeological study in the region by the Tanana Chiefs Conference (TCC). In collaboration with Texas A&M University (TAMU), TCC has directed and sponsored archaeological testing, excavation, and field school education from 2010–2014 at the Linda's Point site on the northern shore of the lake. The site has been found to exhibit stratigraphic deposition and cultural materials similar to those seen at the Village site, providing an opportunity for comparison between sites.

Figure 3. Excavations at the Linda's Point site, 2013 field season.

Research Questions

Within the context of the current focal questions in Beringian archaeological research, and the history of previous work at Healy Lake, this dissertation has focused on five key specific research goals:

1. To define the geologic and stratigraphic contexts of the occupations at the Linda's Point site. Collaborative geoarchaeological analysis with researchers from the Tanana Chiefs Conference and Baylor University helped to define the depositional and soil development history of the Linda's Point site, and compare it to records from the

nearby Village site. Most importantly, sources of potential stratigraphic disturbance were sought, explored, and mitigated during analysis, when possible.

2. To determine the sequence and age of cultural occupations at Healy Lake. The primary culture-historical goal was to separate the basal component at Linda's Point, and determine whether it represents a single Chindadn-aged occupation. Secondarily, Holocene components were explored to determine whether they can be separated, either stratigraphically or spatially, followed by absolute and relative dating of all occupations. Finally, these occupations were correlated to dates and materials from the Village site.

3. To characterize technological activities and organizational strategies represented in the Chindadn and later assemblages. Lithic technological organization was explored through a variety of avenues. This study assessed the reduction sequences present at Linda's Point and the Village site, hoping to answer questions of how the site's occupants procured, used, and discarded tool-stone. I examined variation in these practices between sites and over time, asking whether lithic technological strategies vary in relation to social and environmental influences.

4. To assess technological organization in response to changing environments. Using the information gathered by addressing the first three research questions, I endeavored to place the results in context to assess site occupation, mobility, and subsistence strategies at Healy Lake. Do changes in these activities through time coincide with climatological variations or the development of lakeshore environments?

Can evidence from other archaeological sites in the region be used to assess wider patterns of environmental adaptations and cultural responses?

5. To consider the scientific results in the context of multivocality and community involvement. We endeavored to include the Healy Lake community in all steps of the archaeological process. Both myself and TCC staff presented research goals, ongoing excavation, site tours, and results to the Village Council at multiple junctures. During these meetings, we discussed community concerns and interests, answered questions about our methods and interpretations, performed site tours, and gained the opportunity to discover a wide range of local knowledge of the region's history and prehistory. TCC employed a youth from Healy Lake village during 2011-2012 archaeological excavations, and community archaeology was practiced with the incorporation of both Native and non-Native Alaskan volunteers and field schools.

Dissertation Outline

This dissertation is organized as a series of independent chapters, linked by a central goal of exploring the meaning of the Chindadn complex and early human occupations in the Alaskan interior. Do archaeological excavations in correlative deposits elsewhere around Healy Lake support the artifact groupings established at the Village site? Can technological analyses, rather than typological analyses, provide insight into the lives and settlement patterns of early Alaskans, expanding our knowledge of human occupations beyond proposed cultural lineages? And how do the enigmatic Chindadn bifaces fit into a larger picture of early Beringian technological activities?

In Chapter II, I present a technical report of recent archaeological excavations at Linda's Point. This chapter addresses research questions 1 and 2 regarding geology and chronology, while touching on questions 3 and 4 regarding lithic technology. Chapter II is published as a coauthored paper (Younie and Gillispie 2016), and is included in the dissertation with the permission of the copyright holder, *Arctic*. I prepared the majority of the paper and figures, including the lithic analysis that makes up the research focus. Sections on the stratigraphy and dating of the site, and Figure 7, were drafted with geoarchaeologist and coauthor Tom Gillispie of TCC.

In Chapter III, I discuss the technological characteristics of occupations at Linda's Point and the Village site, comparing lithic material use and procurement patterns between locales and over time. This chapter focuses on research question 3 in detail, characterizing lithic assemblages and technology, and in turn contributing to aspects of environmental contexts in research question 4.

In Chapter IV, I present a detailed analysis of Chindadn biface technology, assessing aspects of manufacture, use, and discard that might provide clues to their role in Beringian toolkits, and to their disappearance at the beginning of the Holocene. This chapter uses the results of the previous chapters to place the Linda's Point and Village site bifaces chronologically within the entire sample of Chindadn-era bifaces. It addresses a new facet of research question 4, using technological analyses to address a typological question, the meaning of Chindadn bifaces within Beringian cultural adaptive systems.

Finally, I summarize these results in Chapter V, and discuss their relevance to our wider understanding of Beringian prehistory.

CHAPTER II

LITHIC TECHNOLOGY AT LINDA'S POINT, HEALY LAKE, ALASKA[1]

The prehistory of interior Alaska is represented by numerous well-stratified sites concentrated along the major drainage basins of the Tanana and Nenana valleys (Figure 4), many of which are securely dated to the late Pleistocene and early Holocene (LPEH) (Goebel and Buvit 2011; Potter 2008c). With the exception of the unique early component at Swan Point (Holmes 2011), the earliest occupations are approximately contemporaneous with Clovis, the earliest widespread and well-represented archaeological culture to have proliferated south of the continental ice sheets (Waters and Stafford 2007). Intensive excavation, numerous site reports, and geological and paleoenvironmental studies published during the last two decades have broadened our understanding of early Beringian chronology (Potter 2008c; Saleeby 2010). This work is complemented by an emerging literature on Beringian lithic technological organization (Goebel 2011; Graf and Goebel 2009) and faunal subsistence (Potter et al. 2013; Yesner 2007), standing in contrast to more traditional narratives based on typology and the question of a microblade/non-microblade dichotomy (Dumond 2011; Goebel and Buvit 2011). Discussion centers around two general technological forms: bifacial tools and composite osseous tools inset with tiny specialized flakes known as microblades (Elston and Brantingham 2002; Wygal 2011).

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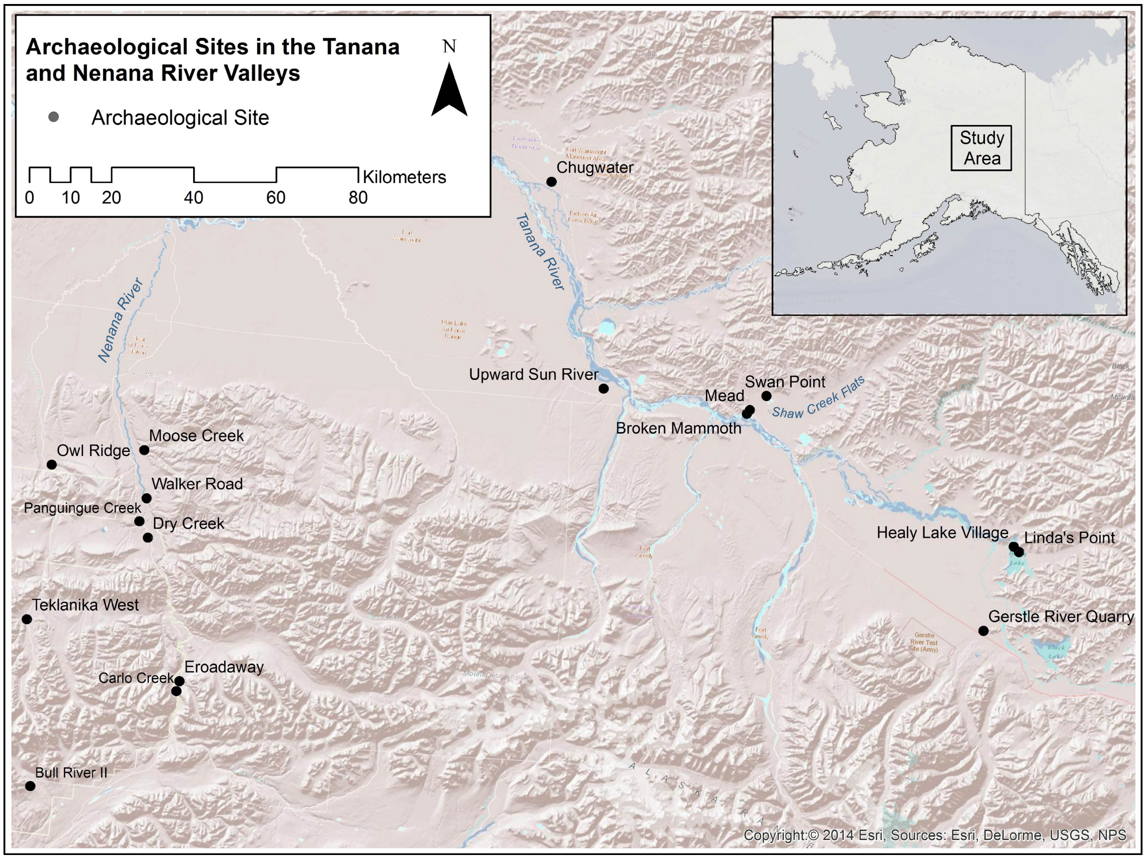

Figure 4. Archaeological sites of interior Alaska dating to the late Pleistocene and early Holocene. Figure created usingArcMap (Esri 2011; Esri et al. 2014b).

In the Nenana valley, a fairly straightforward pattern exists beginning 13,300 cal B.P. Basal occupations at Dry Creek, Owl Ridge, Moose Creek, and Walker Road have been assigned to the Nenana complex based on the presence of blade tools, flake tools, gravers, and small, thin bifacial teardrop-shaped and triangular points (often called Chindadn points), as well as a consistent lack of microblade technology (Goebel 2011; Gore and Graf in press; Hoffecker et al. 1993; Pearson 1999; Powers and Hamilton 1978; Powers and Hoffecker 1989). After 12,750 cal B.P., Chindadn points disappear, and core and blade technologies are replaced by those centered around microblades and wedge-shaped cores, lanceolate bifaces, and burins, assigned to the Denali complex (Powers and Hoffecker 1989; West 1980) and found at Dry Creek (Component 2), Moose Creek (Component 2), Teklanika West, and Owl Ridge (Component 2) (Coffman 2011; Gore and Graf in press; Pearson 1999; Powers and Hamilton 1978). Similarly-aged basal components at Carlo Creek and Panguingue Creek contain Denali-like assemblages, although they lack microblades (Bowers 1980; Bowers and Reuther 2008; Goebel and Bigelow 1996). This toolkit persists throughout the Younger Dryas and early Holocene. Traditionally, the two complexes are interpreted as distinct cultural groups with different technological systems.

Tanana valley cultural sequences are not so clearly separated. The earliest occupations at Swan Point date from 14,440–13,550 cal B.P., representing the earliest known occupation of eastern Beringia, and containing a microblade technology interpreted to be similar to Diuktai in Yakutia, Russia (Holmes 2011; Holmes et al. 1996). After this, the Tanana record shows a pattern similar to that seen in the Nenana valley, with blades and small thin bifaces in early components. However, Chindadn-like points occur as late as 12,000–11,300 cal B.P. at Broken Mammoth and Swan Point, and are potentially associated with microblade technology (Holmes 1996, 2011; Krasinski 2005; Potter 2008b, 2011). These regional inconsistencies have led to the proposition that different technologies signify behaviorally adaptive strategies rather than stylistic or culturally normative choices (Potter et al. 2013; Wygal 2011). Different technological choices may represent variation in climate, seasonality, prey choice, raw-material availability, site use, or a combination of factors (Graf and Bigelow 2011; Rasic 2011). However, despite local temporal differences within the Tanana basin, the overarching pattern remains the same: lanceolate bifaces are notably absent, and microblades and burins are rare prior to the Younger Dryas, after which both are found at Upward Sun River, Healy Lake, and Gerstle River, and farther south in the Tangle Lakes region (Cook 1996; Graf and Bigelow 2011; Potter 2005; Potter et al. 2014; West 1996; West et al. 1996).

The Healy Lake Village site has been referenced as a prime example of the coinciding presence of various technologies during the LPEH in the Tanana valley (Holmes 2001; Potter 2008b). Based on 1967–1972 excavation data, J. Cook grouped basally thinned triangular and teardrop-shaped points, lanceolate bifaces, microblades, wedge-shaped cores, and burins into the Chindadn complex, assigned to a single component dating from 13,500–9150 cal B.P. (Cook 1969, 1996). It has since been questioned whether these materials truly represent a single cultural tradition, or whether instead their apparent co-ocurrence could be attributed to compressed stratigraphy, natural and cultural disturbances, and excavation methods (Dilley 1998:248; Dixon 1985; Erlandson et al. 1991; Hamilton and Goebel 1999). Lack of detailed published information on the site has precluded clear answers.

As part of a series of studies aimed at clarifying the Healy Lake archaeological record, we conducted excavations from 2011–2014 at Linda's Point, an archaeological site located on the northern shore of Healy Lake only 1.8 km east of the Village site (Figure 5). Here we report on our initial results, focusing on our preliminary research goals: summarizing the stratigraphy and cultural chronology of the site, with special focus on the lithic assemblages. Based on spatial and stratigraphic data, we first divide the assemblage into two major components, a lower suite of occupations dating to the late Allerød and Younger Dryas, and upper occupations dating to the early Holocene. We then describe the lithic assemblage of each component. Finally, we discuss changes in lithic procurement and technological organization at the site through time, as well as in a regional context at Healy Lake and in the wider Alaskan interior. Future research goals will build from this work, focusing on more detailed geochronological analysis and assessments of lithic technological organization.

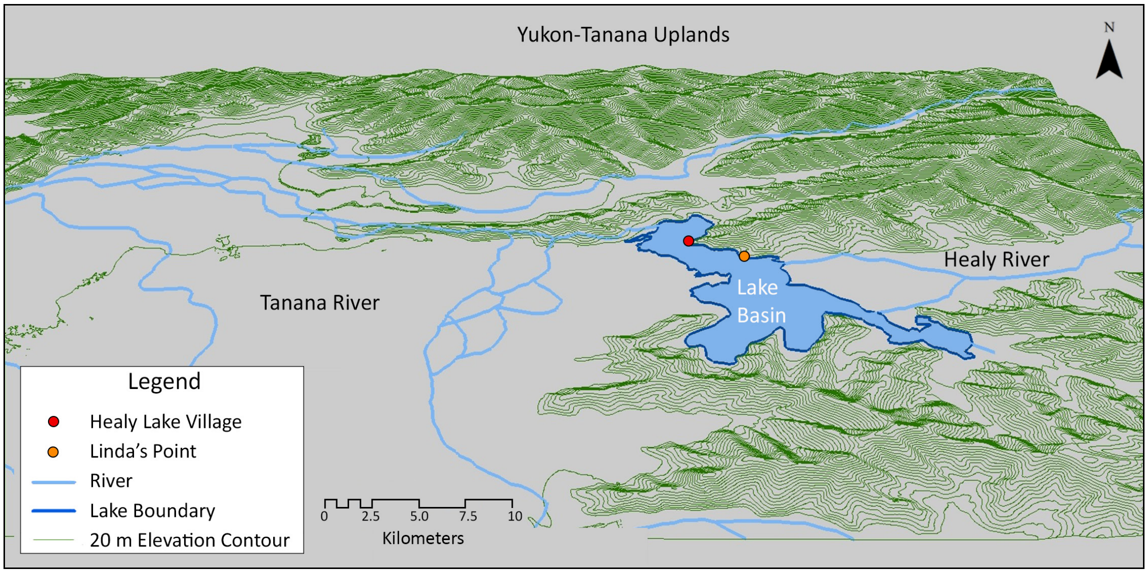

Figure 5. Environmental context of the Healy Lake basin (by Christine A. Fik).

Linda's Point

Local Environment

Healy Lake is one of several water bodies impounded along the east margin of the Tanana River floodplain, where the broad fluvial lowlands intersect the bedrock escarpments of the Yukon-Tanana uplands (Figure 5). The uplands are forested by birch (*Betula papyrifera*), spruce (*Picea glauca* and *P. mariana*), and aspen (*Populus tremuloides*) typical of boreal continental macroclimates. The lake is shallow, with a shoreline dotted by numerous islands, marshes, inlets, ponds, and wetlands where willow (*Salix* spp.) and shrub birch (*Betula glandulosa*) are dominant (Anderson 1975). Today it presents an ideal residential setting, with nearby access to lake and wetland resources, upland hunting overlooks, and intermediary sheltered forests. At the lake outlet, the narrow Healy River snakes through silty overbank deposits and marshland into the Tanana River two kilometers to the west, presenting a major transportation corridor.

The Linda's Point site is located on a series of terraces on the hillside of a wide point of land on the northern lakeshore. Healy Lake is an open-basin system impounded against the foothills of the uplands by a low, natural levee of the Tanana River. The gradient between the lake and the river is slight, and during summer flood events drainage is frequently reversed, causing large volumes of silt-laden water from the Tanana to enter the lake. Over time, this has resulted in the development of a complex delta (Reger et al. 2008:3). Lake levels in nearby closed-basin systems in the Tanana valley fluctuated widely during the LPEH in response to changes in effective moisture

(Abbott et al. 2000; Barber and Finney 2000), but whether Healy Lake followed a similar history is difficult to evaluate due to differing basin geometries and uncertainties surrounding the timing of the Healy Lake impoundment. It may have been initiated by glacio-fluvial alluviation of the Tanana valley during the last glacial maximum (Reuther 2013:441), followed by decreased sediment input and local dissection during the late glacial (Péwé 1977:38). However, the modern Tanana is an aggrading river system, and given the slight elevation of the modern levee, aggradation during Holocene flooding appears equally likely (Anderson 1975; Mason and Begét 1991).

During the time of earliest known human occupation of the region, Beringian landscapes were composed of arid steppe and tundra-like biomes, inhabited by grazing migratory megafauna and influenced by extreme, seasonally variable, and annually unpredictable climates (Bigelow and Powers 2001; Guthrie 2001; Hoffecker and Elias 2007). Available resources and environmental challenges would have been quite different from those influencing ethnographic populations: unsheltered open vistas, predominance of large grazing herd animals, and limited small shrubby vegetation to provide woody materials for dwellings, sleds, basic tools, or fuel (Hoffecker 2005). It is commonly hypothesized that early humans on the open Beringian landscapes practiced higher levels of mobility than seen in ethnographic foraging populations, maintaining lower population densities, residential mobility, a heavy reliance on faunal resources, and seasonally determined patterns of landscape and resource use (Graf 2010; Hazelwood and Steele 2003; Kelly 2003; Meltzer 1995). In contrast, precontact and early-contact era Athabascans of the Tanana region followed patterns of logistical seasonal mobility, following seasonal changes in resource availability. Family groups coalesced into larger bands at summer fishing villages, and dispersed back into smaller foraging parties in the winter when game became more scarce (Helm 1981; McKennan 1959; VanStone 1974). Potter (2008a) hypothesizes that this system of logistical mobility did not develop until increasing population densities and moderating environmental conditions of the Holocene favored semi-sedentary settlement patterns.

Site Excavation

First recorded in the 1960s by local resident Linda Kirsteatter, Linda's Point was provisionally tested in 2005, and systematically between 2010–2014 (Sattler et al. 2011). Testing of the middle terrace in 2010 produced ample concentrations of debitage and bone, flake tools, microblades, a lanceolate biface, and a deeply buried, intact hearth dating to 13,120–12,830 cal B.P. (Beta-293544). From 2011–2013, we excavated twelve 1x1-m units to below the base of cultural deposits (Figure 6), focusing on an area surrounding the hearth to ensure the recovery of early deposits within our sample area. Excavations produced a total of 6164 cultural items. Field methods included data recording of three-point provenience, angle of repose, and stratigraphic context of all artifacts found in situ. All sediments were screened by quadrant and 5-cm level through one-eighth-inch mesh, with mapping and photography of each floor by unit and level. To maximize stratigraphic analysis, we preserved balks 0.5 to 1 m wide between excavation blocks. Shovel tests from the upper terrace have produced an obsidian scraper, obsidian microblade-production debitage, and a deeply buried small discoidal biface. Additional excavation is ongoing in this area, the results of which will be discussed separately upon completion.

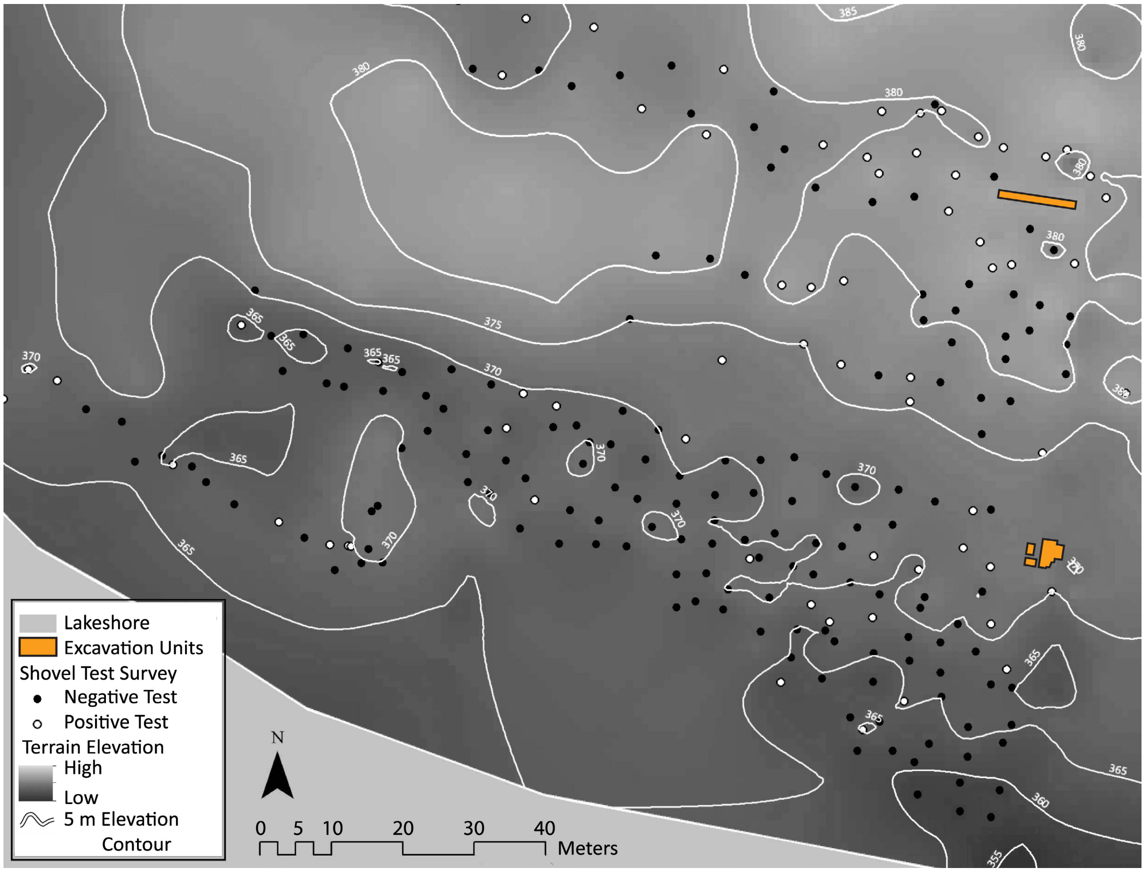

Figure 6. Linda’s Point shovel testing and excavation (by Christine A. Fik).

Site Chronology

The cultural materials from Linda’s Point are separable into two major components, each representing multiple occupations, and a third sparse component found within the modern soil. Artifacts were assigned to components based on their relationship to marker beds and soil horizons observed during excavation, discussed below, as well as through two- and three-dimensional plotting of artifact locations, and the locations of refitted artifacts. Of 30 refits, 27 are among artifacts from the same component, while three reflect intrusive disturbance by a pit feature in the northwest area of the excavation. Further excavation of a wider sampling area may allow for identification of individual occupations within the two main components.

Delineation of geoarchaeological strata was conducted by one of the authors (Gillispie), combining the assessment of site-formation processes and geochemical and micromorphological assessments of depositional activities, details of which will be reported separately. Briefly, there are ten major sedimentary deposits distinguishable, containing two major paleosols and reaching 130 cm in total depth (Figure 7). The depositional sequence is similar to that seen at other sites in the Tanana valley, most notably Swan Point (Hamilton and Goebel 1999; Holmes 2001, 2011; Reuther 2013). Resting on schist bedrock and frost-shattered schist regolith (Bed 1), containing quartz ventifacts (Bed 2), are three late-glacial eolian sand deposits (Beds 3 through 5) totaling 40–60 cm thick. They are overlain by a series of loess deposits (Beds 6 through 8) totaling 50–70 cm thick. The lowest (Bed 6) is 15–20 cm of sand-loess containing two paleosols, lower PS1 and upper PS2. Fine loess above the paleosols contains two slightly overlapping zones of thermal contraction, each 15–30 cm thick. The upper zone (Bed 8) contains fine cracks of Holocene origin, while the lower zone (Bed 7) is assigned to the early Holocene, and contains a network of iron-clay lamellae and soil wedges, relicts of infilled thermal contraction cracks developed during seasonal permafrost freeze-thaw cycles (French 2007). Finally, the top 5–10 cm of the section contain a weakly developed A horizon composed of organic silt (Bed 9) overlain by a thin organic horizon of roots and leaf litter (Bed 10).

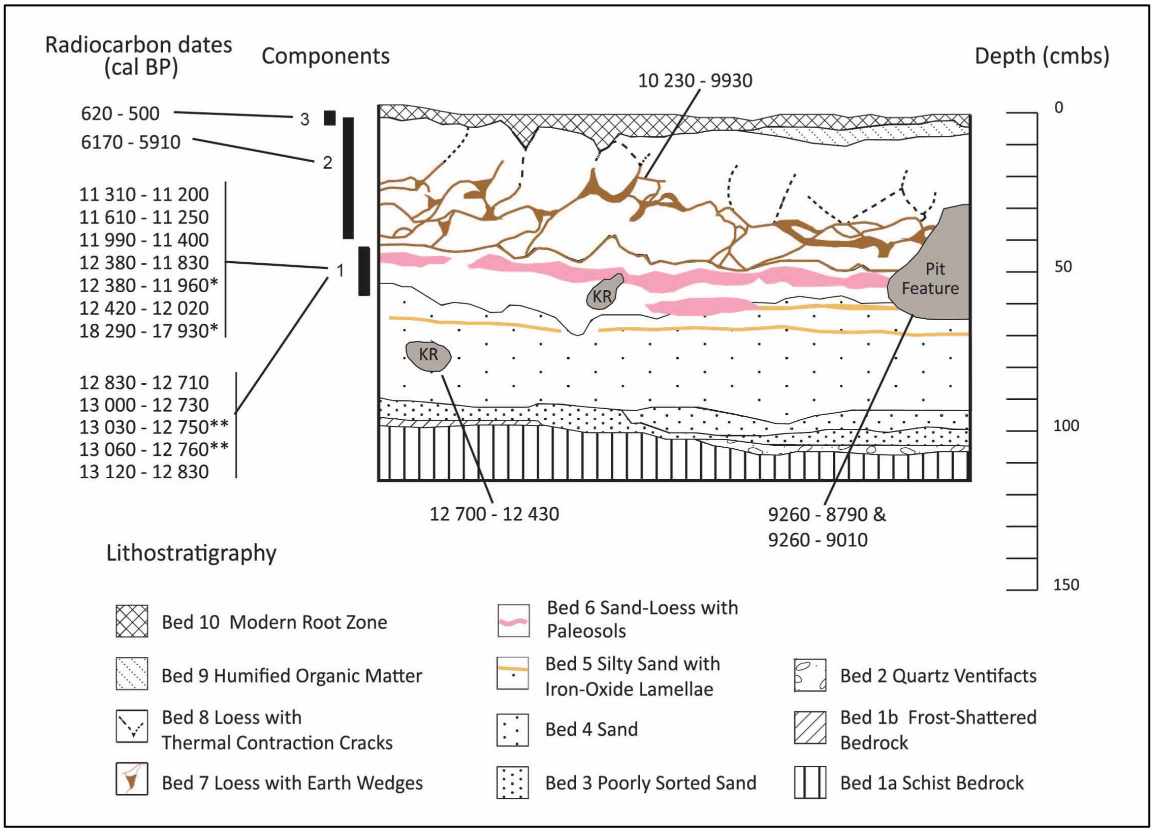

Figure 7. Generalized stratigraphic profile at Linda's Point (split-sample dates noted by * and **).

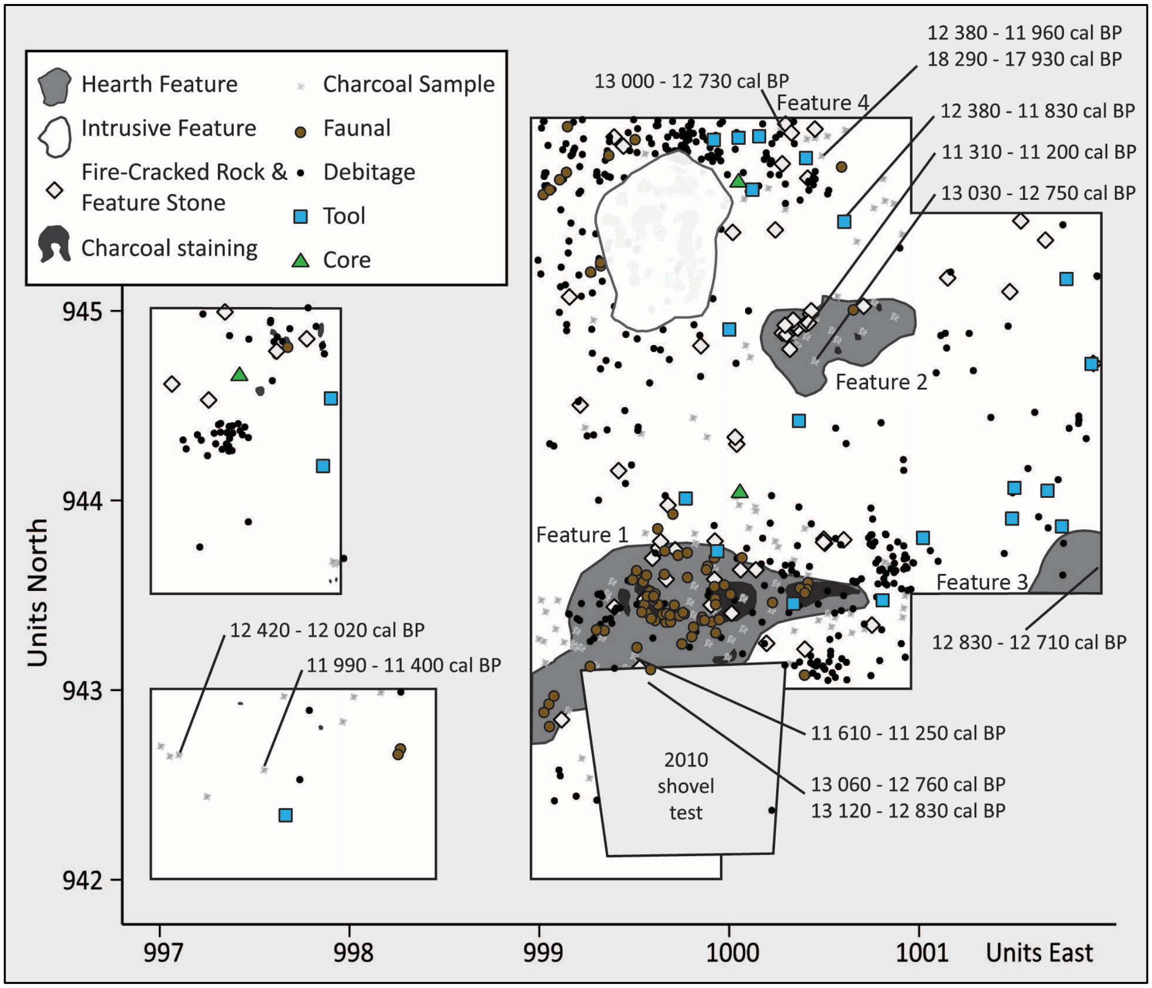

Figure 8. Artifact and feature distributions within C1.

The earliest cultural occupation is represented by a horizon of lithic artifacts, bone fragments, manuports, and four closely-spaced features (Figure 8). These are assigned to Component 1 (C1), found either resting on the PS2 surface, or impressed into the underlying silt-loess. Artifacts from C1 are mainly oriented horizontally, with an average maximum resting angle of 25.3 degrees from the horizonal, indicating minimal post-depositional disruption. Two hearths are represented by reddened soil, fire-cracked rock, and high concentrations of burnt and calcined bone, and the third is visible as charcoal and reddened soil in the eastern wall of the excavated block, associated with heat-reddened quartz. A fourth feature of unknown function is visible as an area of disrupted paleosol in the north wall of the excavation block, with associated stones, artifacts, and a light scatter of charcoal. Preliminary identification of bone fragments indicates the presence of large-mammal vertebrae and longbone shaft fragments.

Eleven charcoal samples, including two split samples, from C1 hearths and dispersed contexts have provided thirteen dates ranging between 18 200 and 11,200 cal B.P. (Table 3). Eleven of these fall between 13,100 and 11,200 cal B.P. and likely represent the age of C1. Of the remaining two, one is a small sample of *Salix* charcoal collected from the stone feature near the northern wall (Beta-378556) that yielded an aberrant date of 18 340–17 930 cal B.P., which we reject based on a split from this sample (UGAMS-18995) that provides a stratigraphically consistent result of 12,380–11,960 cal B.P. The discordant date is potentially attributed to laboratory error or anomaly, while the consistent date of the split supports acceptance of the sample within the site chronology. A twelfth date (Beta-343988), collected from below C1 in mid-Bed 5, yielded a discordantly late date of 12,700–12,430 cal B.P. Subsequent excavation revealed the sample location to be an in-filled, charcoal-containing rodent burrow, and we interpret that the sample and date should be rejected as having been displaced from the overlying C1.

Table 3. Radiocarbon Dates from the Linda's Point Site.

Laboratory ID No.	Comp-onent	Stratum	Charcoal ID	Conventional Radiocarbon Age	$\delta^{13}C$	2σ Date (cal B.P.)[a]
Beta-343989	3	Bed 9 hearth feature		510 ± 30	-24.8	620-610; 550-500
Beta-395435	2	Bed 8		5220 ± 30	-24.5	6170-6160; 6100-6080; 6010-5910
Beta-361630	2	intrusive feature	*Salix* sp.	8110 ± 50	-25.4	9260-8980; 8910-8900; 8880-8870; 8830-8790
Beta-361631	2	intrusive feature	*Salix* sp.	8160 ± 50	-24.4	9260-9010
Beta-314661	2	Bed 7/8 contact		8970 ± 40	-26.8	10,230-10,120; 10,070-9930
Beta-378554	1	Bed 6 feature 2	*Salix* sp.	9840 ± 40	-25.9	11,310-11,200
Beta-378555	1	PS2, Bed 6 feature 1		9960 ± 40	-25.0	11,610-11,520; 11,500-11,250
Beta-372906	1	Bed 6		10,110 ± 60	-25.6	11,990-11,400
Beta-343986	1	Bed 6		10,290 ± 40	-24.3	12,380-12,330; 12,310-12,270; 12,240-11,940; 11,890-11,830
UGAMS-18995[b]	1	Bed 6 feature 4		10,310 ± 30	-25.2	12,380-12,340; 12,300-12,280; 12,240-11,960
Beta-378556[b]	1	Bed 6 feature 4	*Salix* sp.	14,900 ± 50	-24.5	18 290-17 930
Beta-372905	1	Bed 6	*Salix* sp.	10,370 ± 50	-26.2	12,420-12,020
Beta-343988	-	Bed 5 *krotovina*		10,600 ± 50	-23.3	12,700-12,520; 12,490-12,430
UGAMS-18996	1	Bed 6 feature 3		10,930 ± 30	-25.8	12,830-12,710
Beta-372911	1	PS2, Bed 6 feature 4	*Salix* sp.	10,990 ± 50	-23.5	13,000-12,730
Beta-343987	1	Bed 6 feature 2		11,030 ± 50	-23.8	13,030-12,750
Beta-293543[c]	1	Bed 6 feature 1		11,050 ± 60	-25.2	13,060-12,760
Beta-293544[c]	1	Bed 6 feature 1		11,150 ± 60	-24.8	13,120-12,830

[a] calibrated with CALIB v 7.0.2 using the IntCal 13 calibration curve (Reimer et al. 2013)

[b], [c] split samples

The ten accepted samples show a range of ages indicating a palimpsest of terminal Pleistocene occupations with re-use of hearths and surrounding activity areas. Temporal clustering suggests that C1 may be divided into two main occupation intervals: one dating from 13,100–12,700 cal B.P. and another from 12,400–11,200 cal B.P. While the artifacts themselves cannot be divided into separate occupations, further excavation may isolate activity areas, allowing a partial separation.

Above the paleosols, a 10–15-cm layer of culturally sterile loess separates C1 from a younger series of occupations. Component 2 (C2) is a dense cloud of bone and lithic artifacts within stratigraphic beds 7 and 8, and seems to represent multiple palimpsest occupations dating into the Holocene. Bone fragments are scattered throughout the upper deposits rather than concentrated in features, with a few items identified preliminarily as small mammal. Dispersed charcoal dating to the early Holocene (10,100 cal B.P., Beta-314661) was found closely associated with large fragments of quartz debitage from the middle-lower portion of the C2 artifact cloud, marked by the transition between beds 7 and 8. This component is also represented by a pit feature, containing a fill of silt, flakes, and high concentrations of well-preserved wood charcoal dating around 9200 cal B.P. It originates near the base of Bed 8 and extends into Bed 5. Artifacts from within the fill were refitted to artifacts from undisturbed sediments of both C1 and C2, indicating the intrusive feature was dug into the lower deposits and then infilled with a mixture of old and new deposits. Finally, a dispersed charcoal sample from near the top of the artifact cloud within Bed 8 dates around 6,100 cal B.P. Based on this information, C2 likely includes a wide range from 10,200 to 5900 cal B.P.

Charcoal from a hearth feature in the wall just below Bed 10 dates to approximately 550 cal B.P., representing a potential Component 3, which was not included in the present analysis due to the sparseness of artifacts just below the organic horizon.

Piece-plotted artifacts were assigned to each component based on their direct spatial and stratigraphic location, while screened artifacts were assigned to component based on the stratigraphic associations of the quadrant and level from which they were excavated. Ambiguous stratigraphic contexts such as rodent burrows, the pit feature, and quadrants containing multiple potential stratigraphic associations were not ascribed to a component (NA), and their artifacts were omitted from analysis.

Research Methods

One of the authors (Younie) conducted lithic analysis of the excavated assemblage from Linda's Point. Lithic materials were divided into tools and debitage, with marginally modified flakes assessed in both categories. Formal tools were photographed, classified and described following standard methods. Bifaces were classified as hafted versus unhafted, with descriptions for outline, flaking, abrasion, fracture patterns, and reduction stage following Andrefsky (2005). Flake tools were classified based on characteristics of the working edge, and described based on outline, retouch type and location, and fracture patterns, again following Andrefsky. Microblade tools and debitage are described collectively to evaluate the full microblade reduction sequence.

Complete and proximal debitage was classified by type based mainly on platform characteristics, with additional information according to shape, size, and dorsal flake-scar characteristics following standard technological analysis (Andrefsky 2005:120-127). Simple core-reduction flakes were identified as having non-acute platform angles, wide bodies, and wide or crushed platforms, with more robust percussion bulbs, ripple marks, éraillure scars, and hinged, stepped, or broken terminations. Retouch flakes included pieces resulting from thinning and trimming retouch. Flakes with acute angles, feathered terminations, and lipped platforms were classed as thinning flakes, and smaller items with narrow pressure-flaked platforms as trimming flakes. Trimming flakes were further distinguished as unifacial, with single-faceted platforms and sharp curvature, or bifacial, with multifaceted platforms and lower curvature (Andrefsky 2005). To provide accurate minimum flake counts, complete pieces and proximal fragments were assessed collectively as “proximal flakes,” while distal and medial fragments were grouped as unidentifiable flake fragments. All debitage was assigned to size classes in 1-cm increments, based on maximum dimension. For the purposes of our discussion, primary-reduction debitage includes those pieces relating to core reduction and flake production, including cores, cortical spalls, simple flakes, and shatter. Secondary-reduction debitage includes those pieces relating to tool shaping and edge working, including unifacial and bifacial thinning and trimming flakes, burin spalls, and other specialized flakes.

Toolstone types were classed through visual examination of grain size, luster, and color under 15x magnification. To identify geographic sources for obsidian and rhyolite and to differentiate ambiguous materials, we conducted pXRF analysis of geochemistry using a Bruker Tracer III-V at the University of Alaska Museum of the North, following methods described by Phillips and Speakman (2009). We assessed all obsidian pieces over 1 cm in diameter, as well as a sample of cortical and non-cortical rhyolite tools and debitage. Obsidian sources were assigned with reference to the Alaska Obsidian Database (Reuther et al. 2011), and rhyolite sources with reference to work by Coffman and Rasic (Coffman and Rasic 2015).

Lithic Assemblages

Lithic tools and debitage make up the majority of the Linda's Point archaeological materials (Table 4), followed by mainly small, fragmentary faunal remains, and finally larger pieces of fire-cracked rock (FCR), unmodified cobbles, and blocks of schist and quartz bedrock manuports used in hearths or other features. Overall, the upper and lower components share basic similarities, such as high proportions of debitage, and low numbers of cores and tools. C1 differs distinctly in the relatively high frequency of schist and quartz feature stones, reflecting a high density of hearth features.

Raw Materials

The Linda's Point assemblage exhibits a diversity of lithic materials, with ten raw-material classes represented (Table 5). The majority are a variety of crypto-crystalline silicates, divided into fibrous chalcedony, granular cherts, and microcrystalline silicates (MCS) distinguished by coarser grains visible under a hand lens. Macro-crystalline quartz is common as quartz cobbles and ventifacts, as well as a few rare quartz crystal and quartzite artifacts. Igneous materials present at the site include mainly rhyolites and basalts, some obsidian, and a few coarser andesites classified under "other."

Table 4. Cultural Materials from Linda's Point by Component.

Artifact Types	Lower (C1)	Upper (C2)	Recent (C3)	NA	Total
Debitage	1140	3394	25	296	4855
Faunal Remains	456	488	2	77	1023
Fire-Cracked Rock	106	13	1	4	124
Flake Tool	9	25	-	2	36
Microblade	-	34	-	2	36
Retouched Flake	9	18	-	-	27
Biface	8	17	-	-	25
Core	3	16	-	1	20
Feature Stone	13	1	-	1	15
Cobble	1	1	-	-	2
Floral Remains	-	1	-	-	1
Total	1745	4008	28	383	6164

Local lake beaches, streams, and rivers are sandy with few cobbles or pebbles available other than quartz and schist bedrock. Quartz is locally present as marginally knappable blocks of irregular crystal size, found in bedrock outcrops along the shores of the lake, and as ventifacted cobbles at the base of the soil profile. There is a distinct difference between the two components in the use of this local toolstone, with quartz making up only 11% of the C1 lithic assemblage compared to 41% in C2. Quartz crystal is reported by local residents to have been collected in the uplands north of the lake.

Table 5. Toolstone Types from Linda's Point.

Lithic Material	Lower (C1)	Upper (C2)	Recent (C3)	NA	Total
Quartz	130	1421	16	116	1683
Rhyolite	161	860	3	53	1077
Chert	389	491	2	52	934
Chalcedony	289	452	-	35	776
Argillite	116	63	2	29	210
Basalt	84	34	-	3	121
Obsidian	1	86	1	5	93
Other	6	55	-	4	65
MCS	14	22	1	6	43
Quartz Crystal	2	24	-	-	28
Total	1192	3508	25	303	5028

Obsidian in C2 is sourced to Wiki Peak and Baza Tena (Table 6), two of the most common sources in the region, located over 300 km from the site to the southeast and to the northwest, respectively (Cook 1995; Reuther et al. 2011). C1 contains a single piece of obsidian, a concave-based projectile point (Figure 9a). It closely matches the rare obsidian group CC, currently known to include this artifact and ten pieces from the Trapper Creek Overlook site in the Susitna valley of southcentral Alaska: five pieces from the early Holocene component I, and five from the middle Holocene component II, including a microblade (Rasic 2015; Wygal and Goebel 2012).

Five major rhyolite source groups are represented at Linda's Point (Table 6). Although their exact origins are at this time unknown, they also occur at the Village site (S. Coffman, pers. comm. 2014). At Linda's Point, C1 is characterized by groups E and F, while C2 rhyolite derives mainly from the more widespread A and B groups. The rhyolite groups are not identifiable by color; based on artifacts with color mottling and refitted pieces of varied colors, it seems color differences are more likely related to internal variations, soil staining, weathering, or heat treatment.

Table 6. Items Assigned to Lithic Source Groups at Linda's Point.

Source Group	Lower (C1)	Upper (C2)	NA	Total
Obsidian				
A (Wiki Peak)	0	7	0	7
B (Baza Tena)	0	15	0	15
Unknown	1	0	0	1
Rhyolite				
A	1	14	4	19
B	0	13	0	13
E	3	0	0	3
F	3	1	0	4
H	0	2	0	2
Total	8	52	4	64

Component 1

Component 1 displays fairly even counts of bifaces and flake tools (Table 7), with a heavy emphasis on cherts and chalcedonies in the debitage, and an even greater emphasis on chalcedony used for formal tools (Table 8).

Table 7. Tools from Linda's Point.

Tool Type	Lower (C1)	Upper (C2)	Total
Biface Tool	*8*	*17*	*25*
Unfinished Biface Fragment	3	10	13
Unhafted Biface	1	4	5
Hafted Biface	4	3	7
Flake Tool	*9*	*25*	*35*
Unknown	0	8	8
Combination Tool	2	5	6
Side and End Scraper	0	4	4
End Scraper	2	2	4
Scraper	1	0	3
Intensively Retouched Flake	3	1	3
Side Scraper	0	2	2
Burin	0	2	2
Notch	1	0	2
Knife	0	1	1
Total	17	42	60

Table 8. Linda’s Point Debitage and Tools by Material Type (continued next page).

Flake Type	Argillite		Basalt		Chert		Chalcedony		MCS	
	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2
Proximal Flake										
Retouch Flake	53	21	25	13	133	177	105	161	3	14
Simple Flake	3	3	6	1	10	32	7	14	2	1
Bipolar Flake										
Cortical Spall						2				
Technical Spall						4				
Core Rejuvenation Flake						1				
Flake Fragment										
Flake Fragment	56	38	51	19	224	218	166	266	9	6
Shatter			1		13	7	1	1		
Potlid					1	1				
Microblade										
Microblade		1				24		3		1
Microblade Core						1		1		
Technical Spall						1				
Cobble										
Core						2				
Marginally Retouched Flake	2				5	5	2			
Formal Tool	2		1		2	16	8	6		
Total	116	63	84	33	388	491	289	452	14	22

Table 8 Continued.

Flake Type	Obsidian		Other		Quartz		Quartz Crystal		Rhyolite		Total	
	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2
Proximal Flake												
Retouch Flake		47	1	10	5	70			64	251	389	764
Simple Flake		7		8	14	167		3	9	93	51	329
Bipolar Flake					1	14		1			1	15
Cortical Spall					8	4				1	8	7
Technical Spall						1				1	0	6
Core Rejuvenation Flake										1	0	2
Flake Fragment												
Flake Fragment		30	4	36	53	635	2	14	84	480	649	1742
Shatter					23	498		5	2	13	40	524
Potlid						3			1	2	2	6
Microblade												
Microblade										1	0	30
Microblade Core											0	2
Technical Spall											0	1
Cobble				1	1						1	1
Core					3	10		1		3	3	16
Marginally Retouched Flake		2				9				2	9	18
Formal Tool	1				2	8			1	12	17	42
Total	1	86	5	55	110	1419	2	24	161	860	1170	3505

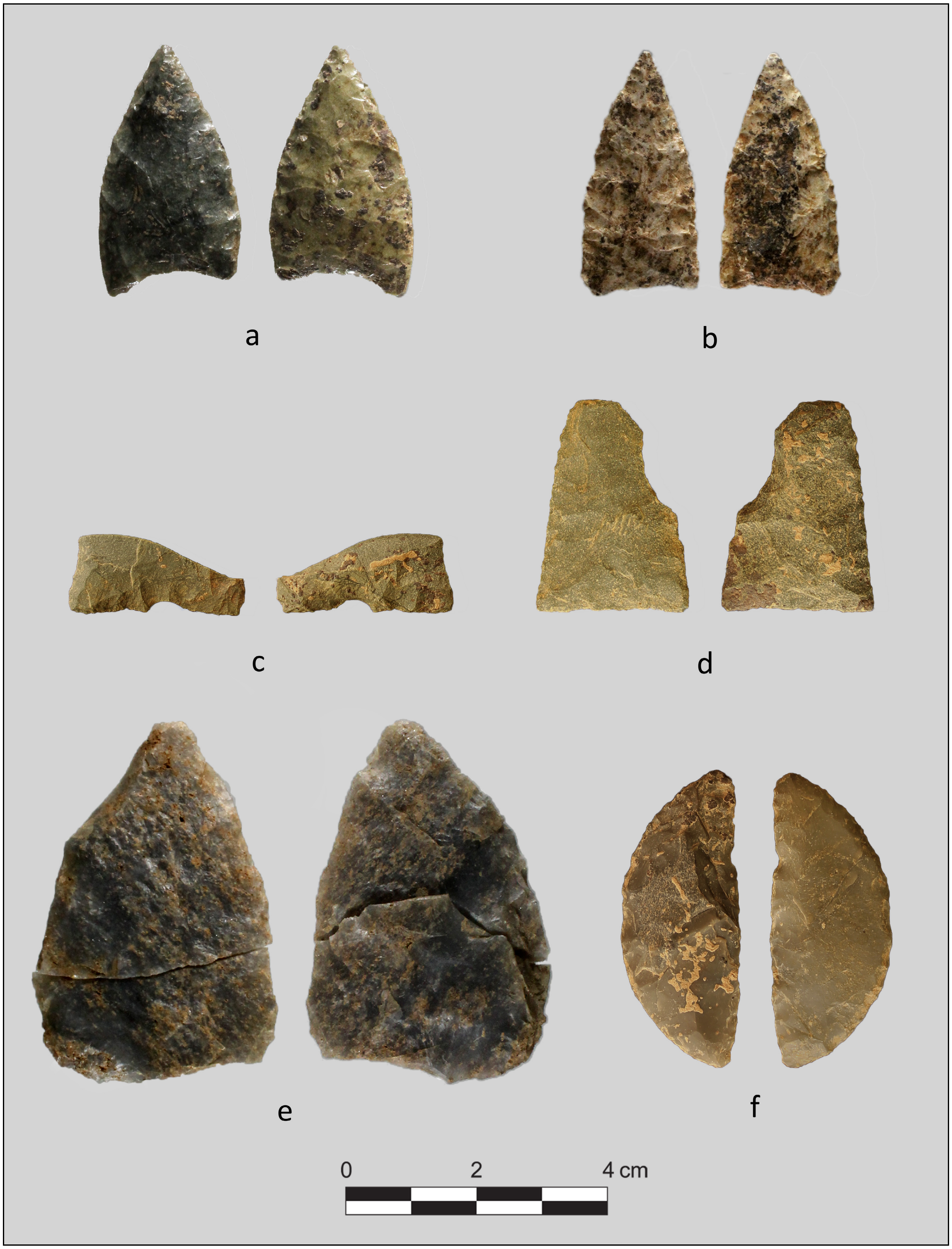

Figure 9. C1 bifaces:(a-b) complete triangular points; (c-d) basal fragments of triangular points; (e) refitted unfinished biface; (f) crescentic biface.

Bifacial Tools

C1 contains four complete bifaces and four biface fragments. These include two finished hafted bifaces and two bases, a nearly complete mid-stage preform refitted from two fragments, a complete crescentic biface, and an unfinished edge fragment (Figure 9). With the exception of the latter two items, all are consistent with the central Alaskan Chindadn biface type.

A complete subtriangular, concave-based point of opaque green-brown obsidian is the most striking of the bifaces (Figure 9a). It is extensively worked, with finely feathered and stepped straight and oblique parallel flaking, as well as light edge-grinding, and abrasion along the basal and proximal lateral margins. Parallel basal thinning flakes extend from both faces of the basal margin, obscuring prior thinning flakes on the proximal half of the point. The margins are smoothly convex and symmetrical, while one corner of the base is longer than the other, potentially indicating reworking of a broken corner. As discussed above, its geochemical signature is rare for Alaska.

The second complete biface is very thin, triangular in outline, and lenticular in cross-section, extensively but irregularly flaked on Group A rhyolite (Figure 9b). Lateral margins are slightly convex and asymmetrical. Edge-grinding is present along the margins, and obscured by light abrasion near the proximal end.

Two straight-based fragments of green argillite were found at the same elevation but horizontally about 1 m apart. Their basal-corner angles are slightly acute, indicating they are likely fragments of triangular points. Both exhibit short, narrow, feathered basal-thinning scars. The shorter fragment is broken just above the base in a rolling snap fracture (Figure 9c), and it has a shallow notch on the basal margin created by a smaller fracture. The larger fragment exhibits fine, shallow, straight parallel flaking and straight, regular margins, with light hafting abrasion near the base. The distal end is unusually thick and has been fully reworked, obscuring any previous breakage with a steep, concave scraping edge (Figure 9d).

The refitted biface is on a semi-translucent, pitted and irregular gray chalcedony that appears to have broken during manufacture (Figure 9e). The two pieces were found at the same elevation, approximately 40 cm apart horizontally, and conjoin at a heavy rolling hinge off the stepped termination of a few wide thinning flake scars. Another fragment of the same material (Figure 10i) was found 2 m away at a similar depth below surface. It is small with minimal flaking and appears to have been broken along an incipient flaw in the material.

The final biface is a bi-marginally retouched tool on a thin gray chert flake, semi-circular and crescentic in outline (Figure 9f). The reduction approach is similar to that seen on many teardrop-shaped Chindadn points: marginal and unpatterned, with a few remnant dorsal scars and stepped thinning flakes not crossing the entire artifact. A small patch of stream-rolled cobble cortex is visible on the dorsal face; however, the artifact has been sufficiently reduced to completely obscure the original flake platform. No edge-grinding or abrasion is visible on the margins, but there is light stepped use-wear towards the center of the convex edge.

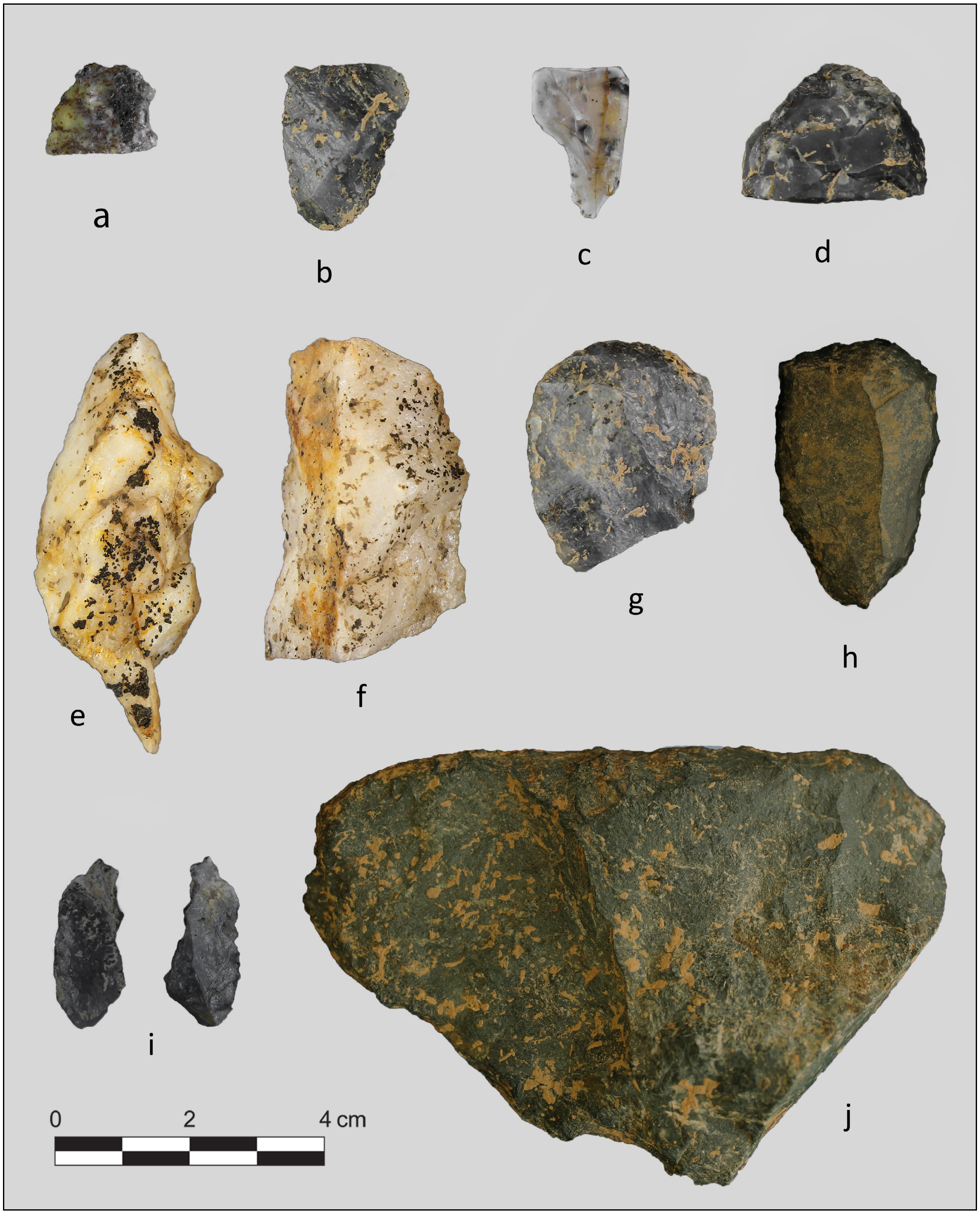

Figure 10. C1 flake tools and biface fragment: (a,c) combination tools; (b, d, f) heavily retouched flakes; (e) notch; (g,h) end scrapers; (i) biface edge fragment; (j) large basalt scraper.

Flake Tools

C1 flake tools (n=9) are mainly small, fairly informal fragments of scrapers and heavily edge-retouched flakes (Table 7). Of the three complete items, the largest is a thick basalt side scraper on a robust flake (Figure 10j). It appears to have been heavily used so that the ventral face was abraded smooth along the working edge, accompanied by a few macroscopically visible striations perpendicular to the working edge. Two smaller end scrapers, one of chalcedony (Figure 10g) and the other of chert (Figure 10h), exhibit steep unifacial retouch and heavy use wear, as well as moderate to light shaping of the lateral margins.

The remaining flake tools are more expedient, on the border between formal tools and marginally retouched flakes. The largest are two robust quartz tools on thick blocky flakes, steeply retouched with extensive use damage on both lateral margins. One exhibits yellowed cortex (Figure 10f), while the other exhibits a wide, steep notch near the distal end (Figure 10e). Of the smaller tools only one is compete, a small triangular flake on gray chalcedony, with distal flaking to create a straight, shallow scraping edge (Figure 10b). A second retouched flake is on a cortical spall of dark gray chert, exhibiting patches of stream-rolled cobble cortex and steep use-wear on both margins, terminating in step fractures along natural fracture planes in the dorsal cortex (Figure 10d). The tool exhibits light use-wear and is broken, apparently through heavy bipolar impact. The final two items are classified as combination tools due to the presence of multiple working edges, both on small delicate flakes of toolstone rare to the collection. One is a notched graving tool on a distal flake fragment of cream-colored chert, with two small spurs, one at the snapped edge and the other on the other end of the notch (Figure 10a). The other is clear chalcedony, and also exhibits retouch on a snapped edge, with use-damage on the proximal and distal broken corners (Figure 10c). As well as the formal tools, an equal number of marginally retouched flakes of a variety of materials are present, most of which are fragmentary (Table 8).

Debitage

The C1 debitage assemblage contains 1152 items and is dominated in numbers by flake fragments and secondary retouch flakes of chert and chalcedony (Table 8). By weight, the assemblage is represented mainly by quartz and marginally also by chert (Table 9). Although shatter, cores, cortical spalls, a single cobble, and single bipolar flake are present, they make up only 4.7% of the debitage, and the majority of these items (63%) are quartz. Simple flakes make up another 4.4% and are dominated by quartz, chert, and chalcedony. Overall, the debitage is extremely small. Removing the cores and cobbles from the sample, the debitage has an average weight of .64 g, while 93% of the debitage measures less than 2 cm and 67% measures less than 1 cm in maximum dimension.

Flake characteristics support the classification of the C1 assemblage as representing mainly secondary reduction activities (Figure 11). There is almost no cortex in the assemblage, and 90% of proximal flakes exhibit multiple remnant flake scars on the dorsal surface, with an average count of three. Overall, flake platforms are either smooth or complex with very few cortical or collapsed platforms, indicating an absence of heavy early-stage percussion. Further, 80% of the smooth platforms in the assemblage are accounted for within the retouch debitage, indicating secondary-stage reduction of unifacial flake tools. Of the proximal retouch flakes, 215 (57%) have complex platforms likely relating to biface reduction, compared to 153 (43%) with simple platforms, more likely related to unifacial reduction.

Only three cores are present in the C1 assemblage: two amorphous, unprepared unidirectional cores and a bipolar core, all on quartz with multiple cortical surfaces. With an average weight of 311 g and an average maximum dimension of 102.5 mm, they represent some of the largest pieces in the assemblage, and yet they are only informally reduced, with few faces and only four to seven flake scars per piece.

Table 9. Counts and Weights for all Debitage, Including Cores and Retouched Flakes, Except Cobbles.

Material Type	**Count**			**Weight**		
	C1	**C2**	**Total**	**C1**	**C2**	**Total**
Argillite	114	63	177	23.0	15.9	38.9
Basalt	83	33	116	22.1	2.4	24.5
Chert	386	475	861	49.6	279.9	329.5
Chalcedony	281	446	727	23.7	33.9	57.6
MCS	14	22	36	5.7	8.5	14.2
Obsidian		86	86	.0	5.6	5.6
Other	5	54	59	.0	22.8	22.8
Quartz	107	1411	1518	1522.4	3176.7	4699.1
Quartz Crystal	2	24	26	.1	7.2	7.3
Rhyolite	160	848	1008	28.3	180.4	208.7
Total	*1152*	*3462*	*4614*	*1697.4*	*3733.3*	*5408.2*

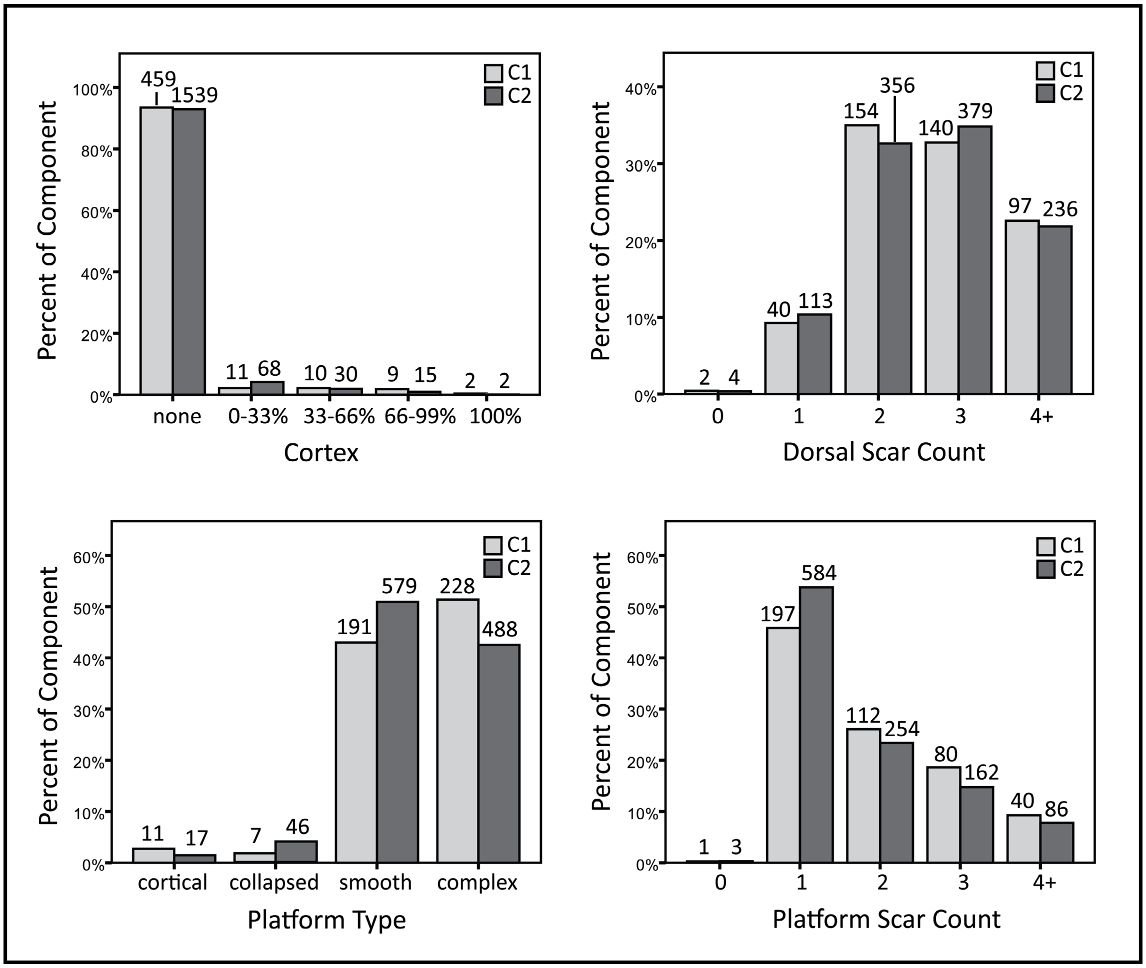

Figure 11. Debitage characteristics for C1 and C2, shown as percentages of the debitage assemblage for each component.Debitage counts given above each bar. Cortex counts also include shatter.

Component 2

C2 displays a relatively high proportion of flake tools, followed by bifacial preform fragments (Table 7). There is a heavy emphasis on the use of quartz and rhyolite in the debitage, compared to an emphasis on chert and rhyolite for formal tools (Table 8).

Bifacial Tools

While C2 contains 17 bifacially worked pieces, only three are finished hafted bifaces. These include one complete specimen each of chert and rhyolite, lanceolate in outline, with narrow tongue-shaped bases and a combination of straight and slightly oblique parallel flaking (Figure 12l,m). Slightly irregular in outline and cross-section, both exhibit proximal hafting abrasion and distal impact fractures. The third is a parallel and collaterally-flaked lanceolate fragment on mottled cream and gray chert (Figure 12k), which has been reworked into a bifacial flake tool after loss of the distal end due to impact fracture. Its distal end exhibits burin and scraping use-damage, and its proximal is broken along one margin and retouched into a steep scraping edge on the other. The remainder are two ovate preforms, one of chert (Figure 12j) and one fragment on rhyolite, two large quartz bifaces, potentially cores or chopping tools (Figure 13d,e), and eight thick, irregular unfinished biface fragments made on chert, chalcedony, and rhyolite. Two of the fragments show evidence of use-retouch on broken and bifacially sharpened edges.

Flake Tools

C2 contains 25 flake tools (Table 7), eight of which are unidentifiable fragments of quartz, rhyolite, chert and chalcedony with evidence of working (for example, Figure 13b). Eight of the identifiable tools are various forms of side and end scrapers. All but one rhyolite end scraper (Figure 12f) and one quartz side scraper (Figure 13a) are made on thick gray chert flakes (for example, Figure 12e,g). With the exception of the quartz scraper, the tools lack cortex and were discarded unbroken.

Figure 12. Sample of C2 tools and bifaces: (a, d-g) scraper tools; (b) microblade core tablet; (c) microblade core; (h) burin spall; (i) limace-like scraper; (j) biface; (k-m) lanceolate bifaces.

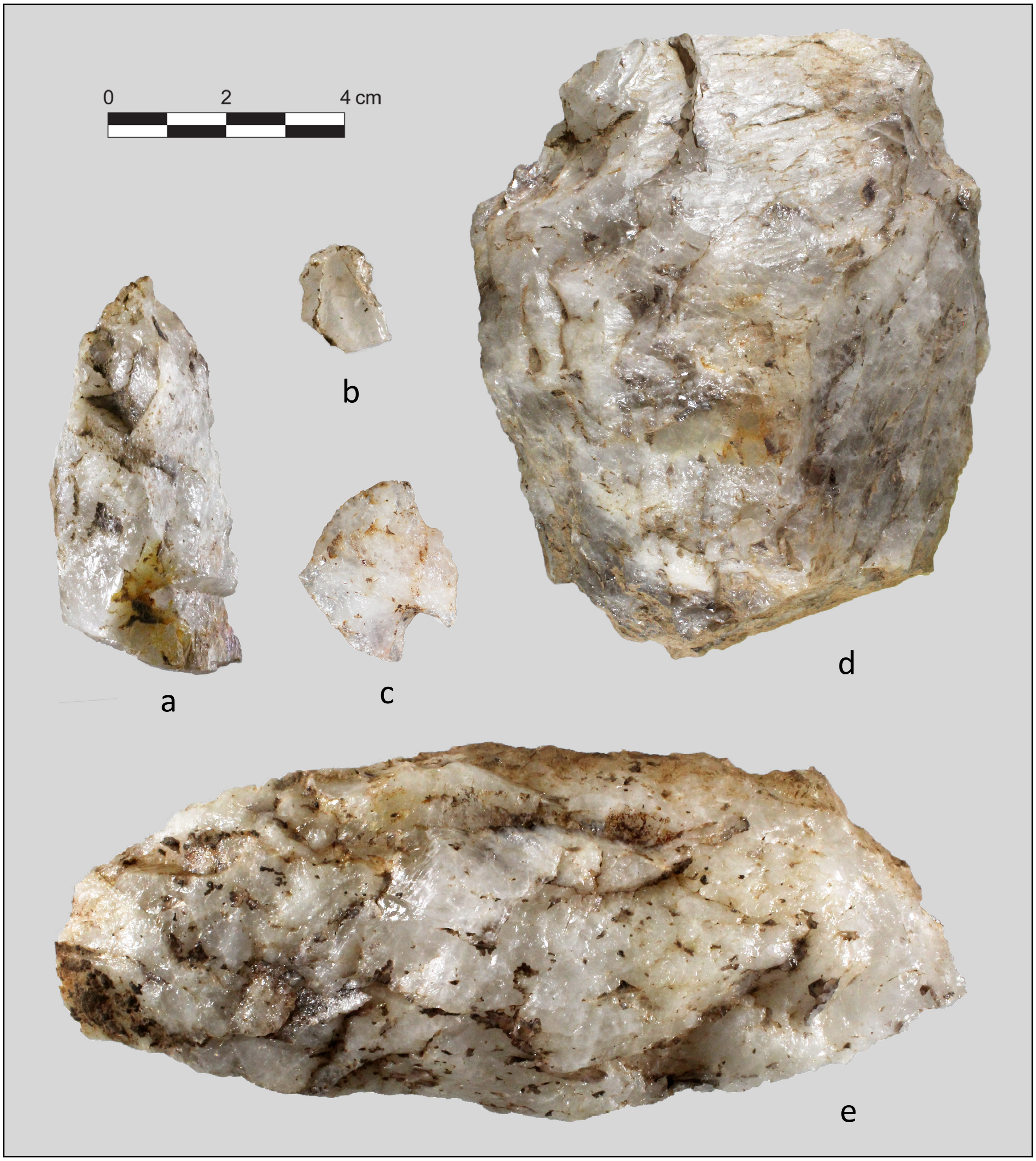

Figure 13. Quartz tools from C2: (a) scraper; (b) flake tool fragment; (c) combination tool; (d,e) bifaces.

The six combination tools in C2 include various working-edge combinations of scrapers, burins, notches, gravers, and bifacial tools, and are made on a variety of sizes and types of quartz, quartz crystal, rhyolite, and chert. Three are simple burinated scraping tools, one is a gray-chert multi-pronged denticulate, graver, and notch (Figure 12d), another is a quartz-crystal tool of unknown original form reworked into a notch with bifacial scraping edge (Figure 13c), and the last shows characteristics of a small, delicate *limace,* a double-sided scraper with rounded ends (Figure 12i). It is re-worked to exhaustion, so that its two working edges meet in the middle. Finally, C2 includes a dihedral burin on a thin gray-chert flake, a burin on a chalcedony flake, and a large brown-chert cortical spall marginally retouched into a robust knife edge (Figure 12a). Besides the formal flake tools, there are 18 marginally retouched flakes and fragments, half of which are on local quartz while the remainder are spread between chert, obsidian, and rhyolite.

Microblade Technology

Microblade-related lithic pieces in C2 consist of a single microblade core of red chert (Figure 12c), a thin, wide core tablet (Figure 12b), a small chalcedony fragment with blade-like scars, and 32 microblades and fragments made almost entirely on gray and brown cherts. Microblades are mainly trapezoidal and include four complete pieces and 11 proximal, 12 distal, and three medial fragments. The core is small and exhausted such that its original shape and reduction process cannot be determined; it shows neither bifacial reduction nor a wedge-shaped outline. The tablet is round and might have come from a semi-conical core rather than a wedge-shaped form. It is very thin (2.8 mm), with a complex platform and four remnant flute scars located on the tablet's slightly hinged distal end, potentially indicating multiple fluted faces. Its upper surface exhibits remnant side-blow flaking, indicating multiple approaches to platform maintenance.

Debitage

The C2 debitage assemblage of 3463 pieces is dominated in numbers and weight by quartz flake fragments and shatter (Table 9). Flake fragments and secondary retouch flakes of rhyolite, chert, and chalcedony are the next-most common (Table 8), with retouch flakes making up 22% of the assemblage. Shatter and simple core flakes make up 25% of the C2 debitage. The majority of shatter is composed of quartz; simple flakes are mainly quartz and rhyolite. Rare debitage includes microblades, cores, bipolar flakes, technical spalls (Figure 12h), cortical spalls, potlidded fragments, and a cortex-covered cobble of unidentifiable material. Overall, debitage sizes are extremely small. Removing the cores and cobble from the sample, the debitage has an average weight of .67 g, despite the high proportion of blocky quartz pieces, which average 1.27 g. In terms of size class, 90% of the debitage pieces measure less than 2 cm, and 62% less than 1 cm, in maximum dimension.

Although overall flake characteristics support the classification of the C2 assemblage as being mainly secondary retouch flake debitage, the local quartz debitage follows a distinct pattern. Quartz is represented mainly by primary debitage of shatter and simple flakes, with low platform counts and larger sizes compared to other debitage. Overall for C2, including quartz, there is almost no cortex, and the majority of proximal flakes exhibit more than one remnant flake scar on their dorsal surface (Figure 11). For the assemblage overall, flake platforms are either smooth or complex with very few cortical or collapsed platforms, suggesting a low rate of early-stage heavy percussion. Although 58% of the smooth platforms in the assemblage are accounted for within the retouch debitage, indicating unifacial tool shaping and retouch, another 37% of the simple flakes are found within simple flake debitage, indicating that core reduction and flake detachment stages are also prominent. Of the retouch flakes, 395 (51%) have complex platforms related to biface thinning and retouch, compared to 338 (44%) with simple platforms, more likely related to unifacial reduction, and the remainder are unidentifiable.

Of the 16 cores in the C2 assemblage, 10 are on quartz, including four multidirectional cores, four unidirectional cores, one bipolar core, and two core fragments. They are large and blocky, with little preparation and an average weight of 86.1 g. Besides these, and the microblade core described above, the remaining cores are small, weighing an average of 5.8 g. They include two unidirectional rhyolite core fragments, a single completely exhausted multidirectional rhyolite core, a chert bipolar split pebble, a bifacially-worked chert core, and a quartz-crystal core fragment.

Lithic Material Use and Technological Organization at Linda’s Point

Toolstone Selection

Throughout prehistory, a few major aspects of lithic material procurement and use appear to have consistently influenced the choices made by occupants at Linda’s

Point. A lack of high-quality local materials has led to variety in the materials brought to the site from regional and exotic locations, seen in mainly late-stage lithic reduction, exhausted cores of high-quality material, and highly curated tools. However, there is a distinct difference between components in the treatment of lower-quality locally-available quartz, which is largely ignored in C1 but became a focal point of an expedient and informal industry in C2, making up nearly half of the C2 assemblage. Rhyolite, slightly coarser than the cherts and chalcedonies, also became relatively more prominent in C2, especially within the tool assemblage. Overall, there appears to be greater selectivity in the Holocene, with quartz used more often for expedient tools, cherts for microblades and flake tools, and rhyolite for bifaces. Although some selectivity in the C1 occupation is seen in a general preference for chalcedonies, it is seen for all tool types, with a variety of other material types following no discernible patterning.

Tool Production and Reduction Strategies

There is a marked difference between components in terms of the toolkits being worked and used on site, potentially reflecting differences in activities and site occupation over time, most notably a diminished emphasis on biface use in C2. For C1, bifacial pieces make up 47% of the formal tool assemblage, and all but two fragments are finished tools or hafted bifaces. For C2, bifacial artifacts make up 40% of the formal tool assemblage, but only three are finished hafted bifaces, and the remainder are rejected, generalized preforms and partially worked bifacial tools. Flake-tool technology is relatively expedient in both components, with a wide variety in shape and size, and high frequency of informal marginally retouched flakes. In general, however, C2 flake tools are more curated than those from C1, with higher proportions of combination tools (25% versus 10% of the flake tools per component, respectively) and an overall lower proportion of expedient marginally retouched flakes (20% of all C2 tools compared to 35% for C1).

Both components at Linda's Point have relatively high proportions of late-stage reduction debitage, and a low proportion of simple flakes and cores. Early-stage debitage is more prevalent in C2, seen mainly as large, blocky pieces of local quartz. C2 reduction technologies are also more diverse; C1 debitage reflects the byproducts of core-and-flake reduction and bifacial reduction, while the C2 assemblage reflects these as well as specialized burination retouch and microblade production. In comparison, C1 exhibits a slightly greater emphasis on bifacial versus unifacial retouch, consistent with the higher proportion of discarded bifaces.

Patterns of Lithic Material and Landscape Use

The emphasis on late-stage secondary reduction of non-local materials in both components indicates that inhabitants manufactured many tools off-site and then transported their materials to Healy Lake to be used, reworked, and occasionally discarded. This pattern appears to have changed little through time, and is expected given that few toolstone resources are available at Linda's Point, while the local quartz that is available is riddled with inclusions and incipient fractures. Substantially higher proportions of quartz debitage in C2 most likely indicate a potential shift in lithic procurement strategies from dominantly nonlocal in the terminal Pleistocene to more locally-focused in the Younger Dryas and Holocene. Alternatively, this could be the result of sampling, and the current discussion may require adjustment upon future excavation.

The earliest site inhabitants preferred a lithic technological strategy emphasizing curation and transport of materials, such that tools manufactured at one site were carried to the next when the group moved within their settlement range, rather than manufacturing new, locally-sourced tools at the new camp (Odell 1996). We hypothesize that the use of local materials became more important later in time as inhabitants became more familiar with the area and its resources, and established larger band-sized groups rather than highly-mobile foraging groups. As larger groups lengthened their residence time at Linda's Point, raw material choices might have shifted towards locally accessible toolstone (Kelly 1988, 1992; Surovell 2009). This is consistent with the observed patterns of material use in C2, such as increased use of local materials, decreased curation, and a decreased reliance on highly portable bifacial technology. Similarly, increased selectivity seen in C2 may be the result of more sedentary populations conserving non-local, high-quality transported toolstone for more delicate knapping tasks such as microblade production. The presence of a pit-hearth feature in C2, compared to the apparently unlined hearths in C1, suggests increased energy investment in feature construction, and provides further evidence for increased occupation length. While exotic obsidian could be evidence of embedded procurement in a developing logistical settlement system, it might also reflect developing regional trade networks, given increasing obsidian usage in the Holocene throughout Alaska.

Alternative environmental explanations for the shift in toolstone emphasis might be that quartz material was accessible at different locations during the terminal Pleistocene due to erosion, fluvial sorting along riverbanks, or seasonal coverage by snow or marshy vegetation. Rising lake levels and erosion, perhaps in the late Pleistocene or perhaps during the Holocene, might have exposed new quartz seams along the shoreline, providing materials accessible directly near the site. The occupants of the earliest component might have flintknapped quartz materials further off-site at exposures on the Healy River or open floodplain. However, the presence of many large schist and quartz feature stones in C1 indicates that at least some sources of bedrock were available nearby during the earlier occupation, and the low presence of smooth cortex on quartz debitage in both components indicates procurement from eroded bedrock exposures rather than smaller, weathered ventifacts.

Rather than affecting lithic procurement alone, the changing environmental context of the Healy River basin likely also affected the role of Linda’s Point within regional subsistence and settlement strategies. The transition from a high-energy riverine environment to a shallow lake with numerous deltaic wetlands likely increased the long-term habitability of the site, providing a wider array of available resources and increased accessibility to the Tanana River. A transition away from residentially mobile settlement patterns would be explained by Holocene impoundment and rising lake levels, and further encouraged by increasing Holocene forestation and the subsequent shift from large seasonally predictable herd animal populations to individually-encountered, solitary browsing ungulates drawn to lakeshores and wetlands.

The presence and meaning of a Holocene transition to a local quartz industry may be explored by further testing and excavation around the lake margins. Localized presence of different reduction stages, such as core testing or decortication at collection sites, or discard of more carefully finished tools at hunting or fishing sites, would indicate increased logistical mobility. An increase in the proportion of quartz over time at multiple sites would provide more generalized evidence for reduced residential mobility and longer site occupation times. Cook identified local quartz material at the Village site, calling it quartzite due to the presence of macroscopic, grain-like crystals (Cook 1969). As with the Linda's Point quartz, flakes of this material were notably larger than those of other materials. He identified the presence of a "Quartzite Horizon," a pulse of quartz activity in the transitional levels between the Chindadn and Athabascan levels, dating circa 9000 cal B.P., but in fact noted a "conspicuous scarcity" of it in the upper levels (Cook 1969:131), indicating the pattern may be more complex than can be interpreted through data from Linda' Point alone. However, this interpreted scarcity is based on flake counts, and Cook's data show that quartz is actually quite prevalent in terms of weight (Cook 1969:131-135). Clearly, further study in the Healy Lake area is needed to clarify the question of a local Holocene quartz industry.

Regional Context

Cultural Chronology

The archaeological record at Linda's Point can answer long-debated questions about the stratigraphy, tool assemblages, and cultural chronology at Healy Lake. Thus far at Linda's Point, microblades, microblade cores, and lanceolate bi-points occur only in the upper strata. They are clearly spatially separated from the small triangular "Chindadn" points associated with multiple hearths in the basal deposits, dating near 12,000–13,000 cal B.P. Although occurring later in time, the C2 quartz items are suggestive of a "Quartz Horizon" similar to that originally proposed by Cook. Given these results, caution is advised in the use of the original definition of the Chindadn complex, which spanned four thousand years. It encompassed the rapid environmental fluctuations of the terminal Pleistocene, including the Allerød warm interval, the sharp cooling of the Younger Dryas at 12,800–11,700 cal B.P., and the return to warmer temperatures during the first millennium of the Holocene (Graf and Bigelow 2011). This makes its temporal context even broader than the overarching concept of the East Beringian Tradition (Holmes 2011). Such broadly defined complexes and traditions inherently pose the danger of glossing over a wide range of potential cultural and behavioral variability, potentially implying static — rather than responsive and adaptive — cultural systems (Odess and Rasic 2007).

Extending the results from C1 further into a regional context adds to the culture history of the middle Tanana as well. At this time, the LPEH is represented in the middle

Tanana by a number of well-dated components spanning from 14,200 cal B.P. to the beginning of the Holocene, covering the entire timeline originally proposed to be encompassed within the Chindadn complex, and slightly earlier at Swan Point (Figure 14). The dates at the earliest components of Linda's Point and the Village site cluster into discrete, non-overlapping date ranges, strongly correlative to occupations at Swan Point, Broken Mammoth, Mead, and Upward Sun. These early components, notably Swan Point CZ3, Broken Mammoth CZ3, and Mead CZ4, share characteristics similar to those at Healy Lake: numerous ephemeral hearths, Chindadn bifaces, and rare or ambiguous microblade technology, focused within a time range of 13,000-11,500 cal B.P., and as early as 13,500 cal B.P. at the Village site. These sites are located in similar lowland settings, overlooking wetland deltas along the glaciofluvial floodplain of the Tanana River.

Subsistence patterns indicate a variety of large-mammal prey in the oldest sites in the Tanana, while early Holocene subsistence shows a range of large-mammal species, and a wider range of small-mammal species, than in the preceding Allerød or Younger Dryas assemblages (Potter et al. 2013). Potter and colleagues suggest a potential link between Chindadn points and upland sheep and caribou hunting, compared to lower-terrain bison and wapiti hunting for microblade technology. They point to evidence of caribou and sheep hunting in Nenana valley components compared to a heavier presence of bison in lowland Tanana sites, which have a longer history of microblade technology (Potter 2011; Potter et al. 2013). However, microblades are present in upland components in the Nenana dating to the Younger Dryas, and a wide array of Chindadn points are present in lowland Tanana basin sites containing a variety of faunal remains and exhibiting complex chronological patterning.

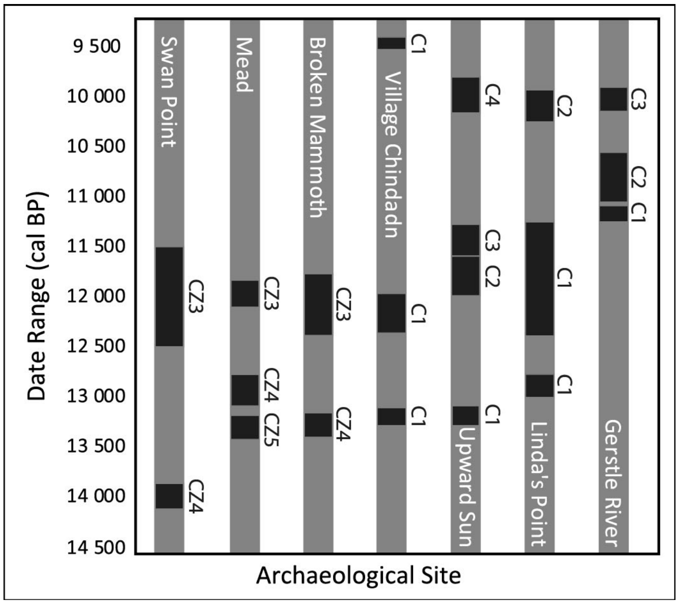

Figure 14. Age ranges of terminal Pleistocene components of archaeological sites in the Tanana basin.Calibrated dates from Cook (1996), Holmes (2011), and Potter et al. (2013).

Initial evaluation of the Linda’s Point faunal materials, though not presented here, indicates similarities to the regional pattern, with a focus on larger mammals in C1 and a variety of smaller mammals in C2. The presence of a crescent-shaped biface in C1, similar in outline to lunate crescents of the Northwest Coast (Moss and Erlandson 2013), hints at greater diversity. Crescents from Northwest Coast and Great Basin wetland locations are commonly medially edge-ground in a similar manner as the Linda’s Point specimen, which is interpreted to facilitate hafting suggestive of ethnographically recorded lunate bird-hunting points (Moss and Erlandson 2013). Lowland Tanana valley site locations like Healy Lake would present ideal locations for the hunting of waterfowl throughout prehistory, and the regional archaeological record presents concurring evidence for the early development of a broad-spectrum diet beyond the pursuit of megafauna. A crescent-like biface also occurs in the CZ3 component of Swan Point (Holmes, 2011:Fig. 10.9.h), resembling "butterfly" or "trapezoidal" crescents in existing typologies (Moss and Erlandson 2013), while avian and fish remains are found at Mead CZ3, Swan Point CZ3, and Broken Mammoth CZ3 (Holmes 2011; Potter et al. 2013). In comparison, the older Swan Point CZ4 with its associated Diuktai microblade assemblage is heavily focused on processing of megafauna (Potter et al. 2013). Clearly, Beringian subsistence patterns are more complex than can be assessed through the current small sample of preserved faunal remains. Detailed faunal analysis at both Linda's Point and the Village site is needed to place Healy Lake in the context of regional subsistence patterns.

Adaptive Strategies of Lithic Resource Use

Linda's Point C1 follows many of the existing patterns of LPEH sites in interior Alaska — multiple hearths with faunal remains, accompanied by debitage, flake and blade tools, and small bifaces. Toolstones are dominated by fine-grained chalcedonies and cherts, acquired off-site but presumably within the general region. Obsidian is rare, especially in comparison to Holocene occupations. Raw materials seem to be chiefly extra-local.

Current data indicate that a variety of lithic resource-use strategies existed within the Alaskan interior. At Walker Road in the Nenana valley, detailed lithic technological analysis showed extensive use of locally available river cobble materials, accompanied by a prevalence of early-stage reduction (Goebel 2011), interpreted to reflect a settlement system relying on local materials to reduce transport costs. Similar patterns are seen in Dry Creek Component I (Graf and Goebel 2009), while the presence of nonlocal materials increased in the later Component II, accompanied by a decrease in cortex, and increase in secondary and finishing stages of reduction. In the Tanana valley, Mead CZ3b shows a combination of local and nonlocal material use; discarded tools are of nonlocal materials while on-site reduction focused strongly on local gray chert (Little 2013). The slightly earlier Mead CZ4 shows similar patterns to Linda's Point C1, with a limited number of material types used compared to other components and a focus on curated chalcedony tools, interpreted to indicate higher mobility and shorter occupation times than CZ3. However, unlike Linda's Point C1, there was a heavy focus on local quartz, which is interpreted to relate to opportunistic use rather than habitation length or group size (Little 2013). Overall, current studies of material use throughout the LPEH indicate variability in lithic procurement and usage, and seem to reflect flexibility to account for toolstone availability on the landscape and duration of occupation, rather than overarching cultural tendencies.

Conclusions and Future Research

Our results suggest that the Linda’s Point site was used as a residential camp during the occupation of both components. Hearths and highly fragmented burnt and calcined animal bone represent domestic cooking and marrow extraction. Small sharpening and retouch flakes, combined with discarded broken projectile points, microblades, small flake tools, and exhausted cores represent the maintenance of a variety of tools for hunting and hide-working. Finally, the presence of burins, burin spalls, steep-angled side scrapers, and spurred flake tools and gravers indicate the working of osseous and woody materials. Lithic raw materials are diverse and debitage overall is small and focused on secondary reduction activities, indicating the use and reuse of tools manufactured elsewhere. These patterns are consistent with the overall lack of local raw-material sources, with the exception of local quartz deposits. All of these characteristics are consistent with human use of an accessible low terrace landform, near to water and to wetland resources, and ideal for habitation by a full residential group.

C1 seems to represent multiple short-term occupations, with numerous, nearly overlapping ephemeral hearth features and scattered lithic deposits. Tools for faunal processing are present but expedient, while there is a notable emphasis on the use and discard of small finished bifaces. C2 is represented by dense scatters of lithic and calcined bone fragments, combined with the presence of intensive early-stage reduction of local quartz, suggesting increased use of local resources and hence longer durations of occupation than during the terminal Pleistocene. The presence of a 9000-year-old flake-and-charcoal-filled pit feature indicates that occupations may have been less transient, with more time taken for the building of fires or disposal of refuse in an organized camp structure.

The currently excavated area is small but has provided a high density of features and materials with precisely defined stratigraphic contexts, showing promise that further excavations using contemporary excavation methods would help to delineate subcomponents within C1 and C2 and further clarify the Healy Lake archaeological record. Expansion of the existing excavation block will enhance the interpretation of activity areas and relationships between features at the site, while addition of new excavation areas will show whether the patterns observed here are consistent across the site, or show variation within more complex site structures. Continued excavation of surrounding sites along the lake margins, and comparisons to contemporary occupations along the Tanana, will help to establish local and regional patterns of differentiated lithic adaptive strategies and settlement patterns. These in turn will help to illuminate our understanding of human responses to LPEH environmental change and ultimately the early human settlement of Beringia.

CHAPTER III

REINVESTIGATING THE ARCHAEOLOGICAL RECORD OF HEALY LAKE, ALASKA: CHANGING PATTERNS OF LITHIC TECHNOLOGICAL ORGANIZATION, AND IMPLICATIONS FOR PREHISTORIC SETTLEMENT AND RESOURCE USE

Terminal Pleistocene archaeological assemblages, dating 15,000–13,000 years ago (cal B.P.), mark the earliest known human occupation of Alaska (Goebel and Buvit 2011; Hoffecker 2011). Migration of early populations from northeast Asia has been traced through genetic and linguistic continuities across the Bering Strait, and continuity of cultural traditions, most notably the production of organic points with inset microblades. However, microblades are in fact rare in the earliest known Alaskan occupations, and lithic traditions are instead focused on small triangular and teardrop-shaped Chindadn bifaces with few cultural affinities outside Alaska (Goebel and Buvit 2011; Wygal 2011), leaving our understanding of early Alaskan culture history ambiguous.

Recent technological studies in Beringia have begun to provide a wider perspective of Beringian cultures and adaptive strategies of lithic procurement, use, and reduction. For example, at Ushki-5 (Kamchatka) and Dry Creek (central Alaska), on opposing sides of the Bering Land Bridge, sites transition from a 13,500–13,000 cal B.P. emphasis on blade and flake core technology during the Allerød to a 12,500–11,600 cal B.P. emphasis on bifacial and microblade technology during the Younger Dryas, with increased use of exotic materials and greater toolstone selectivity (Goebel 2011; Graf 2010; Graf and Goebel 2009). These changes may reflect increasing logistical mobility and command of local and nonlocal resources as migratory populations settled and gained increasing knowledge of the lithic landscape. Within the wider Ushki site complex, obsidian is common throughout early occupations and has been traced to a range of long-distance outcrops, indicating high mobility of Beringian migrants (Kuzmin et al. 2008), as well as thorough landscape knowledge. Further, in the 13,000 cal B.P. Walker Road assemblage, a focus on primary reduction of local materials for blade and flake tools suggests that inhabitants were aware of their lithic landscape and able to travel carrying few curated or pre-manufactured tools (Goebel 2011).

The early archaeology of Healy Lake has played a central role in the archaeological interpretation of terminal Pleistocene Beringia. At the Village site, microblades were found in association with Chindadn bifaces (Cook 1969, 1975, 1996); however, it has been questioned whether this association is due not to concurrent occupations, but instead to compressed and disturbed stratigraphy, or to Cook's recording of artifact provenience using arbitrary depth levels (Bever 2001; Dixon 1985; Hamilton and Goebel 1999; Holmes 2001). The Village site nevertheless contains one of the richest early Beringian archaeological assemblages, and its debitage assemblage has never been presented. The recently excavated Linda's Point site at Healy Lake presents a comparable archaeological record in terms of both antiquity and artifact types.

In this paper, I compare the lithic assemblages from these two Healy Lake sites from a technological perspective, assessing patterns of lithic procurement and reduction with the aim of incorporating Healy Lake into the Beringian archaeological record regardless of culture historical ambiguities. If lithic technological choices represent wider cultural adaptations to environmental and cultural contexts, it is expected that patterns of occupation and lithic material use will be comparable with those from other Beringian sites, and further that they will show change over time with the transition from terminal Pleistocene to Holocene environments.

Healy Lake

Healy Lake is located in the middle Tanana Valley, in the heart of eastern Beringia (Figure 15). Of numerous archaeological sites recorded around the lake's shoreline, two have been extensively studied (Figure 16). The Healy Lake Village (HLV) site, named for a nearby abandoned Native village, is located on a small point of land jutting out from the north shore. In the 1960s and early 1970s, R. McKennan and J. Cook excavated more than 170 five-foot-square units at the Village site, covering an area of about 380 m^2 and collecting approximately 43,000 artifacts (Cook 1969, 1996). Excavators maintained detailed field notes, soil descriptions, and sketches; however, sediments were not screened, and due to a lack of apparent geological stratigraphy, depth was measured in 2-inch arbitrary levels (Cook 1996). On a site-wide basis, Cook grouped excavation levels with similar artifacts into phases, which he interpreted to represent the in-situ development of Athabascan culture through time (Cook 1975). The earliest *Chindadn* phase (13,300–9100 cal B.P.) was represented by Chindadn points, lanceolate points, microblades, blades, scrapers, and a high density of small hearths and processed faunal remains (Cook 1996). The *Transitional* phase (9100–5000 cal B.P.) represents a hiatus in occupation and transition to the *Athapaskan* phase (5000 cal B.P. to the protohistoric period), containing transverse burins, microblades, wedge-shaped and tabular microblade cores, and lanceolate, stemmed, and notched bifacial points.

Approximately 1.8 km to the east, local resident Linda Kirsteatter found a projectile point near the lakeshore, identifying the first evidence of the Linda's Point site

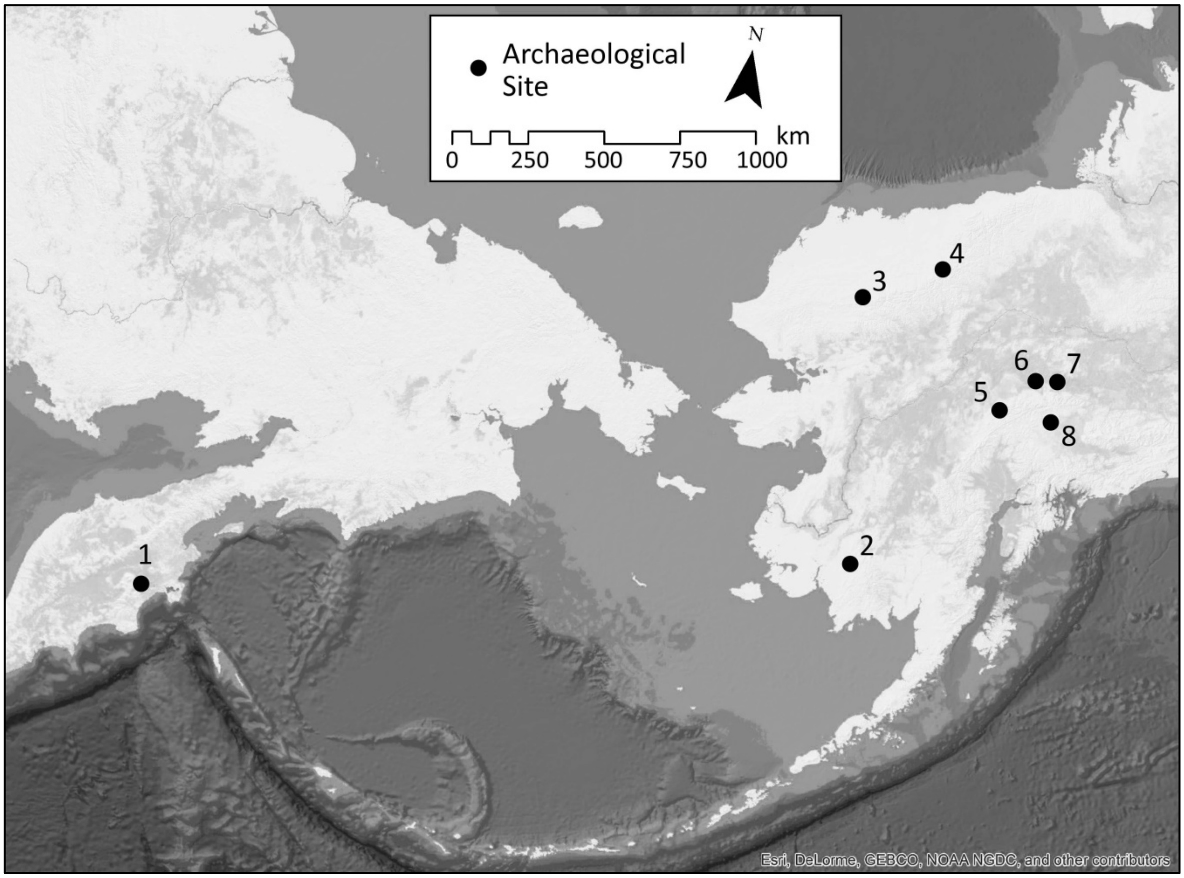

Figure 15. Archaeological sites discussed in text : (1) Ushki Lake sites; (2) Spein Mountain; (3) Mesa; (4) Hilltop; (5) Nenana Valley sites including Dry Creek and Walker Road; (6) Shaw Creek sites including Mead, Swan Point, and Broken Mammoth; (7) Healy Lake sites including Linda's Point and Healy Lake Village; (8) Tangle Lakes region. Figure created using ArcMap (Esri 2011; Esri et al. 2014a).

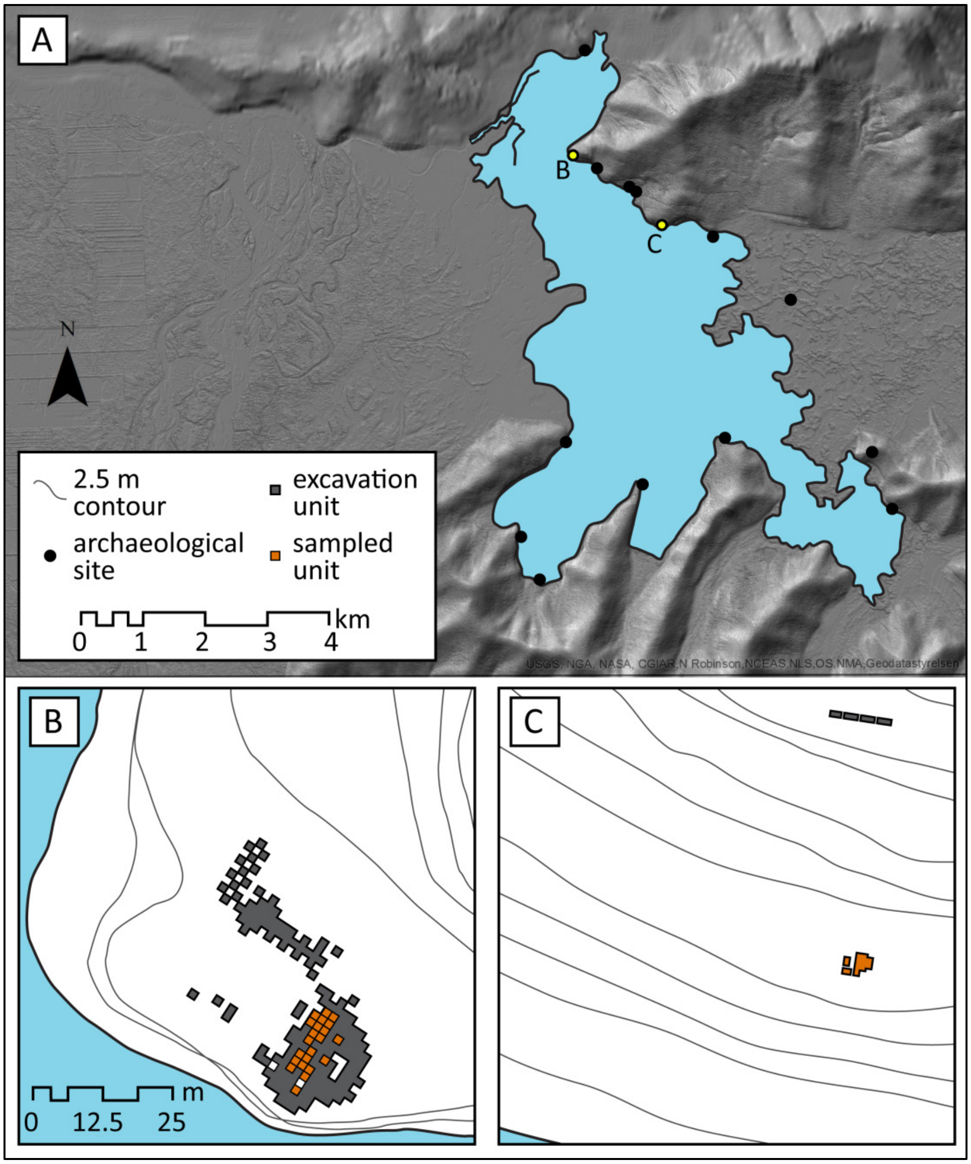

Figure 16. Healy Lake areas of archaeological study showing excavation and sampled units: (a) Healy Lake basin; (b) Healy Lake Village Site; (c) Linda's Point. Part (a) made using ArcMap .(Esri 2011; GINA 2010)

(Figure 16). From 2010–2013, testing and excavation on a relict terrace approximately 20 m above the modern shore revealed a sequence of cultural components similar to that seen at the Village site (Sattler et al. 2011; Younie and Gillispie 2016). From twelve 1x1

m^2 excavation units, researchers collected 6164 cultural items, including lithic debitage, tools, and cores, burnt and calcined bone, and hearth stones.

Geology and Geochronology

The Village and Linda’s Point sites exhibit similar stratigraphic profiles (Gillispie et al. 2014b; Younie and Gillispie 2016), facilitating direct chronological comparisons (Figure 17). At both sites, a base of schist bedrock and layer of quartz ventifacts are buried in a thick deposit of Pleistocene sands that make up the lower half of the profile. Above this, warming climates are suggested by a transition to loess, within which a dark reddish-pink paleosol marks warmth and environmental stability of the Allerød, as well as the earliest cultural component at both sites. Component 1 (C1) contains ephemeral hearths, lithic debris, and burnt and calcined bone. The upper portion of the stratigraphic profile is a 30-cm thick deposit of loess containing Component 2 (C2), spanning much of the Holocene. Pedogenic processes are represented within the loess by a mottled spodic horizon, frost cracks, and a lower series of clay-infilled lamellae. A third historic and late prehistoric suite of deposits appears within the thin forest soil, sparse at Linda’s Point but rich at the Village site (Cook 1989). At Linda’s Point, the profile reaches a depth of 100–120 cm, and a 10–15-cm thick deposit of culturally sterile loess separates the lower paleosol and the upper lamellar zone. At the Village site the profile is more compressed, so that the paleosol and lamellae often overlap, and separation between the Chindadn and upper components is 5 cm or less.

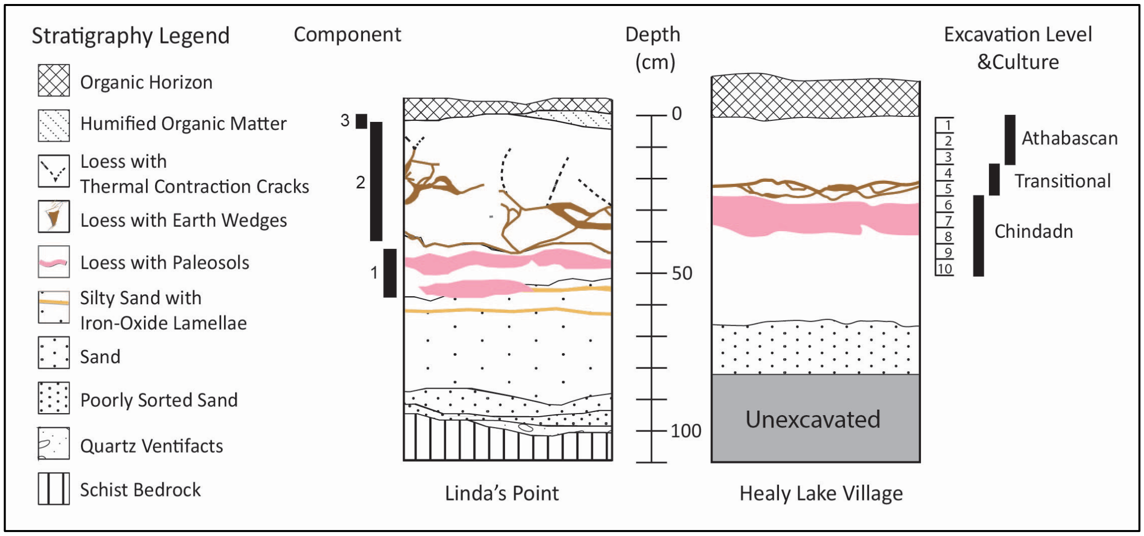

Figure 17. Stratigraphic context of Healy Lake cultural deposits.

Using archived field notes, I assigned Village site artifacts to C1 based on provenience within the paleosol and below the lamellae zone. While Cook's chronology dates the Chindadn component between 13,300–9100 cal B.P. (Cook 1996), this is based on the level system, and likely encompasses a wider date range than the stratigraphically defined C1. A redating program of this component is currently underway (Gillispie et al. 2014a) that suggests this lowest occupation may be consistently dated to 13,500–13,000 cal B.P. (Gillispie et al. 2013). C2 artifacts were identified based on their presence in the upper silts above the culturally sterile section. Based on Cook's existing level-based chronology, these deposits can be assigned a range of at least 6000 cal B.P. to the historic period (Cook 1996), but potentially extending much earlier.

At Linda's Point, C1 hearths and the associated paleosol range in age from 13,100 to 11,200 cal B.P., indicating a palimpsest of multiple occupation periods spanning the late Allerød and Younger Dryas (Younie and Gillispie 2016). Although stratigraphic contexts at Linda’s Point closely mirror those form the Village site, dating of components does not perfectly coincide: thus far charcoal samples from C2 at Linda’s Point have provided dates ranging from 10,200 to 6000 cal B.P. These differences are hypothesized to have been created by the arbitrary level system and associated dating inconsistencies at the Village site. Ongoing geochronological study may clarify the dating of both sites.

Materials & Methods

Theoretical Considerations

The goal of the research presented here is to describe and compare the lithic assemblages of the Village and Linda’s Point sites from a technological framework. It is based on the theoretical perspective that stone tools, their physical properties and intended functions, are strongly tied to adaptive strategies. Prehistoric choices made in tool manufacture, use, refurbishing, and discard reflect reactions to environmental challenges and raw material characteristics, and not just culturally dictated templates (Dunnell 1978; Lyman and O'Brien 2004). Curation may be an adaptive response to material availability, such as a scarcity in a given area or during winter seasons, or selectivity in the reuse and recycling of higher-quality rare or exotic materials (Andrefsky 1994); it is also a reflection of resource procurement strategies within cultural systems of land use and settlement.

Binford’s models of mobility assess hunter-gatherer settlement patterns along a spectrum. At one end are highly mobile residentially-organized foragers, moving residential base-camps to their desired resource locations; at the other are logistically organized collectors, bringing resources to their base-camps from specialized extraction sites (Binford 1980). Similarly, resource management can be viewed within a range of strategies allowing groups either to provision individuals as they move across the landscape, or to bring provisions to a single more permanent place on the landscape (Graf 2010). In a general sense, more mobile groups will be represented archaeologically by the presence of assemblages with little inter-site variability and curated, transportable technologies such as bifaces (Kelly 1988; Shott 1989). In comparison, more logistically organized populations will produce sites with variable activities and occupation lengths. Due to the ability to collect and cache stores of material, more “wasteful” expedient core-and-flake technologies are possible (Parry and Kelly 1987). While providing useful heuristics for discussing strategies of settlement and resource use, these opposing ends of the spectrum are theoretical, with cultural groups often falling somewhere between them. A single group may adopt differing strategies according to seasonal or regional environmental variation, while factors such as seasonal lithic material availability and “gearing up” activities may also mimic settlement strategies.

Within this theoretical framework, it is expected that more mobile Beringian migrant populations should reflect transportable biface technologies and curated materials, with later occupations showing increasing knowledge of the lithic landscape represented by increasing lithic selectivity, tool diversity, specialization of microblade and biface technology, and lithic selection dependent on local availability. Increasing logistical mobility in the Holocene, reflecting a transition to historic Athabascan land-use patterns, is expected to be seen in increasing inter-assemblage diversity and the development of specialized resource extraction sites.

Materials

From the Village site, I selected a sample of 23 5x5 ft^2 units (Figure 16) based on field note descriptions indicating deep profiles and distinct lower paleosols, and presence of C1 deposits. Collections were accessed at John' Cook's laboratory, the University of Alaska Museum of the North, and on loan through the Canadian Museum of Civilization. Of 975 catalog entries selected for the sample, 676 matching items and flake lots were relocated, providing a sample of 5622 lithic artifacts for analysis. Missing entries were distributed across the units and levels and include a variety of artifact types, indicating their loss does not create a systematic bias, and might be attributed to inconsistencies in five decades of curation and cataloguing across various institutions. I accessed the Linda's Point materials at the Tanana Chiefs Conference, and the sample of 4998 lithic artifacts was taken from the entire area of completed excavation units.

I divided the materials into components 1 and 2 at each site based on geological associations recorded in the original site field notes. Although not accounted for during the original Village site analysis, rodent burrows and modern disturbances are clearly marked in the field notes. Artifacts from these contexts, from compressed areas lacking clear spatial separation of components, from areas lacking clear soil descriptions, and from historic occupation levels at the ground surface, were grouped into an “other” category. These were included in overall site counts but omitted from the main comparative analysis.

Lithic Analysis

Lithic analysis followed a single classification scheme for both site assemblages. Toolstones were classified through visual examination under 15X magnification. Material class groups such as chert and rhyolite share common characteristics of workability and general material source, while material type groups represent potential specific lithic packages or package sources, such as red chert or banded chalcedony. During fieldwork, archaeologists at Linda’s Point observed locally available materials along the lakeshores and in bedrock outcrops, while exotic obsidian sources were traced through XRF analyses. To assess regional availability of the remaining material types, I plotted each material by total volume and artifact count against frequency of cortex and retouch, similar to methods used by Potter (2005:394-396).

Classification of different materials according to whether they were most strongly related to bifacial, flake tool, or microblade production included complete and proximal debitage pieces. Assessment was based on shape, size, platform characteristics, and dorsal flake scar characteristics of debitage, following standard technological analysis (Andrefsky 2005:120-127). I also calculated proportions of artifacts displaying characteristics attributable to each stage of a basic reduction sequence (primary debitage, secondary debitage, or tool). Primary reduction debitage included those pieces relating to core reduction and flake production, including cores, cortical spalls, simple flakes, and shatter; secondary reduction debitage included pieces relating to tool shaping and edge working, including unifacial and bifacial thinning and trimming flakes, burin spalls, and other specialized flakes (Goebel 2011; Graf and Goebel 2009).

I assessed tool reduction levels using Kuhn's (1990) geometric index of reduction (GUIR). For bifaces, I assessed overall reduction through a generalized flaking index (Smallwood 2010), and curation and resharpening of finished bifaces through Andrefsky's (2006) hafted-biface retouch index (HRI). I calculated richness, evenness, and an overall diversity index for lithic material types and formal tool types in each of the four assemblages using R Studio © version 2.3-1 (Oksanen et al. 2015; R Core Team 2015). Richness was calculated as the number of types in each component (Jones et al. 1983), complemented by a rarified richness measure using repeated subsampling to control for assemblage size (Hurlbert 1971). Simpson's Measure of Evenness provided a numerical value describing how evenly items are distributed between types; and Simpson's Diversity Index [D-1] measured overall diversity (Bettinger 1980).

Results

Material Summary

Lithic materials used at Healy Lake are highly variable, but encompass a nearly identical suite of over 50 material types in all assemblages (Table 10). At both sites, cherts are found in a wide range of colors, all of which are fine-grained and easily worked, with few inclusions, cortex, or incipient fractures apparent. Rhyolite is fine-grained and workable, and comes in various shades of grey and tan that appear to relate to soil staining, as discussed in Chapter II (p. 35). Although multiple rhyolite source groups have been identified at Healy Lake, full classification would require chemical analysis of each piece, and so rhyolites were classed as a single group. Argillite is found in fine-grained black and green varieties. Obsidian includes two major types, a smoky translucent grey obsidian typically traced to Batza Tena (Alaska Obsidian Database source group B), and banded opaque black and translucent grey obsidian typically traced to Wiki Peak (source group A) (Reuther et al. 2011). Colorless translucent and opaque grey obsidians are also present, as well as opaque brown and red obsidians at the Village site. Linda's Point has a single rare piece of opaque mottled green obsidian sourced to the rare CC group, also discussed in Chapter II (p. 34). Mottled white and clear quartz materials are large-grained, durable, and marginally knappable due to thick cortex, incipient fractures, and straight cleavage planes. They are analogous to materials classified by J. Cook as quartzite. Rarer reddened quartz found at both sites is likely heat-exposed or cortical local quartz. Rare, less workable materials classified under "other" include coarse volcanics, sandstone, slate, petrified wood, and unidentifiable degraded materials.

Table 10. Material Types for all Lithic Artifacts Measured at Healy Lake (continued next page).

Material Type	HLV			LPS			Total	Total (*n*)
	1	2	Other	1	2	Other		
Chert	*36.5%*	*41.3%*	*40.7%*	*33.1%*	*14.0%*	*16.6%*	*30.0%*	*3187*
Dark grey chert	18.6%	14.8%	19.8%	11.6%	5.3%	4.0%	11.8%	1258
Medium grey chert	6.9%	7.1%	7.8%	7.7%	4.7%	4.6%	6.3%	672
Black chert	.1%	5.2%	1.9%	.8%	1.9%	2.8%	2.6%	280
Light grey chert	1.7%	3.9%	1.8%	.6%	.4%	.6%	1.8%	196
Red chert	.9%	1.0%	1.0%	6.8%	.2%	1.2%	1.4%	145
Brown chert	1.9%	1.5%	1.8%	1.3%	.9%	1.8%	1.4%	145
Blue grey chert	2.6%	1.7%	3.1%	.1%	.1%	.0%	1.2%	124
Other chert	.6%	1.4%	1.0%	.9%	.0%	.0%	.7%	75
Tan chert	.5%	1.8%	.4%	.0%	.0%	.0%	.7%	73
Tan/grey mottled chert	.6%	.1%	.4%	3.3%	.2%	.9%	.6%	64
Grey banded chert	.2%	1.4%	.1%	.0%	.3%	.6%	.6%	62
Rainbow chert	.9%	1.1%	.3%	.0%	.0%	.0%	.5%	52
White chert	1.1%	.3%	1.4%	.1%	.1%	.0%	.4%	41
Quartz	*9.0%*	*2.2%*	*11.5%*	*9.4%*	*40.5%*	*39.9%*	*18.4%*	*1955*
White/clear quartz	8.8%	2.0%	11.5%	6.4%	40.1%	37.4%	17.8%	1888
Reddened quartz	.2%	.2%	.0%	3.0%	.4%	2.5%	.6%	67
Rhyolite	*7.9%*	*10.8%*	*11.4%*	*13.8%*	*24.5%*	*17.2%*	*15.6%*	*1652*
Chalcedony	*15.8%*	*13.1%*	*16.6%*	*24.7%*	*12.9%*	*10.7%*	*14.9%*	*1578*
Grey chalcedony	5.1%	7.5%	7.2%	9.4%	4.3%	3.7%	6.2%	660
White/black agate	1.5%	4.2%	5.2%	3.0%	7.7%	4.6%	5.0%	531
Clear chalcedony	3.5%	.8%	1.6%	11.8%	.6%	2.1%	2.4%	253
Orange chalcedony	3.0%	.2%	1.0%	.1%	.0%	.0%	.5%	54
White chalcedony	1.3%	.2%	.5%	.3%	.3%	.3%	.4%	42
Other chalcedony	1.3%	.2%	1.0%	.2%	.1%	.0%	.4%	38

Table 10 Continued.

Material Type	HLV			LPS			Total	Total (*n*)
	1	2	Other	1	2	Other		
Argillite	*18.3%*	*15.5%*	*13.5%*	*9.9%*	*1.8%*	*9.5%*	*10.3%*	*1099*
Black argillite	2.0%	14.6%	8.9%	2.5%	1.5%	3.1%	6.6%	698
Green argillite	16.4%	.9%	4.6%	7.4%	.3%	6.4%	3.8%	401
Basalt	*7.2%*	*10.9%*	*1.5%*	*7.2%*	*.9%*	*.9%*	*5.7%*	*601*
Obsidian	*.3%*	*2.6%*	*1.1%*	*.1%*	*2.5%*	*1.8%*	*1.8%*	*195*
Smoky obsidian	.2%	.9%	.5%	.0%	1.7%	1.5%	1.0%	101
Black/banded obsidian	.1%	1.0%	.2%	.0%	.6%	.3%	.5%	58
Other obsidian	.1%	.7%	.3%	.1%	.2%	.0%	.3%	36
Mcs	*2.3%*	*1.2%*	*.8%*	*1.2%*	*.6%*	*2.1%*	*1.1%*	*120*
Other	*1.2%*	*1.2%*	*.7%*	*.3%*	*.9%*	*.6%*	*.9%*	*100*
Welded tuff	*1.2%*	*.6%*	*1.9%*	*.0%*	*.0%*	*.0%*	*.5%*	*53*
Quartzite	*.1%*	*.6%*	*.1%*	*.2%*	*.7%*	*.6%*	*.5%*	*49*
Quartz crystal	*.2%*	*.0%*	*.1%*	*.2%*	*.7%*	*.0%*	*.3%*	*30*
Schist	*.0%*	*.0%*	*.1%*	*.0%*	*.0%*	*.0%*	*.0%*	*1*
Total (*n* = 100%)	1286	3432	911	1169	3503	326	100.0%	10,620

The Village site C1 and C2 assemblages are similarly composed (Table 10), with chert representing 40% of overall materials, followed by argillite (16%), chalcedony (14%), rhyolite (10%), and basalt (9%). The remaining 11% is made up of a wide array of rare materials. Linda's Point shows more variability between components, mainly due to a shift from very low presence of quartz in C1 (9%) to very high in C2 (41%). The remaining Linda's Point assemblage is split nearly evenly between rhyolites (22%), cherts (19%), and chalceonies (16%), and various rare materials (10%). The Village site contains a slightly wider variety of rare materials, and has consistently higher richness values in both components (Table 11). However, diversity indices are similarly high at both sites, with low evenness reflecting the overall prevalence of rhyolite and grey chert and chalcedony, although indices of both diversity and evenness are lower at the quartz-heavy Linda's Point C2.

Table 11. Diversity Measures of Toolstone Types and Flake Tools.

Statistic	Measure	HLV 1	HLV 2	LPS 1	LPS 2
	n	1282	3429	1170	3504
Lithic Types	Richness	42	54	30	36
	Rarified Richness	41	44	30	30
	Diversity Index	.907	.914	.915	.765
	Evenness	.255	.216	.394	.118
	n	30	69	12	28
Tool Types	Richness	12	13	7	11
	Rarified Richness	8	7	7	8
	Diversity Index	.878	.886	.806	.883
	Evenness	.682	.672	.735	.775

Local, Nonlocal, and Exotic Materials

The local lithic landscape today appears to provide few sources for the toolstones present in the Healy Lake assemblages. Local quartz outcroppings represent a well-used source material available on-site. Obsidian is a known exotic material, with both major sources originating over 300 km away. Sources for remaining materials are unknown. Regardless of cultural preferences, transport from greater distances should be reflected in lowered relative presence, lowered rates of cortex, and a higher tool to debitage ratio for all assemblages as a whole. Plotting total material weight against frequency of cortex (Figure 18a), exotic materials cluster near the graph origin, showing low weight and cortex as expected, while the known local materials present distant outliers of high weight and cortex. The majority of materials also cluster near the origin, with the exception of rainbow chert, which has a moderate prevalence of stream-rolled cobble cortex. Plotting item count versus retouch frequency (Figure 18b), materials cluster close to the x-axis, showing low retouch, but are separated by overall artifact counts. Cherts, chalcedonies, rhyolites, and basalts are very common by count but not by weight, indicating that they were heavily worked on-site, but perhaps arrived as tools or preforms at later, finer stages of reduction. Known exotic materials cluster as expected near the y axis with low counts and moderate retouch rates, along with other likely exotic materials: cherts and chalcedonies of rare colors, and the banded purple quartzite.

Healy Lake, then, exhibits numerous rare material types, low presence of both cortex and retouch, and moderate levels clustering with exotic obsidian. This suggests a majority of material types were nonlocal but not necessarily exotic, available far enough off-site that they were brought to the site after the decortication stages of reduction. Although rare, cobble cortex indicates procurement from streambeds or cobble fields, suggesting likely sources from streambeds along the nearby Tanana River and its tributaries.

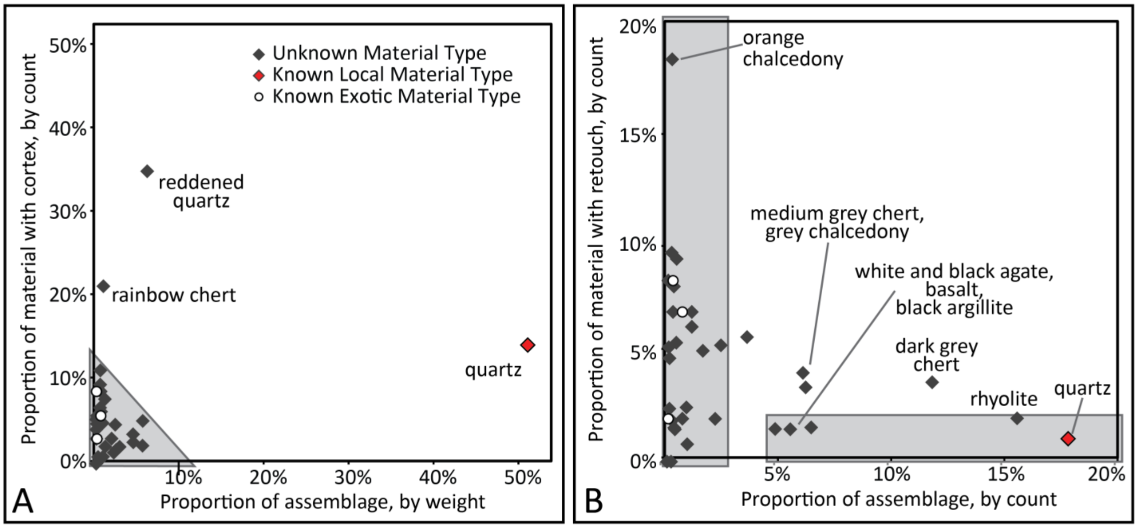

Figure 18. Local and nonlocal toolstone types : (a) proportion of each toolstone in the combined Healy Lake assemblage represented by weight, versus proportion of items in each type group exhibiting cortex; items closer to the origin are more likely to have been procured from remote locations; (b) proportion of each toolstone in the entire Healy Lake assemblage represented by count, versus proportion of items in each type group exhibiting retouch; items along the y-axis are more likely to have been procured from remote locations, and those along the x-axis more likely to have been procured locally.

Assemblage Composition and Reduction Strategy

People at Healy Lake manufactured and used a wide variety of stone tools in nearly all occupations. Bifaces and scrapers make up a large portion of tools in all components, most notably at the Village site (Table 12). At both sites, finished hafted bifaces are most common overall. Unfinished bifaces are almost nonexistent in C1 of both sites, becoming slightly more common during C2, especially at Linda's Point, where C2 contains numerous unidentifiable biface fragments. Marginally retouched flakes are by far the most common flake tool type in all components, followed by side scrapers and end scrapers, combination tools, burins, knives, and amorphously retouched flakes. The combination tools include permutations of scraping edges, denticulates, notches, gravers, and burins, as well as bifaces and points reworked into scraping tools, knives, and burins.

Although richness values are high at the Village site, rarefied values are consistent across all components, ranging from 7–8 tool types and indicating that the greater number of tool types is a result of the large sample size at the Village site (Table 11). Diversity indices range from .878–.886, with a slightly lower value of .806 at Linda's Point C1. Overall the results suggest a high diversity of tool types for the given sample sizes. Tools are well-dispersed among these types, leading to overall high evenness values of .735–.775 at Linda's Point and .672–.682 at the Village site. Lower values at the Village site are likely caused by a high proportion of scrapers in both components. Despite this variation, Fisher's exact test (FET) shows no significant difference between components in terms of biface types (FET = 8.26; *df* = 6, 38; *p* = .153), flake tool types (FET = 37.19; *df* = 33, 84; *p* = .087), or overall proportions of biface and flake tools (FET = 14.12; *df* = 12, 122; *p* = .220).

Table 12. Healy Lake Tool Types.

Tool Type	HLV		LPS		Total
	1	2	1	2	
Biface	*17%*	*20%*	*28%*	*20%*	*20%*
Hafted biface	10%	10%	16%	3%	9%
Unhafted biface	3%	4%	8%	6%	4%
Unknown biface	1%	2%	4%	9%	4%
Unhafted biface fragment	1%	2%	-	2%	2%
Hafted biface fragment	1%	2%	-	-	1%
Scraper	*23%*	*22%*	*16%*	*13%*	*20%*
End scraper	9%	4%	8%	3%	5%
Scraper	1%	7%	8%	-	4%
End and side scraper	4%	3%	-	6%	4%
Side scraper	-	4%	-	3%	3%
Scraper fragment	6%	1%	-	-	2%
Side-side scraper	-	2%	-	-	1%
Thumb scraper	3%	1%	-	-	1%
Flake tool	*10%*	*2%*	*4%*	*17%*	*7%*
Flake tool fragment	3%	1%	4%	13%	4%
Burin	3%	1%	-	2%	2%
Knife	3%	-	-	2%	1%
Burin fragment	-	-	-	2%	0%
Wedge	1%	-	-	-	0%
Combination tool	*1%*	*7%*	*8%*	*13%*	*7%*
Combination tool	1%	6%	4%	6%	5%
Reworked biface	-	1%	-	3%	1%
Combination tool fragment	-	-	4%	2%	1%
Reworked biface fragment	-	-	-	2%	0%
Retouched flake	*46%*	*41%*	*44%*	*30%*	*40%*
Retouched flake/fragment	3%	4%	8%	2%	4%
Marginally retouched flk/frg	43%	36%	36%	28%	36%
Microblade	*3%*	*8%*	-	*8%*	*6%*
Total	100%	100%	100%	100%	100%
(*n*)	(70)	(137)	(25)	(64)	(296)

Reduction strategies for individual material types follow similar overall patterns within each component (Tables 4–7). Low-quality quartz is represented largely by core-and-flake technologies, consistent with its use mainly for flake tools and informally retouched flakes. Brittle obsidian materials are also represented by core-and-flake debitage, and although rare in the tool assemblages include both bifaces and flake tools. Tougher rhyolites are also more strongly represented by core-and-flake debitage, despite being strongly represented by bifacial tools and points in the tool assemblages. Conversely, argillite and basalt debitage emphasize bifacial characteristics, despite a strong emphasis on flake tools in the tool assemblages. Debitage characteristics are fairly evenly distributed among the more versatile chert and chalcedony materials, with minor variations between components. These last two material types make up the majority of the tools in all components, reflecting their dominance in the overall site assemblages. They are most commonly seen as flake tools but are also represented by bifacial tools and points. In C2 at both sites, chert and chalcedony were selectively used for microblade production.

Table 13. Biface, Microblade, and Flake Tool Reduction Represented in HLV 1 Debitage and Tools.

Material Type	Debitage					Tool						
	Biface	Core & Flake	Micro-blade	Total *n*	Total %	Biface	Blade	Flake Tool	Retouch-ed Flake	Micro-blade	Total *n*	Total %
Argillite	56%	41%	2%	87	100%	-	-	44%	56%	-	9	100%
Basalt	40%	60%	-	47	100%	-	-	100%	-	-	1	100%
Chalcedony	44%	50%	6%	84	100%	17%	-	39%	44%	-	18	100%
Chert	66%	31%	3%	179	100%	24%	-	31%	38%	7%	29	100%
MCS	-	100%	-	14	100%	100%	-	-	-	-	1	100%
Obsidian	100%	-	-	1	100%	-	-	-	-	-	1	100%
Other	-	100%	-	8	100%	-	-	100%	-	-	1	100%
Quartz	3%	97%	-	73	100%	-	-	100%	-	-	1	100%
Quartzite	-	100%	-	1	100%	-	-	-	-	-	0	0%
Rhyolite	31%	69%	-	41	100%	14%	14%	14%	57%	-	7	100%
Welded tuff	10%	90%	-	10	100%	-	-	-	-	-	0	0%
Total	44%	54%	2%	545	100%	18%	1%	36%	42%	3%	70	100%

Table 14. Biface, Microblade, and Flake Tool Reduction Represented in HLV 2 Debitage and Tools.

Material Type	Debitage					Tool					
	Biface	Core & Flake	Micro-blade	Total *n*	Total %	Biface	Flake Tool	Retouched Flake	Micro-blade	Total *n*	Total %
Argillite	69%	31%	-	178	100%	11%	44%	44%	-	18	100%
Basalt	59%	41%	-	157	100%	71%	14%	14%	-	7	100%
Chalcedony	35%	59%	6%	186	100%	14%	43%	19%	24%	21	100%
Chert	44%	49%	7%	688	100%	14%	36%	42%	7%	69	100%
MCS	56%	38%	6%	16	100%	-	-	100%	-	1	100%
Obsidian	31%	67%	2%	55	100%	40%	20%	40%		5	100%
Other	20%	70%	10%	20	100%	100%	-	-	-	1	100%
Quartz	7%	93%	-	42	100%	-	-	100%	-	1	100%
Quartzite	88%	13%	-	8	100%	-	-	-	-	0	0%
Rhyolite	57%	42%	1%	142	100%	36%	36%	27%	-	11	100%
Welded tuff	27%	73%	-	11	100%	-	-	-	-	0	0%
Total	47%	49%	4%	1503	100%	20%	36%	37%	7%	134	100%

Table 15. Biface, Microblade, and Flake Tool Reduction Represented in LPS 1 Debitage and Tools.

Material Type	Debitage					Tool					
	Biface	Core & Flake	Micro-blade	Total *n*	Total %	Biface	Flake Tool	Retouched Flake	Micro-blade	Total *n*	Total %
Argillite	71%	29%	-	52	100%	50%	-	50%	-	4	100%
Basalt	48%	52%	-	31	100%	-	100%	-	-	1	100%
Chalcedony	65%	35%	-	112	100%	22%	56%	22%	-	9	100%
Chert	52%	48%	-	154	100%	14%	14%	71%	-	7	100%
MCS	60%	40%	-	5	100%	-	-	-	-	0	100%
Obsidian	-	-	-	0	0%	100%	-	-	-	1	100%
Other	-	100%	-	1	100%	-	-	-	-	0	0%
Quartz	5%	95%	-	55	100%	-	100%	-	-	2	100%
Rhyolite	42%	58%	-	76	100%	100%	-	-	-	1	100%
Total	50%	50%	0%	486	100%	28%	36%	36%	0%	25	100%

Table 16. Biface, Microblade, and Flake Tool Reduction Represented in LPS 2 Debitage and Tools.

Material Type	Debitage					Tool					
	Biface	Core & Flake	Micro-blade	Total *n*	Total %	Biface	Flake Tool	Retouched Flake	Micro-blade	Total *n*	Total %
Argillite	46%	54%	-	24	100%	-	-	-	100%	1	100%
Basalt	57%	43%	-	14	100%	-	-	-	-	0	0%
Chalcedony	54%	44%	2%	179	100%	33%	67%	-	-	6	100%
Chert	41%	50%	9%	246	100%	21%	46%	21%	13%	24	100%
MCS	47%	53%	-	15	100%	-	-	-	100%	1	100%
Obsidian	39%	61%	-	49	100%	-	-	100%	-	2	100%
Other	25%	75%	-	12	100%	-	-	-	-	0	0%
Quartz	4%	96%	-	763	100%	12%	35%	53%	-	17	100%
Quartz crystal	-	100%	-	10	100%	-	-	-	-	0	0%
Quartzite	71%	29%	-	7	100%	-	-	-	-	0	0%
Rhyolite	43%	57%	-	362	100%	54%	31%	15%	-	13	100%
Total	26%	72%	2%	1681	100%	25%	39%	28%	8%	64	100%

Village Site

The earliest Village site occupations in the study sample are characterized by high tool counts, few cores, high proportions of bifacial reduction debitage among chert materials, and high proportions of core-and-flake reduction debitage among rhyolite, basalt, and welded tuff (Table 13; Figure 19). Bifaces are present as five small teardrop-shaped points and fragments, one triangular point, a finely-thinned indented point base, a point tip, and five unhafted ovate to teardrop-shaped preforms and fragments. Flake tools are most heavily represented by retouched flakes, end scrapers, and side scrapers, as well as a few burins and knives, a wedge-shaped piece, and a combination tool (Table 12). A single rhyolite blade tool is also present. Cherts and chalcedonies are the most common material for all tool groups.

Within the sample area, 23 artifacts from Levels 6–9 had previously been identified as Chindadn microblades. Based on field notes, many of these microblades were in fact from upper sediments and stratigraphically ambiguous locations, and eight items were re-identified as bladelets and blade-like flake fragments. Within C1 as defined in the current study, microblade technology is more limited, represented by a chert ridge flake, chalcedony platform preparation flake, and 12 microblade fragments of argillite, chert, and chalcedony. Of these, a ridge flake and two proximal microblade fragments were described in field notes to have come directly from the purple paleosol marking the earliest occupations, while the remaining 11 pieces were assigned to C1 based on their position in the lower silt package or below the sterile section between components. Whether this placement represents the presence of microblade technology within the earliest occupations, or compression of 9000–13,000 cal B.P. deposits into a palimpsest spanning multiple cultural horizons, may be at least partially clarified with future dating programs.

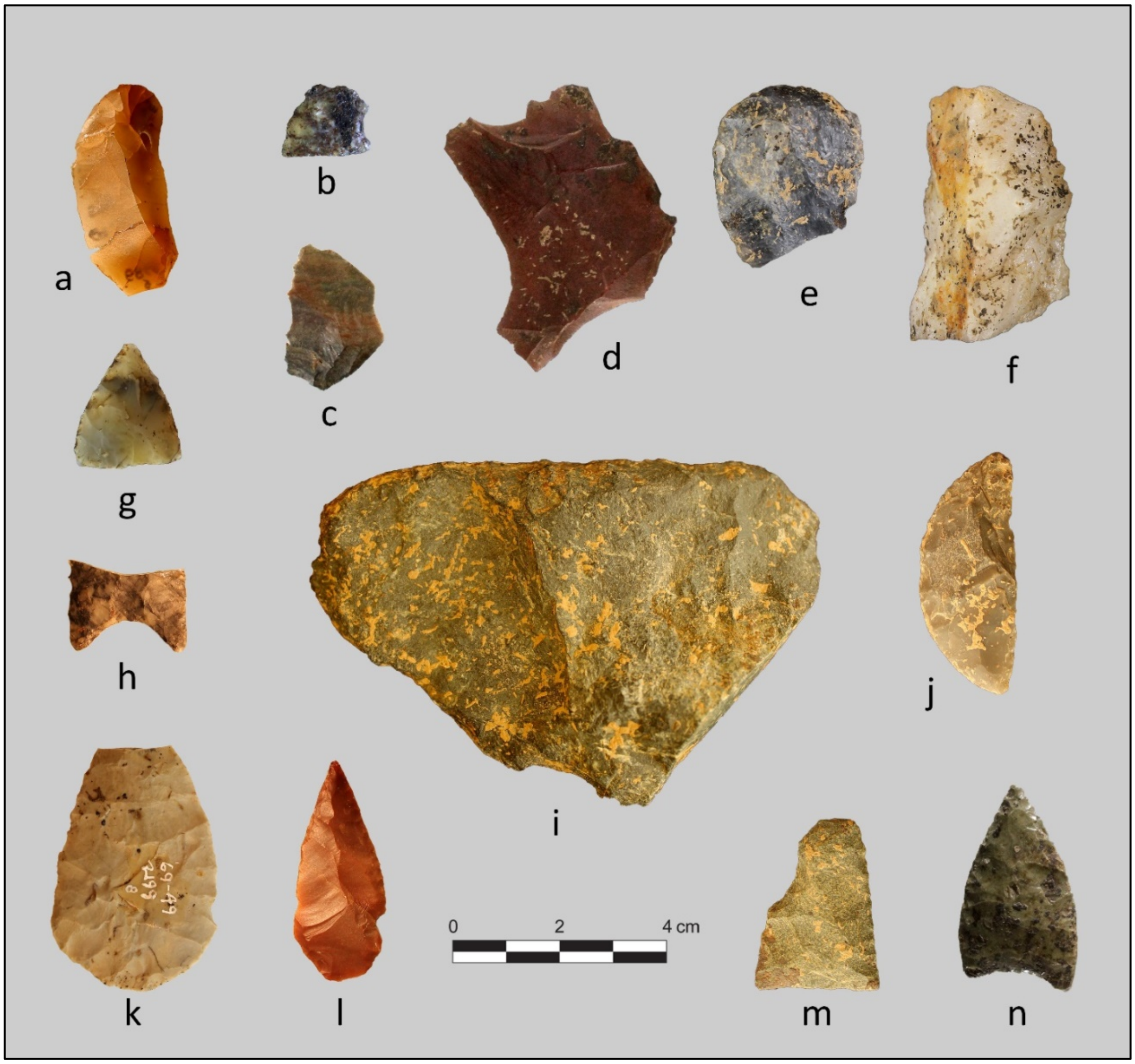

Figure 19. Component 1 tools from Healy Lake Village (a, g, h, k, l) and Linda's Point (b-f, i-j, m-n): a) bladelet tool, b-d, f) flake tools, e) end scraper, g-h) bifaces, i) end scraper, j) crescentic biface, k-n) Chindadn bifaces.

The C2 component of the Village site is characterized by nearly even distributions of flake tools and informally retouched flakes, slightly fewer bifaces, and a relatively small number of retouched microblades (Table 14; Figure 20). Debitage overall is evenly divided between biface and core-and-flake technologies, with individual material types following general patterns common to all components. Bifaces are made from a variety of materials, and include eight lanceolate points and fragments, eight unidentifiable base and tip fragments, four ovate unhafted bifaces, one foliate biface, and six unfinished edge fragments. Flake tools are composed mainly of scrapers, including side scrapers, end scrapers, and combination tools (Table 12). Within the tool assemblage, basalt and rhyolite exhibit an emphasis on bifaces while the remaining types are mainly used for flake tools and retouched flakes. Microblade technology includes 2 microblade cores, 3 ridge flakes, 3 platform tablets, 2 frontal rejuvenation spalls, 10 retouched microblade fragments and 56 discarded unretouched microblade fragments. The majority of these are chert, as well as a few of chalcedony, rhyolite, obsidian, and other rare materials.

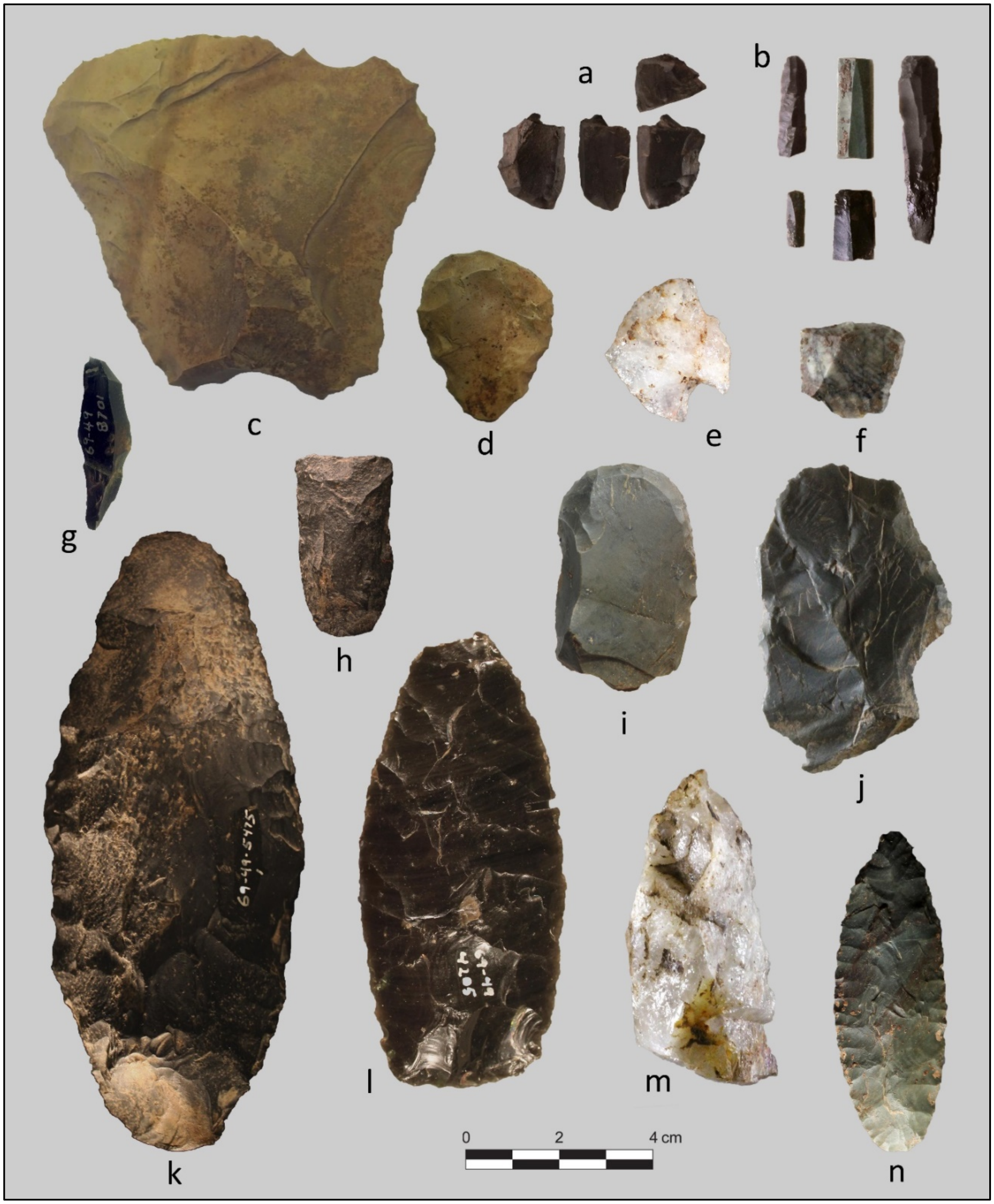

Figure 20. Component 2 tools from Healy Lake Village (c-d, g-h, k-l) and Linda's Point (a-b, e-f, i-j, m-n): a) microblade core, b) microblades and fragments; c-d, i) scrapers; e-f, j, m) retouched flake tools; g) platform tablet; h, k-l) broken bifaces and preforms, n) lanceolate point.

Linda's Point

C1 of Linda's Point is unique for a complete lack of microblade technology in the tool and debitage assemblages (Table 15; Figure 19). It has a slightly higher proportion of biface technology compared to the other components, represented by a small triangular point, a finely thinned indented-based point, two small straight-based basal point fragments, a crescent-shaped biface, a broken preform and a small unfinished edge fragment. Bifaces are made on chert, chalcedony, argillite, rhyolite, and obsidian — many of which are rarer types with little to no corresponding debitage on-site. Flake tools include two end scrapers, a robust basalt scraper, small burinated retouched flakes, and a few marginally retouched flakes, with flake tools made primarily on chalcedonies, as well as chert and basalt, and informally retouched flakes more commonly made from cherts (Table 12).

At Linda's Point C2, local quartz is prominent compared to other components, as well as heavily dominated by core-and-flake debitage (Table 16; Figure 20). Bifaces in this component are represented by two lanceolate projectile points, a medial point fragment, four ovate unhafted bifaces and preforms, and eight unfinished fragments. Flake tools include a wide variety of end scrapers, side scrapers, combination tools, reworked bifaces, burins, and a knife tool (Table 12). Microblade technology is represented by a small wedge-shaped core and a fragment, a wide core tablet, 5 retouched microblade fragments and 25 discarded unretouched microblade fragments. Few discarded C2 tools are represented by rare or exotic materials, instead being mainly represented by the common rhyolite, grey chert, and local quartz. Selectivity is evident:

nearly all microblades are made on chert, while the majority of rhyolite tools are bifaces, and chalcedony was more commonly used for flake tools. The less workable local quartz was most commonly used for flake tools and informal retouched flakes.

Reduction Intensity

Reduction intensity is similar across components at Healy Lake. While bifaces are generally finished or near complete, they are not finely finished, reflected in average flaking indices of 3.2–3.6, and HRI indices near .52–.56 (Table 17), with the exception of Linda’s Point C1, which has a significantly higher flaking index than the other assemblages. Flake tools appear to be well-curated, with GUIR values near .7–.9 for flake tools overall, and a marginally significantly lower average value for Linda’s Point C2, mainly in comparison to Linda’s Point C1 (Table 17). Reduction indices of scrapers alone show no significant differences, which may be due to the standardized measurable edge on scraper tools, indicating that the significant differences in reduction may relate to variability among other flake tools.

Table 17. Tool Reduction Indices at Healy Lake.

Reduction Index	Statistic	HLV 1	HLV 2	LPS 1	LPS 2	Kruskal-Wallis *p*-value
Biface Flaking Index	*n*	10	17	4	6	.037
	μ	3.626	3.181	5.052	3.281	
	s	.838	1.033	.626	1.440	
Biface HRI	*n*	7	12	3	5	.125
	μ	.524	.561	.947	.548	
	s	.350	.245	.065	.123	
Flake Tool GUIR	*n*	21	23	8	20	.050
	μ	.707	.782	.595	.863	
	s	.188	.203	.324	.263	
Scraper GUIR	*n*	14	15	4	8	.728
	μ	.799	.799	.842	.871	
	s	.120	.200	.260	.286	

Reduction Sequences

Every step of the reduction sequence from core to finished tool is represented in the four assemblages at Healy Lake; however, activities are distinctly skewed towards the later steps (Figure 21). Within the entire sample of analyzed artifacts for both sites, there are 32 cores, 1619 primary debitage pieces, 2625 secondary pieces, and 290 tools. The remaining 4766 pieces are distal flakes and fragments that could not reliably be assigned to a stage.

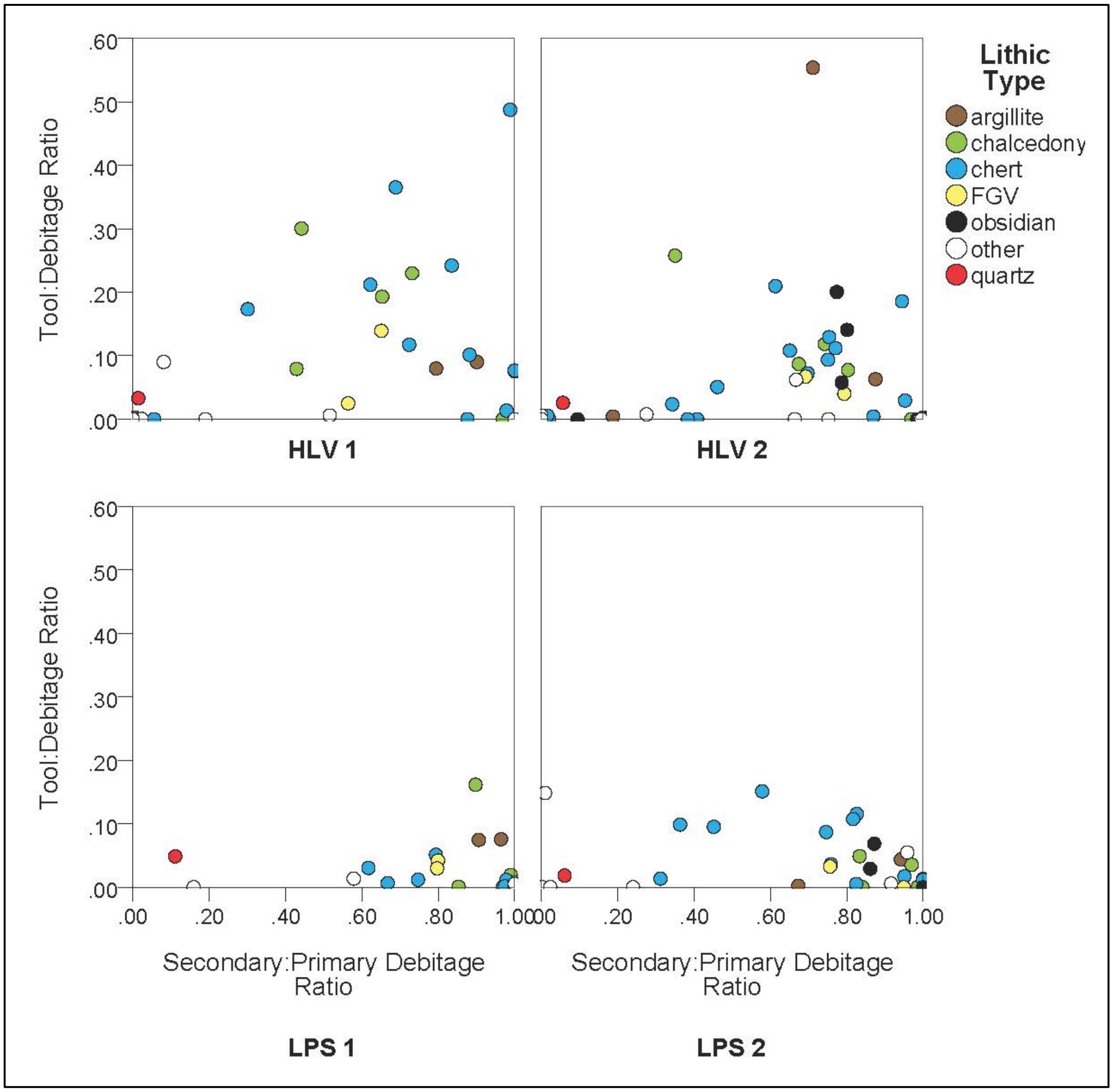

Figure 21. Reduction stage composition of lithic material assemblages in each component.

In both components of the Village site, a weak correlation is visible between proportion of secondary debitage and proportion of tools. While chert and chalcedony range widely from mostly primary to mostly secondary debitage, fine-grained volcanics are more balanced, and local quartz and low-quality "other" materials are represented by mainly primary debitage. The majority of C1 materials at the Village site represent intermediate to late stages of reduction with a relatively high proportion of discarded tools compared to the other components (Figure 21). Only a single core of medium-grey chert is present. In comparison, the C2 assemblage shows a lower proportion of tools and a slight increase in cores and primary debitage, although reduction is still mainly secondary (Figure 21). Material types are more consistently used, with obsidian, fine-grained volcanics, and the majority of chalcedonies grouped together near 5–15% tool rates, and 70–80% secondary debitage.

The Linda's Point site is almost entirely represented by secondary reduction in C1 (Figure 21), with relatively few discarded tools. Local quartz includes cores and primary reduction debitage, representing the only common material to be represented mainly by primary reduction. Rare, poor quality materials are also represented by higher proportions of secondary debitage. Similar patterns are seen in C2, with a few notable exceptions. There is a shift in focus towards greater primary reduction of quartz and many of the chert materials, while other rarer and exotic materials cluster very highly towards secondary reduction. Cores of quartz, rhyolite, and grey chert also become more prevalent.

Discussion: Lithic Reduction Strategies at Healy Lake

Some of the originally predicted patterns of technological organization are apparent at Healy Lake, such as increasing selectivity, increasing prominence of microblade technology, and increasing presence of exotic materials between C1 and C2. Although differing from early occupations at Dry Creek and Walker Road, a high proportion of late-stage reduction debitage in C1 suggests curation and transport of nonlocal materials, and is consistent with expectations for highly mobile terminal Pleistocene populations, as is the presence of high average biface flaking indices. Furthermore, the presence of different lithic procurement and reduction strategies between the sites in C2 is consistent with the expected transition towards logistical organization.

A few potential sources of sampling bias should be noted. The current Village site study sample was selected from units at the center of the main excavation area, where C1 deposits were known to be present. This was intended to mirror the excavation sampling strategy at Linda's Point, where the initial group of excavation units was placed over a known C1-aged hearth, but still may have introduced some bias. Further, screens were not used at the Village site, so that potential loss of smaller debitage during excavation may inflate tool-to-debitage ratios while decreasing secondary debitage ratios. Finally, it is not known whether Village site excavators consistently identified and collected the large, blocky quartz debitage as cultural materials, as was done at Linda's Point. These potential inconsistencies in sampling may increase differences in apparent material selectivity and tool diversity.

Assemblage Diversity and Site Function

A wide variety of similar tool types are found throughout all assemblages at Healy Lake, indicating a variety of activities related to hunting, food processing, leatherworking, tool maintenance, and fine working of organic materials. Their occupations can be interpreted to represent some extent of habitation beyond simple hunting or extraction activities. Although proportions of hafted bifaces are similar in all components, reduction indices differ. This perhaps reflects differences in reduction of different types: crescentic, triangular, and indented-based points at Linda's Point, compared to more informally reduced teardrop-shaped bifaces at the Village site (see Chapter IV for detailed discussion of technological differences between these biface types). Higher levels of point reduction and curation may indicate Linda's Point C1 represents a more limited-use hunting and faunal processing camp, in contrast to longer-term occupation at the Village site where bifaces were produced and used for functions other than projectiles. Conversely lower flake-tool reduction indices at Linda's Point C1 may also support this, indicating more expedient tool use during a shorter occupation period.

Procurement Strategies and Reduction Stages

All four assemblages at Healy Lake show a strong emphasis on later-stage reduction from nonlocal but regionally available materials, consistent with the lack of locally available high-quality materials. One of the few exceptions to this trend is the local quartz industry, which makes up a substantial aspect of the Healy Lake archaeological record despite the low workability of the material. Although present in all components, heavy use of local quartz appears to be unique to C2 at Linda's Point. The Village site does not show a similar spike in local material use in C2, indicating inter-site differences in procurement. However, given the potential influence of differing excavation methodologies, definitive conclusions cannot be reached without further excavation in the region to clarify the role of local quartz use at multiple sites.

Corresponding with the changing focus from C1 to C2 towards greater primary reduction of local materials, there is a trend at both sites toward increasing primary reduction of other material types. Overall, patterns of lithic reduction of nonlocal materials are consistent with the transport of previously worked cores and preforms to the site from other locations. Non-quartz cores are generally found only in common materials such as rhyolite and grey chert, and are often small, discarded after exhaustion. Increasing visibility of primary reduction and core discard in C2 may reflect longer occupation times, and therefore time during which to exhaust flake cores; alternatively it may reflect a shift to occupation patterns where inhabitants knew they could procure new materials easily at their next camp location, or where cores were exhausted during "gearing-up" tool production activities.

Increasingly selective use of lithic materials between C1 and C2 corresponds to increasing production of microblades, which are made primarily from fine-grained cherts with predictable fracture patterns, as well as increasing use of fine-grained volcanics for biface production, and chalcedonies for almost all other tools. This is adaptively explained by the sharper edges provided by more brittle chert and obsidian, and a potentially lower failure rate for more resilient rhyolite projectiles. Producing larger and more expedient flake tools from the poorly knappable local quartz would further allow selective use of finer-grained materials for more delicate burins and microblade tools. These intentional choices would become increasingly adaptive with increasing knowledge of the lithic landscape over time, and with increasing flexibility to access them during procurement forays within a logistical system.

The relative lack of emphasis on local materials in C1 of both sites mirrors lithic use choices seen at Ushki Lake in Kamchatka, with its low availability of high-quality toolstones and corresponding emphasis on nonlocal materials (Graf and Goebel 2009). Within the Tanana valley, the C1 occupations at Healy Lake differ from the 13,000 cal B.P. Mead CZ4, where similar locally available quartz makes up a large portion of the debitage assemblage, accompanied by maintenance and use of tools of nonlocal material (Little 2013). They are instead similar to the 12,000 cal B.P. Mead CZ3, where low diversity of tools and materials are interpreted to represent high-mobility residential camp bases, or possibly multiple short-term palimpsest occupations (Little 2013). Although differences in the richness of tools and materials between Linda's Point and Village site have been shown to be a result of sample size, preventing comparative interpretations of occupation length based on richness and diversity, radiocarbon chronologies of both sites indicate the potential for palimpsest occupations.

Overall, it seems that Beringian lithic procurement strategies, and possibly also mobility, varied in response to environmental conditions and the lithic landscape. Adaptive choices appear to have been based as much on availability and opportunistic use of materials as on predetermined selectivity and settlement patterns. As suggested by Goebel, the foreknowledge to predict local availability at campsites would allow inhabitants to discard heavy stone tools before travel and to manufacture new tools from locally available materials at the next stopping point (Goebel 2011). This foreknowledge requires both planning and knowledge of the landscape, and indicates that early Beringian occupations do not simply represent transient migrants passing through the region, but a well-adapted, long-lasting cultural system within the larger Beringian environment.

Conclusions

Toolstone selection and use strategies of the early inhabitants of Healy Lake were influenced by the scarcity and low quality of local materials, with evidence for curation, selectivity, and later-stage reduction of nonlocal materials found throughout the occupation of both the Village site and Linda's Point. A wide diversity of material types common to all sites, combined with a low presence of cortex and low discard rates of exhausted cores, all indicate a combination of procurement from nonlocal sources, perhaps glacial cobble beds, as well as intentional strategies for procuring and transporting materials. The shift towards primary reduction and use of lower-quality but readily-available local material, most notably in the later component at Linda's Point, potentially indicates longer occupation times and reduced overall mobility in the Holocene compared to earlier terminal Pleistocene populations.

Similar to Healy Lake, patterns of increasing toolstone selectivity over time are seen at Dry Creek and Ushki (Graf and Goebel 2009), suggesting common behaviors across Beringia in response to changing environments. Patterns of selectivity are consistent, showing use of fine-grained volcanics for bifaces and crypto-crystalline silicates for flake tools, and are even seen quite early in Alaska at Walker Road (Goebel

2011). Toolstone selection and use also appears to have been tailored to the lithic resources present at different sites, indicating either knowledge of the lithic landscape, limited logistical organization, or both. These patterns together suggest the presence of nascent adaptive strategies that became stronger as populations gained increasing familiarity with the local resources after extended habitation of Beringia, and shifted to more complex settlement patterns allowing greater command of available lithic resources.

CHAPTER IV

TERMINAL PLEISTOCENE BIFACES OF CENTRAL ALASKA: TYPOLOGY, TECHNOLOGY, AND ADAPTIVE STRATEGIES

Chindadn points, the diagnostic biface used to mark the Chindadn (Cook 1975; Cook et al. 1971) and Nenana complexes (Goebel et al. 1991), are an integral part of the early interior Alaskan archaeological record. Simply defined, a Chindadn point is a small, thin, triangular or teardrop-shaped biface, and most likely to be a part of an otherwise unifacial late Pleistocene toolkit of blade tools, flake tools, gravers, and scrapers (Goebel 2011; Goebel et al. 1991; Holmes 2001, 2011). Chindadn points are found in early occupations of archaeological sites in the Nenana and Tanana River basins (Figure 22), where some of the earliest human activity in eastern Beringia is represented in components ranging from 13,470-11,390 cal BP (Holmes 2011; Potter et al. 2013). Although easily recognized typologically, the very simplicity of the Chindadn form has left it a poorly understood, loosely defined artifact type, with an ambiguous role within the terminal Pleistocene cultural repertoire. Its functions are not well understood — despite the presence of a distinct distal tip, the simple shape of the basal element does not directly imply hafting or use as projectiles, nor are there readily apparent utilized edges. Further, although associated toolkits are relatively consistent, the biface’s role in relation to microblade technology is not well-established. The current research seeks to address these problems by providing a more detailed technological definition of Chindadn biface technology, and to understand their adaptive role within a terminal Pleistocene Beringian cultural system.

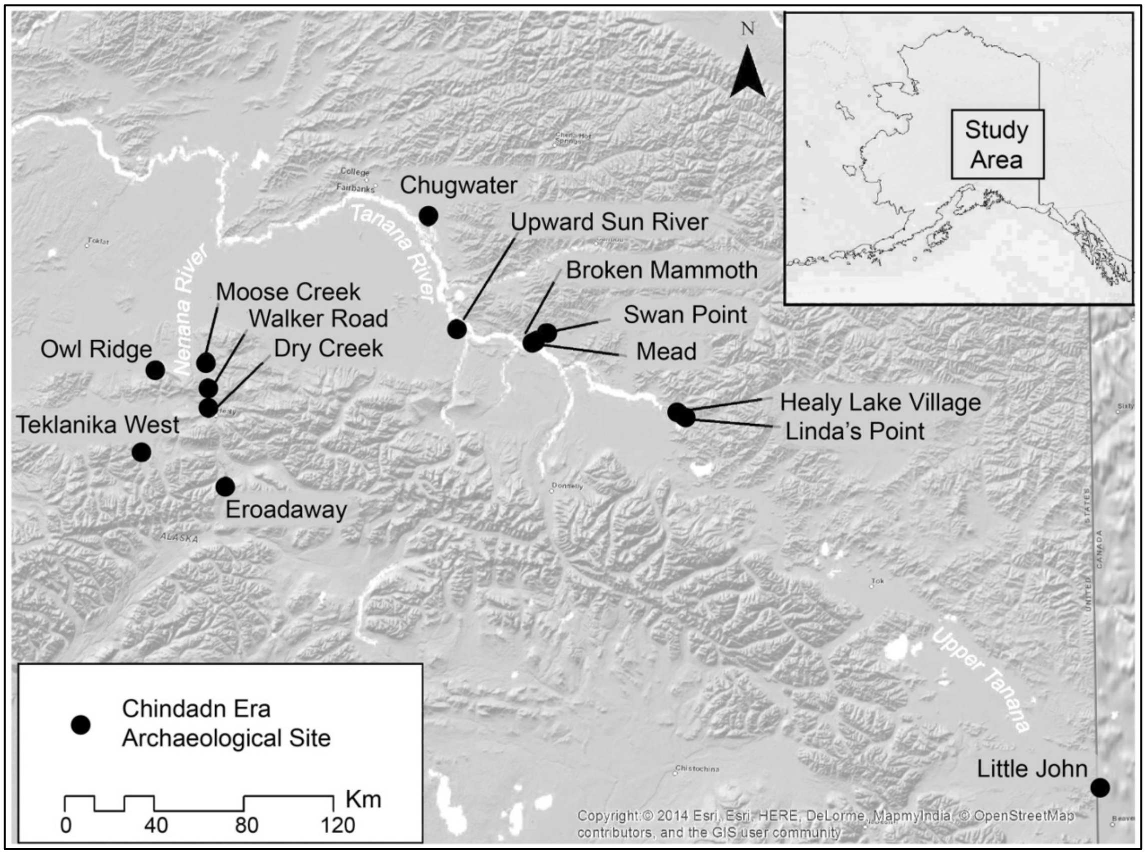

Figure 22. Map of interior Alaska showing terminal Pleistocene archaeological sites. Figure produced using ArcMap (Esri 2011; Esri et al. 2014b).

Background

Chindadn points were originally recognized by John Cook in the earliest occupation levels of the Village site at Healy Lake as very thin teardrop-shaped bifaces

(Cook 1975:131; Cook and McKennan 1970). He assigned them to the Healy Lake Chindadn complex, containing triangular and basally thinned bifaces, microblades, Denali-like microblade cores, and Donnelly burins, all estimated to be about 11,000 years old (Cook 1969, 1975). Since this time, similar small, thin bifaces with teardrop, triangular, or subtriangular outlines have been found throughout the Tanana River basin, in the earliest occupation at the nearby Linda's Point site (Younie and Gillispie 2016), the earliest component at Chugwater (Maitland 1986), and in the second-earliest occupations at Broken Mammoth (CZ3), Swan Point (CZ3), and Mead (CZ4) (Holmes 2001, 2011; Potter et al. 2013). A14,200 cal BP microblade industry has been found stratigraphically underlying Chindadn bifaces at Swan Point (Holmes 2011), and the chronological relationship between these technologies is ambiguous in the Tanana valley. Holmes divides early Alaskan bifaces from these sites into four types, placing them within a wider East Beringian Tradition: Chindadn type 1 (>12,800 cal BP), Cook's original teardrop shaped outline; Chindadn type 2 (ca. 12,050 cal BP), a triangular to subtrianguloid form; Chindadn type 3 (ca. 12,050 cal BP), a basally thinned, convex-based form; and Chindadn type 4 (ca. 11,000 cal BP), a lanceolate bi-pointed form typically attributed to the Denali complex, but reportedly found in earlier components at the Healy Lake Village site (Cook 1996; Holmes 2001, 2011).

In the neighboring Nenana River valley, Goebel and Pontti (1991) defined Chindadn points as small, thin teardrop-shaped bifaces, 3 to 5 cm in length, made on bifacially and bimarginally retouched flakes and blades. Along with triangular forms, they have been noted in the earliest cultural components at Dry Creek (Powers et al.

1983; Powers and Hamilton 1978), Walker Road (Powers et al. 1990), Moose Creek (Pearson 1999), and Owl Ridge (Graf and Bigelow 2011). They are a diagnostic artifact of the Nenana complex, which represents the earliest occupation in the region at 13,500-13,000 cal BP and is characterized by blade and flake cores, unifacial scrapers and blade tools, and gravers (Goebel 2011; Goebel et al. 1991; Hoffecker et al. 1993). Within the Nenana valley, the complex is consistently stratigraphically separated from later microblade-bearing components assigned to the Denali complex (Goebel and Buvit 2011; Powers and Hoffecker 1989).

Chindadn bifaces are typically referred to as points, and often discussed as projectile tips related to hunting; however, these hypotheses have not been tested. Based on their presence in association with hide processing implements at campsites, Goebel and Pontti (1991) hypothesized that the teardrop-shaped bifaces likely functioned as perforators or knives, noting the presence of similar artifacts at Ushki and Berelekh in Siberia, while Powers et al. (1983) interpreted the triangular bifaces to represent projectile points, due to their sharp regular margins, symmetrical tip, and flat cross-section. Noting their small size, Dixon (2011) hypothesized their potential role within an early northern bow-and-arrow technological system. Graf and Bigelow (2011) hypothesized that they were used as part of a simple, expedient hunting toolkit specialized to the pre-Younger Dryas, compared to the more diverse and deliberate Younger Dryas toolkit of bifaces and composite points. In contrast, Potter and colleagues have suggested that throughout all periods of the terminal Pleistocene, small triangular points in the uplands of the Nenana valley were used in upland sheep and caribou hunting, while microblade-composite projectile systems were related to the lowland hunting of larger bison and wapiti (Potter 2011; Potter et al. 2013).

This study describes and quantifies the technology of Chindadn biface manufacture, and evidence for use and reuse, to clarify the potential role of these bifaces within the adaptive cultural system of eastern Beringians. While the shape and size of the triangular varieties are similar to Holocene projectile tips, the teardrop forms are more ambiguous, and the associated presence of concave-based and subtriangular forms all hint at a range of potential functions. To explore reasons for this variation in shape, I consider regional and temporal distributions, lithic materials, technologies, breakage, and discard patterns. Finally, results are considered within the context of Beringian environments and potential adaptive systems, providing new hypotheses for future testing and analysis.

Materials and Methods

Sample Selection

The sample selected for analysis includes the available bifaces from the terminal Pleistocene components of archaeological sites in interior Alaska, dating to 12,000 cal BP and earlier (Appendix A). Specialized bifacially-shaped tools such as crescents and spokeshaves were not included, nor were informally-worked bifacial fragments. From 12 different sites, I evaluated 80 bifaces, 70 directly and 10 based on published data (Table 18), as well as 12 small biface edge and tip fragments. Bifaces unavailable at the time of research included four from Mead (Potter et al. 2013), one from Broken Mammoth (Heidenreich 2012), and a stolen biface from Dry Creek (Hoffecker et al. 1996; Powers et al. 1983). Four bifaces from Little John (Easton 2008), were also indirectly assessed. Chronology was established using pooled mean radiocarbon dates presented by Potter (Potter 2008c; Potter et al. 2013), updated to IntCal13 from IntCal09 (Ramsey 2009), with exceptions calculated following Ward and Wilson (1978) and calibrated with CALIB v 7.0.2 using the IntCal 13 calibration curve (Ramsey 2009; Reimer et al. 2013).

Statistical tests are based mainly on a primary sample of 58 bifaces. The remaining 22 bifaces were excluded from statistical study, but still used for general regional comparisons. The Little John bifaces are stratigraphically assessed to be older than an overlying 10,000 cal BP occupation, but not directly dated (Easton 2008; Easton et al. 2011). The Chugwater site is shallow, with most bifaces either surface collected or found in stratigraphically insecure contexts, as well as having chronological inconsistencies within the target study period (Erlandson et al. 1991; Lively 1996). Insufficient published information is available for the Mead bifaces to be included. Finally, bifaces from Eroadaway, found at the southern limit of the study area (Holmes et al. 2010), were assessed separately and determined to be unique from the Chindadn bifaces (Appendix B).

Table 18. Chindadn Biface Sample.

Sample	Archaeological Site[1]	Date (cal BP)	Comp-onent	Complete /Basal Fragments	Unidenti-fiable Fragments	Total
Primary				56	12	68
	Village Chindadn[2]	13,300 - 9,410	basal	21	3	24
	Swan Point CZ3[3]	12,830-11,390	second	9	5	14
	Walker Road	13,270-12,850	basal	7	-	7
	Broken Mammoth CZ3	12,390-11,810	second	5	-	5
	Dry Creek C1	13,130-12,760	basal	5	1	6
	Linda's Point C1[4]	12,540-12,420	basal	5	-	5
	Moose Creek C1	13,180-12,880	basal	2	-	2
	Owl Ridge C1	13,080-12,810	basal	2	3	5
	Owl Ridge C2[5]	12,420-12,080	second	1		1
	Broken Mammoth CZ4	13.420-13,140	basal	1	0	1
Secondary				22	-	22
	Eroadaway	12,820-12,700	basal	13	-	13
	Little John	>10,000	basal	4	-	4
	Mead CZ4	13,050–12,830	second	4	-	4
	Chugwater	>10,000	basal	1	-	1
Total				80	12	92

[1] Dates based on average C14 values from Potter at al. 2013 unless otherwise noted

[2] Cook 1996

[3] Holmes 2014

[4] pooled mean from dates presented by Younie et al. (in press).

[5] Pooled mean from dates presented by Graf et al. (2011)

Ironically, the inclusion of Healy Lake Village site bifaces was problematic. Prior definition of the Chindadn complex was based on absolute depth measurements and arbitrary levels, preventing confident chronological assessment (Erlandson et al. 1991). I based the current selection of Village site bifaces on stratigraphic association and relative depth within the profile, following methods outlined in Chapter III (see p. 71). Several lanceolate bipoints originally attributed to the Chindadn complex were re-assigned to the base of the overlying component or to potentially compressed contexts, and so these items were excluded.

Classification

Many common methods of biface classification and analysis were difficult to apply to the study sample. First, a clear distinction between finished and unfinished bifaces was not present. Many artifacts with only marginal flaking, or thinning of only one face, were otherwise fully finished with regular margins, edge-grinding, and sometimes even hafting abrasion. Secondly, simple basal shapes and ambiguity of the hafting element prevented classification according the shaping and finishing of the haft. To isolate unfinished preforms from finished bifaces for further analysis, I instead explored the assemblage according to more objective measures of shape and size. I measured all complete artifacts with a digital scale and digital calipers to determine weight, maximum length, maximum thickness, and maximum width (Figure 2), and calculated a geometric mean of all four variables.

Analysis of finished biface form was also limited by the simplicity of Chindadn hafting elements. No notch, stem, or haft element lengths, angles, or ratios were available for measurement. Given the small sample size, I sought measurements that could be applied to fragments so as not to further limit the sample to only complete specimens. Three variables were used for shape classification (Figure 23). Basal width ratio (BWR) and basal indentation ratio (BIR) are taken from Morrow and Morrow (1999), calculating the ratios of basal width and basal indentation, respectively, to maximum width. The maximum width ratio (MWR) used here is modified from the ratio used by Morrow and Morrow, replacing maximum length with maximum width to calculates the ratio of the height of the maximum width position to the value of the maximum width.

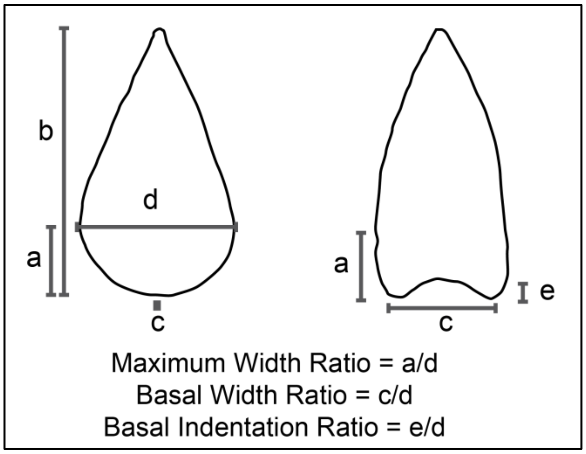

Figure 23. Metrics evaluated, as seen on various haft shapes: (a) maximum width position; (b) maximum length; (c) basal width; (d) maximum width; (e) basal indentation.

Description & Comparison

To evaluate the technology of biface production, I recorded the lithic raw material type, presence and type of cortex, flake scar size, termination, and directionality, the presence and regularity of the longitudinal midline, regularity of the lateral margins, presence of basal thinning, extent of flaking overlap, and presence of differences between the two faces in terms of these characteristics. Flaking variables were assessed qualitatively, and assigned to nominal categories. I assigned reduction stages on a ranked scale from biface blank to finished biface following Andrefsky (2005:187-190). Flaking intensity was quantified using a flake scar count index (Smallwood 2010), and retouch on finished bifaces quantified with a hafted biface retouch index (HRI) (Andrefsky 2006). Artifact function was assessed through size, cross section, and macroscopic evidence of hafting abrasion, edge grinding, and use-wear when examined under a 15x magnification hand lens. Breakage patterns and evidence of recycling were used to assess function, reuse, and discard patterns.

Within the basal shape classes, I assessed technological characteristics as a whole within each group, and compared each variable across groups to determine whether there are statistically relevant differences in reduction based on basal shape. Accounting for small sample size, I used the Kruskall-Wallis and Mann-Whitney U-Test for metric and ranked variables such as reduction index, and Fisher's exact test (FET) with post-hoc Bonferroni comparisons for nominal variables such as presence of hafting abrasion. Statistical testing was conducted using IBM SPSS Statistics © Version 22. Finally, generalized descriptions of each biface reduction sequence were compiled based on categorical and descriptive data collected.

Results

Isolation of Finished Bifaces

Complete bifaces show strong positive correlations between metric values (Table 19), indicating that variability between artifacts is related to overall size and not to variation in length, width, or thickness ratios. Plots of length, width, thickness, weight, and edge angle show consistent weak clustering across nearly all variables, with the exception of edge angle (Figure 24). The smallest size group, containing 21 bifaces, is closely clustered with measurements ranging 20-45 mm in length, 15-30 mm in width, and 0-8 g in weight (Table 20). The next largest group, containing 14 bifaces, ranges 45-75 mm in length, 30-50 mm in width, and 10-35 g in weight. Finally, two outliers are distinct for having thicknesses >15 mm and weight >40 g. For further analysis, I used these criteria to classify incomplete bifaces for a total of 47 small, 25 large, and 3 outlier bifaces (40 small, 15 large, and 2 outlier items within the primary sample).

Table 19. Correlation Matrix of Metric Values for Complete Bifaces in Primary Sample, (*p* = .000 for all results).

	Weight	Length	Width	Thickness	Geometric Mean
Weight	1.000	.861	.785	.961	.930
Length	-	1.000	.845	.789	.981
Width	-	-	1.000	.731	.885
Thickness	-	-	-	1.000	.867
Geometric Mean	-	-	-	-	1.000

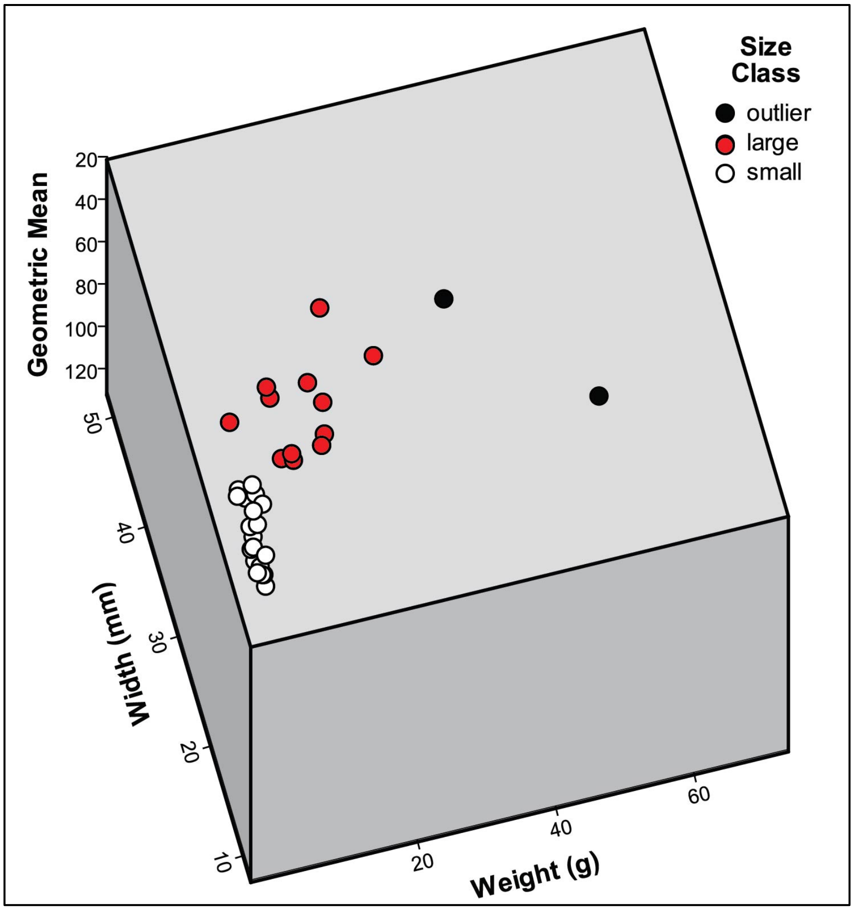

Figure 24. Complete bifaces plotted according to weight, width, and geometric mean.

Table 20. Distinguishing Metric Variables of Biface Size Classes.

Size Class	Variable	μ	Range	s
Outlier	weight	51.55	42.00 - 61.10	13.51
	length	74.70	63.59 - 85.81	15.71
	width	42.52	38.95 - 46.08	5.04
	thickness	18.44	15.07 - 21.80	4.76
	geometric mean	102.36	90.32-114.41	17.03
Large	weight	16.47	5.60 - 30.00	6.55
	length	59.95	42.02 - 72.34	9.55
	width	36.42	27.87 – 50.86	6.08
	thickness	8.32	4.56 - 11.56	1.99
	geometric mean	69.66	52.99-87.59	10.09
Small	weight	2.96	1.07 – 5.90	1.44
	length	34.83	22.71 - 45.37	6.50
	width	21.06	15.11 – 27.22	3.51
	thickness	4.57	2.12 – 7.36	1.18
	geometric mean	41.56	29.83-52.29	7.08

Table 21. Reduction Indices for Size Classes.

Measurement	Shape Class	n	μ	σ	Mann-Whitney: Small vs. Large Bifaces
Visually assessed stage	small	139	4.7	.7	$U = 5.333$, $p = .000$
	large	16	3.1	1.0	
	outlier	2	2.3	.4	
Flaking index	small	30	3.87	1.27	$U = 3.301$, $p = .000$
	large	14	2.41	1.08	
	outlier	2	1.56	.72	
Andrefsky HRI	small	34	.691	.281	$U = 2.436$, $p = .014$
	large	7	.421	.185	
	outlier	0	-	-	

Within the primary sample, significant differences in reduction indices support the distinction of the smaller group as finished pieces compared to the larger group as preforms, knives, and unhafted tools (Table 21). The outliers both exhibit cortex as well as very low reduction indices, indicating discard at the early preform stage. Overall, the larger biface group shows basic, unremarkable flaking patterns indicative of mid-stage biface reduction (Figure 25): minimal to moderate overlap of flakes with high variability in size and termination, random or roughly collateral flaking, irregular cross sections, and one face generally showing greater intensity and regularity of flaking than the other. Outlines are most often teardrop and ovate, with a high rate of complete specimens. The majority of fractures that are present are most likely attributable to manufacturing errors, often originating near hinged and stepped flake scars, and often with complete refitting pieces found closely associated in situ. Fisher's exact comparisons show no significant difference between large and small bifaces in terms of lithic material choices (FET = 5.357, df = 7, 55; p = .666), which may indicate that size groups are related along a single reduction stream, or may simply indicate selectivity in biface production overall.

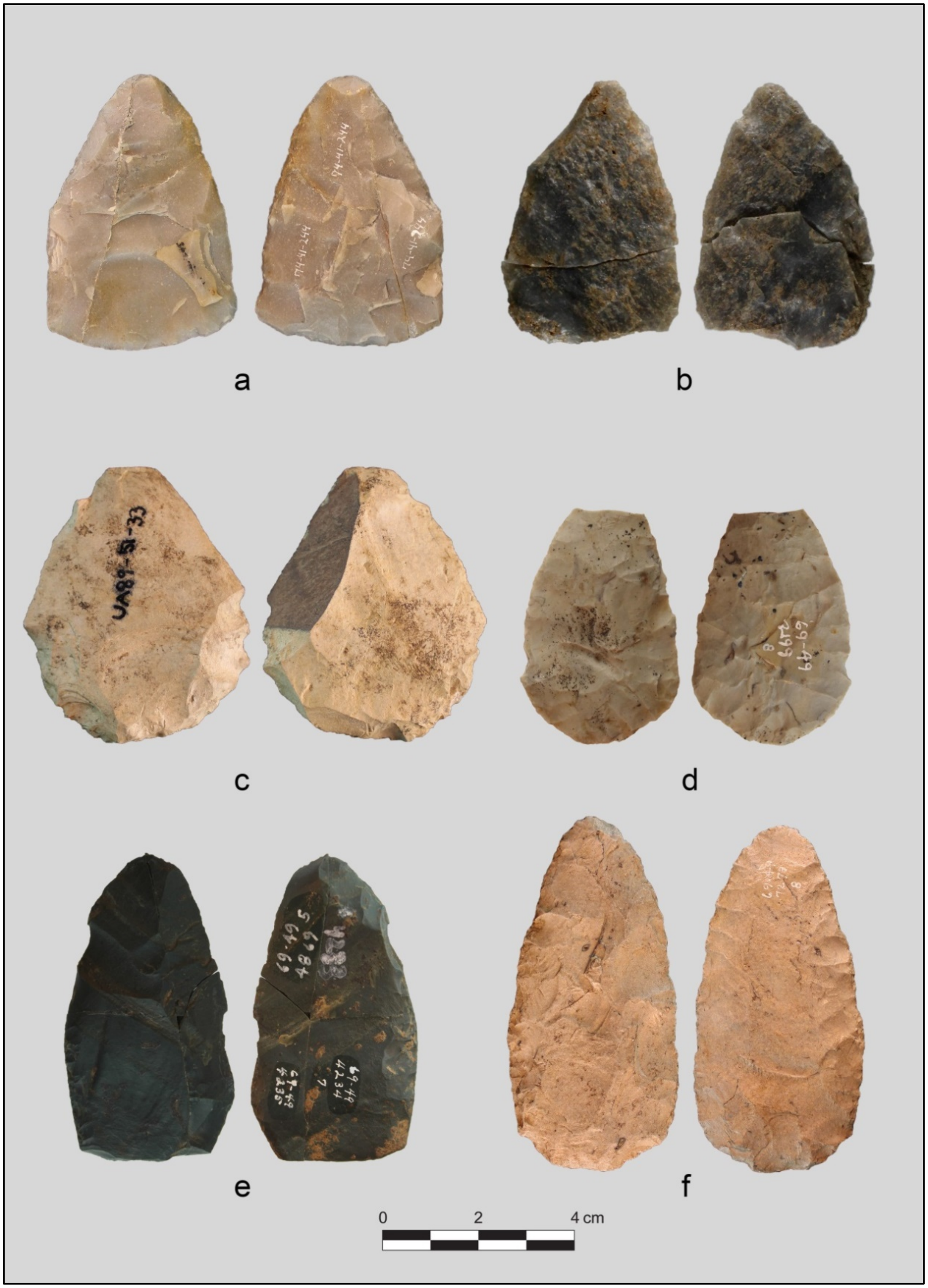

Figure 25. Large Chindadn bifaces: (a) Dry Creek; (b) Linda's Point C1; (c) Walker Road; (d-f) Healy Lake Village Chindadn.

Base Shape Classification

Clustering of haft shape variables produced four distinct groups, three of which are distinguished by extreme values of one of the measured variables, and a fourth distinguished by a combination of values (Figure 26; Table 22). A group of 11 bifaces is distinguished by a lack of basal indentation, lack of corner angles, basal width ratios near zero, and maximum widths found well above the base, creating a convex base and overall teardrop-shaped outline (Figure 27). A second group of 11 bifaces is distinguished by a maximum width located at or very near the base (MWR = 0, BWR ≈ .9-1.0) and a lack of basal indentation, creating a triangular outline (Figure 28). The third group, containing only five bifaces, is distinguished by noticeable basal indentation (BIR > .1) (Figure 29a-d). Occasionally overlapping with other groups in clustering analyses is a final, less well-distinguished group of nine bifaces with variable values for all indices, reflecting very slight basal indentation, and slight contraction toward the base, creating a subtriangular outline (Figure 29e-i).

Unclassified Pieces

An additional sample of 12 non-basal fragments includes four base and corner fragments, five tip fragments, an unidentified edge fragment, and one nearly complete small biface missing the basal edge. Two corner fragments show strong indentation indicating they are likely concave-based points, and the nearly complete biface lacks corners on the visibly remaining surface, indicating it is likely a convex-based form. Two thicker late-stage lanceolate-like fragments were found in an ambiguous stratigraphic level of the Village site, slightly above the paleosol in which the majority of Chindadn points are found. A few of the convex-based points are also from this section, and this portion of the stratigraphy may represent a disturbed or compressed section that explains the original incorporation of bipointed lanceolates into the Chindadn complex.

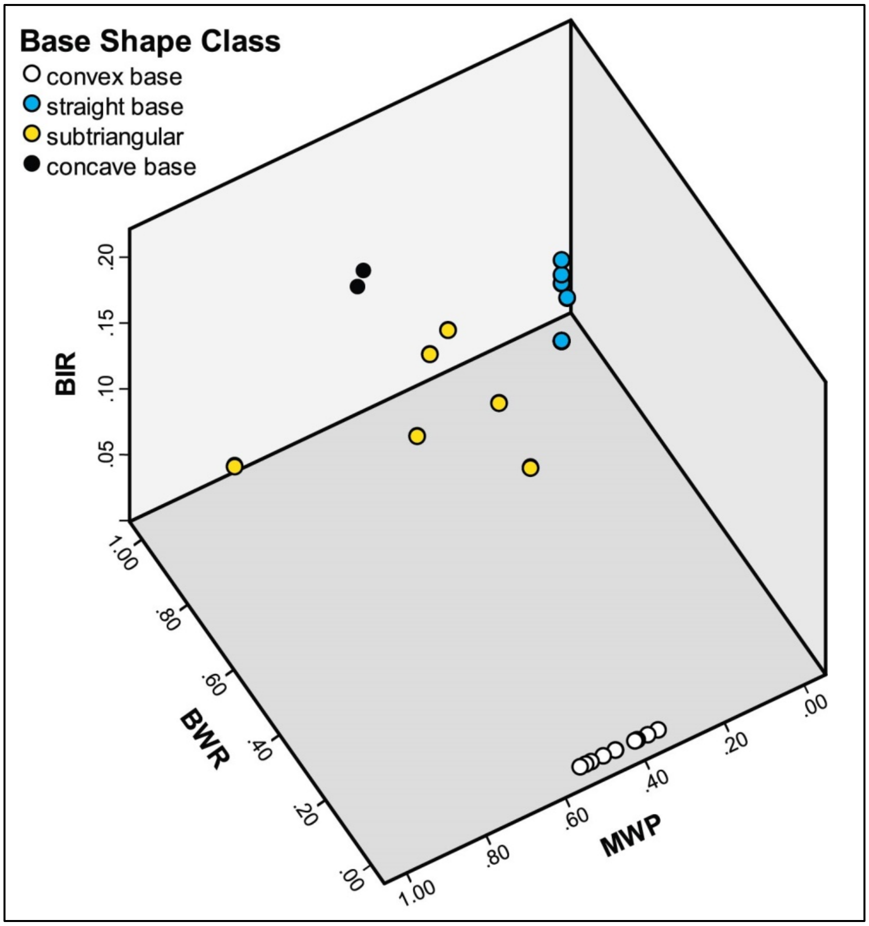

Figure 26. Small bifaces plotted according to BWR, MWP, and BIR.

Table 22. Distinguishing Variables of Basal Shape Classes.

Measurement	Shape Class	μ	Range	s
BWR	convex base	.000	.000 - .000	.000
	straight base	.998	.976 - 1.00	.008
	subtriangular	.862	.691 - .977	.102
	concave base	.912	.845 - .959	.055
BIR	convex base	.000	.000 - .000	.000
	straight base	.018	.000 - .061	.025
	subtriangular	.031	.000 - .100	.044
	concave base	.198	.086 - .295	.089
MWR	convex base	.434	.335 - .531	.066
	straight base	.000	.000 - .000	.000
	subtriangular	.434	.200 - .959	.257
	concave base	.609	.578 - .659	.044

Regional & Temporal Patterns

With the exception of the Little John and Eroadaway, archaeological sites containing Chindadn bifaces are fairly strongly concentrated in two separate areas, the Tanana and Nenana drainage basins. Although five such sites are found in each basin (Table 23), those in the Tanana valley have produced large collections of bifaces, compared to relatively isolated finds in the Nenana valley. Regional differences in basal shape are visible although not statistically significant ($FET = 2.404$; $df = 3$; $p = .532$): while a full half of the Nenana small bifaces are convex-based specimens, the Tanana contains a wider variety of forms, and all but one of the concave-based items, as well as the two concave-like corner fragments. Large bifaces are rare but present in both locations.

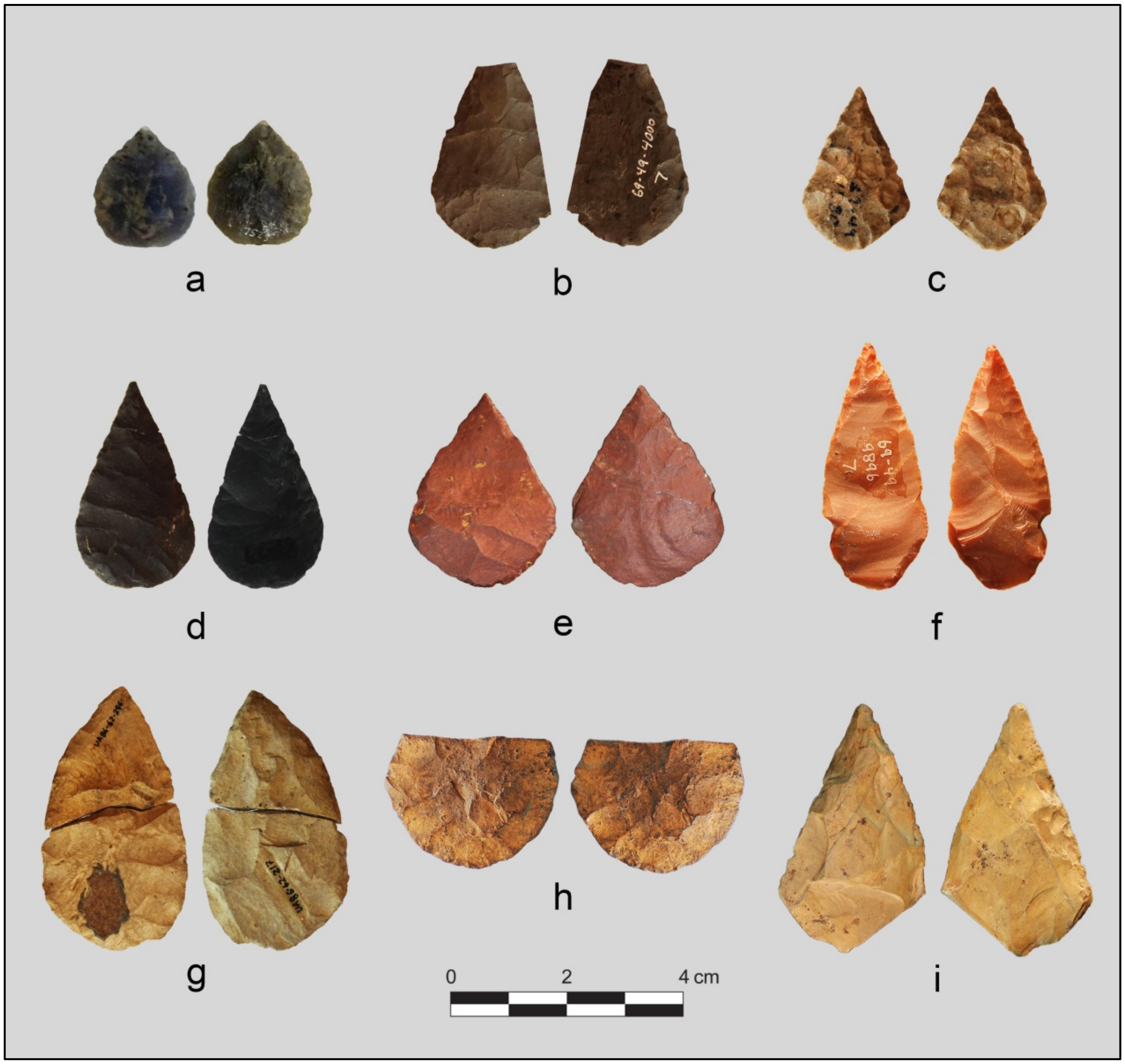

Figure 27. Sample of convex-based bifaces. (a) Swan Point CZ3; (b-c), (f), (h-i): Healy Lake Village Chindadn; (d), (g): Walker Road; (e): Moose Creek C1.

The short time span of pre-Denali occupation, and the fact that the majority of sites are overlapping in time range, makes an evaluation of chronological patterning difficult. Biface types show fairly nebulous seriation (Table 24), with the classic convex and straight-based forms being most common early in Alaskan occupation, giving way to subtriangular and concave bases over time, with visibly increasing tendencies towards basal constriction after approximately 12,500 cal BP. However, Chindadn bifaces in general are found slightly later in the Tanana, and unlike in the Nenana, do not represent the earliest occupation of the area. Greater variation in the Tanana may be accounted for by a greater timespan during which biface technology could develop and diversify, or it might simply be an artifact of the larger sample size from the Tanana valley.

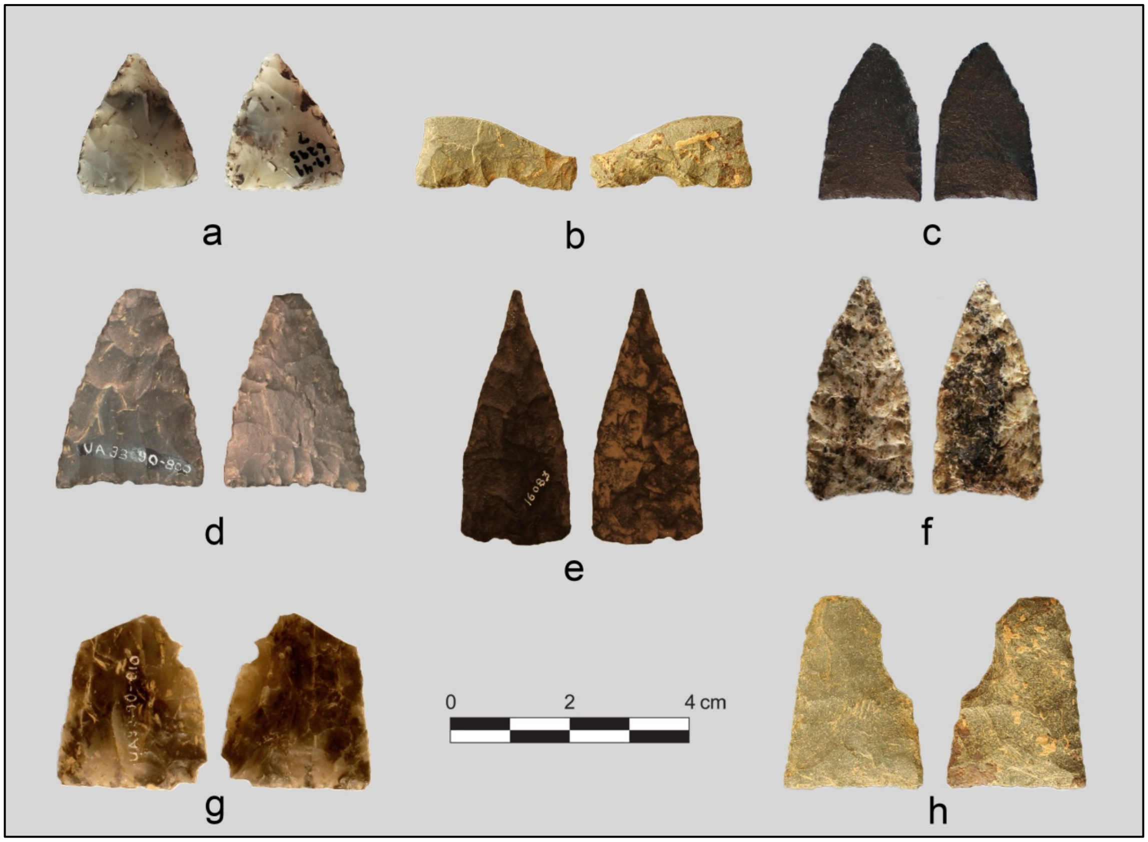

Figure 28. Sample of straight-based bifaces: (a), Village Site; (b), (f), (h) Linda's Point C1 ; (c) Moose Creek C1; (d-e), (g) Swan Point CZ3.

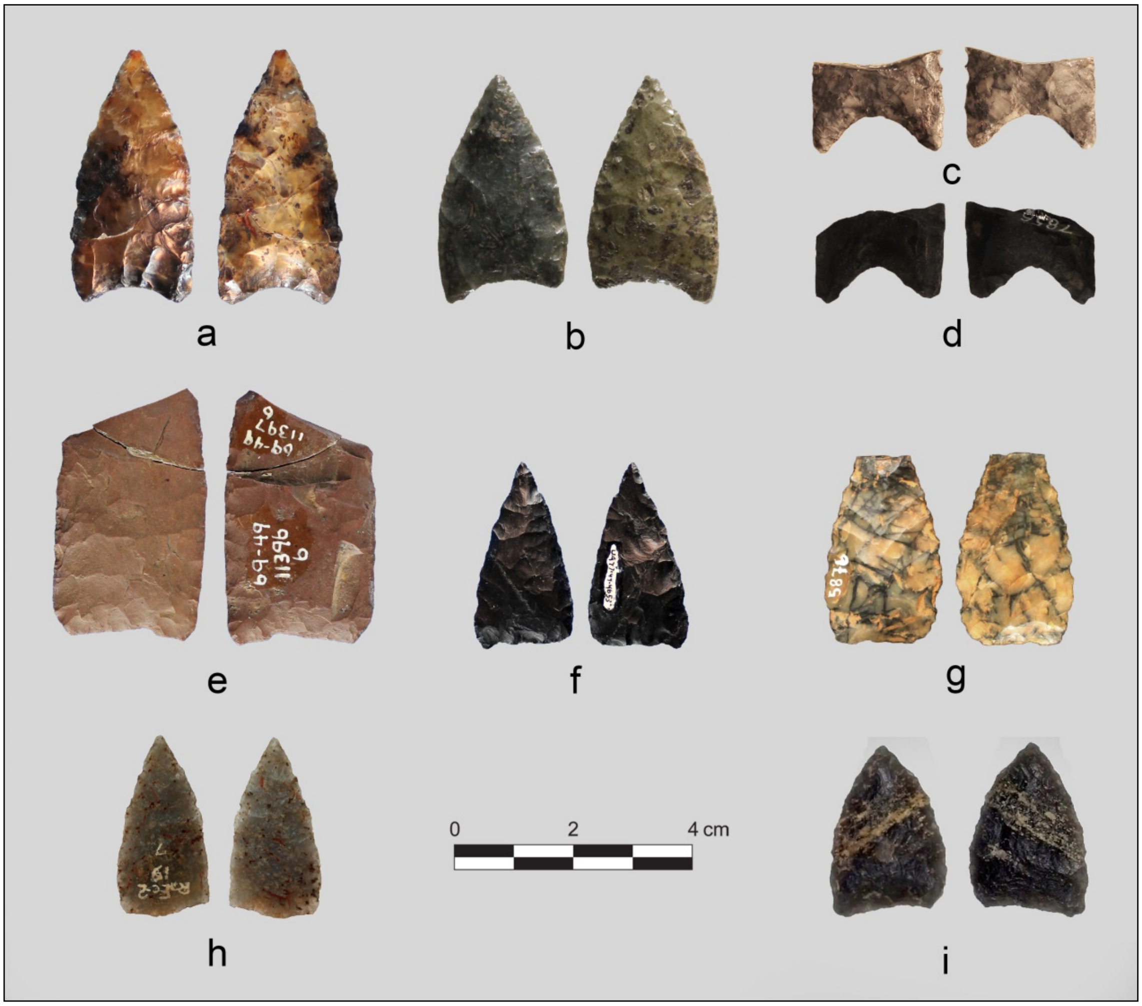

Figure 29. Sample of concave-based (top row) and subtriangular (middle and bottom row) bifaces: (a), (c), (e), (h) Village Site Chindadn; (b) Linda's Point C1; (d), (g) Swan Point CZ3; (f) Dry Creek C1; (i) Broken Mammoth CZ3.

Table 23. Locations of Chindadn Bifaces.

Area	Archaeological Site	Large	Outlier	*Convex Base*	*Straight Base*	*Subtri-angular*	*Concave Base*	*Un-classed*	Total
Nenana		7	1	4	2	2	1	4	21
	Walker Road	3	1	3	-	-	-	-	7
	Dry Creek	3	-	-	-	2	-	1	5
	Moose Creek	-	-	1	1	-	-	-	2
	Owl Ridge	1	-	-	1	-	1	3	6
Tanana		9	1	7	9	7	5	16	54
	Village Chindadn	6	1	6	1	2	2	6	24
	Swan Point	1	-	1	5	1	1	5	14
	Broken Mammoth	1	-	-	-	4	1	-	6
	Linda's Point	1	-	-	3	-	1	-	5
	Mead	-	-	-	-	-	-	4	4
	Chugwater	-	-	-	-	-	-	1	1
Additional		6	0	0	0	0	0	11	17
	Eroadaway	4	-	-	-	-	-	9	13
	Little John	2	-	-	-	-	-	2	4
Total		22	2	11	11	9	6	31	92

Table 24. Date Ranges of Chindadn Bifaces

Site	Age Range (cal BP[1])	Large	Convex Base	Straight Base	Sub-triangular	Concave Base	Total
Swan Point CZ3a	11,970-11,390	1	-	-	1	1	3
Broken Mammoth CZ3	12,390-11,810		-	-	4	1	5
Owl Ridge C2	12,420-12,080					1	1
Linda's Point C1	12,540-12,420	1	-	3	-	1	5
Swan Point CZ3b	12,830-12,190	-	1	5	-	-	6
Owl Ridge C1	13,080-12,810	1	-	1	-	-	2
Dry Creek C1	13,130-12,760	3	-	-	2	-	5
Moose Creek C1	13,180-12,880	-	1	1	-	-	2
Walker Road	13,270-12,850	3	3	-	-	-	6
Broken Mammoth CZ4	13,420-13,140	1					1
Total	-	10	6	10	6	4	36

[1] See Table 18 for sources of chronological information.

Table 25. Lithic Material Types of Chindadn Bifaces

Material Type	Frag-ments	Outlier Bifaces	Large Bifaces	Convex Base	Straight Base	Sub-triangular	Concave Base	Un-classed	Total
Chert	5	2	9	7	3	6	1	1	34
Chalcedony	3	-	1	1	2	3	2	-	12
Argillite	-	-	1	2	2	-	-	-	6
Rhyolite	1	-	2	1	2	-	-	1	7
Basalt	1	-	1	-	2	-	1	-	5
Andesite	1	-	-	-	-	-	-	-	1
MCS	-	-	1	-	-	-	1	-	2
Obsidian	-	-	-	-	-	-	1	-	1
Quartz crystal	1	-	-	-	-	-	-	-	1
Quartzite	-	-	1	-	-	-	-	-	1
Total	12	2	16	11	11	9	6	2	70

Chindadn Technological Characteristics

Lithic Material

Terminal Pleistocene bifaces are generally made from high-quality, fine-grained materials common to interior Alaskan lithic industries of any time range (Table 25). Fisher's exact comparisons show no significant difference between basal shape groups in terms of lithic selection ($FET = 20.057$; $df = 3, 18$; $p = .144$). All groups show a strong emphasis on the use of chert, which makes up half of the primary sample and fragments, while each group contains only a few items each of any other material type. Chalcedony, argillite, rhyolite, and basalt are common, while a single specimen each are made from coarser microcrystalline silicate, andesite, obsidian, quartz crystal, and quartzite.

Reduction Stage and Intensity

Visually assessed and measurement-based biface reduction stages are high for all basal shape classes, showing that despite wide variation in flaking intensities, the bifaces are generally found as fully-shaped preforms and finished bifaces (Table 26). This is reflected in a general lack of retention of flake blank characteristics, and a general lack of sinuosity in the margins (Table 27). Only two bifaces exhibit manufacturing breakage or cortex that might reflect discard during earlier reduction stages (Table 28). As might be expected, the small fragments identified as point tips and basal corners also show fine flaking and edge-grinding indicative of final reduction stages.

Table 26. Reduction Indices for Basal Shape Classes.

Measurement	Shape Class	*n*	*μ*	Range	*s*	Kruskal-Wallis
Visually Assessed Stage	convex base	11	4.3	3.0 - 5.0	.6	$\chi^2 = 7.57$ *df* = 3, 37 *p* = .056
	straight base	11	4.6	2.0 - 5.0	.9	
	subtriangular	9	4.9	4.0 - 5.0	.4	
	concave base	6	4.8	4.0 - 5.0	.4	
Flaking Index	convex base	8	2.78	1.61 - 4.10	.93	$\chi^2 = 9.20$ *df* = 3, 28 *p* = .027
	straight base	9	3.95	.97 - 5.53	1.47	
	subtriangular	7	4.46	3.56 - 6.12	.86	
	concave base	4	4.83	3.87 - 5.92	1.02	
Andrefsky HRI	convex base	11	.498	.00 - 1.00	.28	$\chi^2 = 7.97$ *df* = 3, 32 *p* = .047
	straight base	10	.747	.00 - 1.00	.34	
	subtriangular	7	.808	.58 - 1.00	.16	
	concave base	4	.852	.72 - 1.00	.12	

Table 27. Biface Flaking and Reduction Characteristics for Basal Shape Classes.

Technological Trait	Convex Base	Straight Base	Subtriangular	Concave Base
Biface retains visible flake blank characteristics	variable, mainly yes	no	no	no
Sinuousity of lateral margins	variable, mainly straight	moderate to straight	variable, mainly straight	moderate to straight
Presence and regularity of midline	variable, often not present	present but irregular	present but irregular	present and regular
Flaking size and termination	variable, even on a single artifact	variable, mainly fine and feathered	variable, mainly fine	fine to very fine, feathered
Extent of flaking Overlap	minimal	variable, mainly moderate	variable, mainly high	extensive
Flaking Pattern	variable, mainly marginal	Various patterns and intensities	Various patterns and intensities	Overlapping and parallel
Margin Shape	variable, often irregular	mainly straight	variable	mainly convex
Portion most often present	complete, some basal	complete, some basal/medial	complete, basal/medial, and basal	basal, some complete

Table 28. Presence/Absence Rates of Technological Traits among the Basal Shape Classes (continued next page).

Technological Trait		Convex Base	Straight Base	Sub-triangular	Concave Base	FET Statistic	*df*	Fischer's *p*
Reduction intensity	Manufacturing fracture	9%	0%	11%	0%	2.045	3	.818
	Cortex	10%	0%	0%	0%	2.777	3	.694
	Edge grinding	25%	55%	63%	80%	4.059	3	.283
	High flaking overlap	18%	60%	44%	80%	6.364	3	.094
Flaking style and characteristics	At least one face with parallel flaking	55%	40%	75%	67%	2.395	3	.550
	At least one face with only marginal flaking	73%*	10%*	13%	0%	11.676	3	.003
	Flaking pattern differs between faces	64%	10%	50%	25%	6.974	3	.058
	Basal thinning	18%**	90%	100%	100%	20.287	3	.000

Table 28 Continued.

Technological Trait		Convex Base	Straight Base	Sub-triangular	Concave Base	FET Statistic	*df*	Fischer's *p*
Function	Impact fracture	9%	36%	22%	17%	2.431	3	.541
	Hafting fracture	0%*	9%	11%	50%*	6.541	3	.039
	Hafting abrasion	0%*	27%	33%	80%*	8.758	3	.024
	Recycling	0%	18%	0%	17%	6.980	3	.111

*different from eachother, $p<.05$ according to Bonferroni assessment
** different from other groups, $p<.05$ according to Bonferroni assessmen

Although all of the biface groups show characteristics generally indicative of late and final reduction stages, the convex-based bifaces show a few significant differences. Pairwise Kruskal Wallis comparisons show the convex-based bifaces to have lower reduction stages (*p* = .015-.055) flaking indices (*p* = .013-.027) and Andrefsky's HRI values (*p* = .025-.034) compared to the other biface groups (Table 26). This is reflected in visually observed technological traits: the convex-based bifaces are the only group to commonly retain observable portions of the flake blank, often lack flaking midlines, and show the highest variability in flaking size and terminations (Table 27). Although not statistically significant, the convex-based bifaces also exhibit low levels of edge-grinding, and are the only basal-shape group to exhibit cortex, found in a single specimen (Table 28).

Flaking Characteristics

Although few statistically significant differences exist between the groups in terms of technological characteristics, this does not appear to be due the presence of shared technologies, but instead to wide variation within groups as well as between them. Flaking size, regularity, and style are so variable that they exhibit no discernible patterns among the small bifaces, either as a group or as individual haft shape classes (Table 27). Flake scar size is constricted by the small size of the bifaces, and varies in size from medium to very small. Terminations are feathered, stepped, and hinged, often all on a single artifact. Patterns vary widely to include marginal, collateral, parallel straight, parallel oblique, parallel converging, chevron, unpatterned flaking, and the occasional overface flake. These characteristics vary not only between bifaces, but often also between the faces and margins of individual artifacts. Similar variation appears in the lateral margin shapes, which include irregular, straight, and convex, and vary between haft shapes. Fisher's Exact Tests indicate that the straight-based and subtriangular bifaces are nearly technologically identical, while the convex and concave-based bifaces are statistically distinguished from eachother and from the group as a whole in characteristics reflecting flaking extent, finishing, and hafting (Table 28).

Use-Wear and Breakage Patterns

Generally, bifaces show evidence for hafting and likely use as projectiles, having high rates of basal thinning, moderate rates of edge-grinding, moderate rates of hafting abrasion, and moderate to low rates of impact and hafting fractures (Table 28). However, the convex-based bifaces show significantly low rates of basal thinning compared to the other basal shapes, slightly lower rates of impact and haft fractures, and a complete lack of hafting abrasion. In contrast, the concave-based bifaces show significantly high rates of hafting abrasion and basal haft fractures, although neither shows significant differences from the straight-based and subtriangular groups. Tip fragments often exhibit impact fractures. All broken corner fragments show evidence of either hafting abrasion or basal grinding, with strong abrasion present on the probable concave-based corner fragments.

Chindadn Reduction Sequences

By bringing together the full assemblage of bifaces, we can identify the overarching characteristics of the Chindadn reduction sequence. Perhaps the most notable trait is a lack of patterning in flaking, which does not seem to be intended for extensive shaping. Flaking is usually sufficient to achieve a somewhat balanced cross section, which itself might take a variety of shapes from lenticular to irregular. Some outliers occur, such as the concave-based bifaces, and two complete, tiny, and very extensively-flaked chalcedony bifaces (Figure 27a and Figure 28a), apparently exhausted such that their original reduction sequence is now obscured. However, patterns do exist, and can be used to trace a reduction, use, and discard sequence for each biface group.

Large Bifaces

The large bifaces show a variety of characteristics that could lead to their definition as cores, tools, or preforms at various stages. While smaller and thinner bifaces within this group show characteristics that might be expected for early-stage biface production, potentially representing the first half of the Chindadn reduction sequence, many others appear to be part of a separate reduction stream from the smaller point types. The smaller biface group is characterized by thin flake blanks, often retaining platforms and remnant ventral surfaces, irregularly or marginally flaked, all of which would be unlikely if they were shaped and thinned from larger biface blanks. Some items within the small biface groups may themselves be discarded preforms. It appears the larger bifaces includes both preforms, and a separate group of tools and cores with Chindadn-like outlines that may be indicative of stylistic cultural templates.

Convex Bases

It is clear why convex-based bifaces, correlating with the traditionally defined "teardrop-shaped" outlines, have been most commonly cited as a unique type specimen for early Alaskan assemblages. These bifaces are unique for more than their general shape, which is neither conducive to hafting, nor otherwise indicative of any specific, intuitively understood function (Figure 27). They have low average reduction indices, and a range of stages from apparent preforms with cortex and marginal retouch, to finished points with ground edges and overlapping feathered flake scars.

Convex-based bifaces are almost universally made from thin flakes, often retaining visible flake blank landmarks. In most cases the dorsal surface exhibits light thinning, often as two or three narrow, parallel flake scars originating from the lateral margins and across the base. Flaking characteristically angles obliquely basewards from the one margin and tip-wards from the opposing margin, and in a few cases thinning angles centrally from the base. The ventral surface is usually smooth, with fine but irregular marginal retouch, creating lateral margins that are regular and straight in longitudinal cross section, although slightly asymmetrical. A few fully-thinned pieces with symmetrical lenticular cross sections are also present. The convex-based points exhibit a low rate of hafting abrasion or breakage. A number are chipped at the very tip, which might be related to use-pressure or to post-depositional breakage of their fine, thin edges. Bases show little to no evidence of macroscopic use-wear or grinding, although edge-grinding is present on lateral margins.

Triangular and Subtriangular

Although the straight-based (Figure 28) and subtriangular (Figure 29) classes generally overlap with the “triangular” and “subtriangular” outlines often also assigned to the Chindadn complex, they in fact appear in a wide variety of outlines. Both groups include specimens with slightly concave bases, and convex, straight, and irregular margins, all sharing a common suite of semi-informal technologies. Flaking is typically very fine and shallow, with feathered and stepped terminations. Although flake blank surfaces are rarely retained, the extreme thinness of the artifacts suggests a flake blank similar to those seen in the convex-based bifaces. There are almost as many flaking styles as there are individual artifacts, varying from parallel straight and oblique to random, and usually with one face more formally patterned or reworked than the other. Many artifacts, especially the smallest specimens, appear to have been reworked multiple times, and have midlines obscured by very fine, highly overlapping and irregular flaking. With the exception of one extremely thin but only marginally worked point, all of these bifaces exhibit fine, short, and usually regular basal thinning, such that many of the artifacts are completely flat in basal cross section and have regular, ground basal margins.

The lateral margins of many of the straight-based and subtriangular bifaces are ground, with minimal sinuosity. Moderate-to-low rates of hafting wear and abrasion, haft fractures, and impact fractures represent some of the only evidence for use present in the sample, with no macroscopically visible evidence of use-retouch, use-breakage, scraping, or cutting. Two straight-based basal fragments have been reworked into tools.

One has been unifacially reworked along a distal break, creating a wide, concave scraper-like surface stretching obliquely from the lateral margin to the edge of the break (Figure 28h). The other has been reworked along a lateral edge, with multiple tiny graver spurs on a basal corner and next to a lateral break across the medial portion of the biface (Figure 28g). The locations of the reworked edges suggest the bifaces were initially broken by impact fractures. Overall, triangular and subtriangular bifaces appear to be potentially classifiable as a single group, with more regular straight bases found earlier in the Nenana basin and more variable subtriangular items found later in the Tanana, potentially representing regional or inter-site stylistic variation.

Concave Bases

At this time, there are few known specimens with notably concave bases found in the Alaskan interior. They exhibit no cortex or residual blank surfaces, with faces covered entirely by finely overlapping, shallowly feathered, parallel straight flaking, creating straight, well-defined midlines (Figure 29). One point exhibits overface flake scars extending to the opposite margin (Figure 29a). Unlike the other classes, concave-based points are flaked similarly on both faces and both margins, leading to smoothly lenticular cross sections that are well-thinned at the base with regular, parallel feathered flake scars. Fine finishing is seen in smooth, ground lateral margins. Accordingly, these bifaces represent the most extensively reduced specimens in the study sample. Concave-based bifaces exhibit strong abrasion indicative of hafting at the base and on the proximal portion of the lateral margins. Breakage of these items almost exclusively reflects impact damage, with breakage occurring at the tips and hafts in conjunction with impact flutes and burin-like scars on the margins below. A single specimen represents the only exception to these patterns, a more irregularly flaked point from Owl Ridge, which is also the only concave-based specimen thus far reported from the Nenana valley. Overall, these bifaces are clearly identifiable as small hafted projectile points, robust for their size compared to other terminal Pleistocene bifaces.

Discussion

Technological analysis of interior Alaskan bifaces securely dated to the terminal Pleistocene (ca. 11,400-13,500 cal BP) confirms many aspects of the existing definition of Chindadn. Bifaces are indeed small, thin, and very often teardrop-shaped. Although there is notable overlap in both time and technology, convex-based pieces appear, on average, temporally slightly earlier than triangular and subtriangular bifaces, and trend towards lower reduction indices and more ambiguous function. Triangular and subtriangular points may be statistically distinguished by general basal shape differences; however, they appear to represent a single technological group. The rare concave-based bifaces might be considered as an outlier group in terms of both technology and intended use. As yet, the sample of currently excavated bifaces in the region is too small for a definitive conclusions, and evidence for function is still ambiguous. At the minimum, further exploration of the Chindadn question is needed in the form of use-wear analyses and actualistic studies of hafting wear and breakage patterns.

Biface Groups

Convex-Based Bifaces

Convex-based bifaces, analogous to the teadrop-shaped type originally proposed by John Cook, show unique technological and morphological characteristics that support their continued distinction as a separate group compared to triangular and concave-based specimens. As a chronological marker, however, they are no more valid or common than the less striking triangular varieties. Their rounded bases provide little to no evidence of hafting or other functions, while their reduction sequence is simple and expedient. The informal approach to production and discard, and common discard of complete bifaces, suggest a relatively low value placed on the items in terms of shaping, curation, and overall effort expenditure. Evidence of lithic material conservation is rare, and only very occasionally do they show evidence of reuse or reworking. Together with a reduction pattern from flake blanks, they are suggestive of bifacially worked flake tools, rather than bifaces in the traditional sense. However, the presence of a distinct distal point suggests use as a projectile tip. While little evidence for use as flake tools was found in the current study, potential functions related to cutting, scraping, perforating, or engraving cannot be ruled out without complementary microscopic use-wear analysis.

Triangular Bifaces

The triangular and subtriangular bifaces are informally produced, similar to convex-based bifaces but not nearly as expediently so. They show low to moderate rates of hafting abrasion, impact damage, and lateral breakage patterns across the upper basal portion, similar to the concave-based points but not nearly as consistently. Despite evidence of hafting, these bifaces were often discarded unbroken. Unlike the convex-based bifaces, these triangular items are technologically and typologically nondescript, and are similar to artifacts that appear within archaeological assemblages across North America throughout the Holocene. Comparisons to Holocene points have also invoked suggestions that the small size of Chindadn points may indicate an early instance of North American bow and arrow technology (Dixon 2011). While the sample of terminal Pleistocene organic artifacts is too small for comparative analysis, no evidence is yet known of arrow shafts; however, other characteristics of small triangular Holocene points may instead be suggested by these forms, described below.

Concave-Based Points

The technologically unique concave-based points present a slightly different case than the others, showing more intensive flaking and finishing, hafting abrasion, and haft damage. They resemble the other early Alaskan bifaces studied here in overall size, shape, and thickess, but otherwise appear to be a separate entity that does not belong within the definition of Chindadn bifaces. They are isolated to the Tanana valley during the later part of the Beringian era, with the exception of a specimen from Owl Ridge C2 (Graf et al. 2011), nearly 1000 years younger than the triangular bifaces found in C1 of the same site. Their extensive basal thinning — regular, long, and narrow — approaches but never quite matches the basal fluting technology seen in western Alaskan fluted points dating between 12,900 to 11,200 cal BP (Smith et al. 2013). However, complete specimens are relatively short, with curved basal indentation and convex margins, rather than the longer, straight margins and v-shaped bases characteristic to Alaskan fluted points. That these items might represent diffusion and incorporation of fluted point characteristics, such as extensive hafting and basal shaping, onto the simpler triangular form is an extremely tempting hypothesis, but one that is not testable given the small sample size.

Beringian Technologies

Compared to the highly specialized fluted points found south of the continental ice sheets, or the extensively shaped stemmed and lanceolate points found in the Mesa complex, interior Alaskan bifaces exhibit a range of technologies, from marginally retouched flake-tools to fully reduced items with unpredictable flaking patterns. No matter the exact age, location, or size of site in which they are found, occupations containing Chindadn technology are almost always the basal component at the site, with a few exceptions in the Tanana River valley having very old underlying components. With the exceptions of the single-component Walker Road and Eroadaway, the post-Chindadn occupation always contains either microblades, lanceolate bifaces, or both (Goebel and Buvit 2011; Graf and Bigelow 2011). Despite some ambiguity regarding the potential contemporaneity of these artifacts at the Village site, Broken Mammoth CZ3, and Swan Point CZ3, the overall pattern is consistent and unlikely to solely be influenced by variation in seasonality or occupation type.

From a technological standpoint, the Beringian climate presented a number of constraints: cold climate, large dangerous prey with thick hides and fur, and lack of access to plant materials for food, fuel, and building materials. Chindadn points present advantages in nearly all technological aspects. As a relatively expedient form of biface production, they are efficient, allowing many points to be made from a single flake core, reducing waste flakes due to their less extensive thinning and shaping. They are flexible, with the potential for preforms to be used or reworked as flake tools. One potential explanation for low rates of hafting abrasion and damage may be the use of small, loosely hafted point tips to increase maintainability in a manner similar to inset microblades, similar to the ubiquitous small, un-notched triangular points of the late Holocene across eastern North America (Engelbrecht 2014). These were a flexible technology, used for killing a wide variety of prey and also as weapons of warfare against other humans, with their key aspect of design as the detachability of the shaft for recovery and reuse (Christenson 1997), increasing penetration and damage to the target while decreasing damage to both the point and shaft (Boszhardt 2003; Engelbrecht 2014). A similar strategy is ethnographically reported in the subarctic, used to ensure the retrieve-ability and reusability of arrow shafts (VanStone 1985).

Although few organic artifacts have been found in terminal Pleistocene components, bone rods found at Broken Mammoth CZ4 have been suggested to be either foreshafts or point tips (Yesner 2000). Hard, impact-resistant materials such as ivory or antler may have been both rare and time-consuming to work. Value placed on such materials is suggested by the presence of antler foreshafts among the grave goods of the 11,500 cal BP infant burial at Upward Sun River (Potter et al. 2014). While late Beringian environments likely provided wood for shaft materials in the form of willow and birch shrub found in riverine and lowland environments (Bigelow and Powers 2001; Graf and Bigelow 2011), larger woody plants for long sturdy spears may have been rare, and difficult to replace during upland hunting forays or cold winter months. Evidence from organic materials preserved in ice-patches, dating from 9500-1100 cal BP, show that darts were preferentially made from birch staves rather than birch or willow saplings (Hare et al. 2004), suggesting larger raw materials may have been more effective and highly valued. These hypotheses might be tested through future research involving actualistic studies of impact damage and use-wear rates related to various hafting methods, with and without foreshafts.

Conclusions

The early Alaskan bifaces as a whole share many characteristics: small, thin, expediently produced, and with extremely simple outlines, lacking landmark features and regular flaking patterns. They are divisible into three separate groups with statistically significant differences in basal shape, flaking technology, evidence of function, and discard patterns. First, the classic "teardrop-shaped" Chindadn biface is unique for the presence of expedient, often marginal flaking and discard of mainly unbroken pieces with no hafting or macroscopic use-wear. In all but size and appearance these artifacts are more similar to flake tools than to the other bifaces. Second, the triangular and subtriangular types are informally reduced, extremely thin, and appear to be used as lightly hafted bifacial point tips. Finally, a few rare concave-based bifaces are more intensively and consistently reduced, with distinct evidence for use as projectile tips and discard after breakage in the haft.

The current evidence suggests that Cook's original intent to separate the teardrop-shaped biface as a unique entity is accurate, although designating it a Chindadn *point* may be misleading. Triangular and subtriangular bifaces are clearly correlated to the teardrop shape in time and space, and assignable to a single phenomenon along with the teardrop-shaped items, though technologically distinct. Both groups might be best described as separate types within the category of *Chindadn biface*. At this time, the sample size of concave-based bifaces in the interior is too small to definitely place them; however, they are technologically distinct and are suggestive of the Northern Fluted Point tradition, making them unlikely candidates for inclusion within the Chindadn biface category, though they do share some traits, such as small size and subtriangular outline.

Expedient technology, small size, and disposability of the Chindadn bifaces provided them a place within a flexible, maintainable, and also transportable Beringian toolkit. The need for conservation of material within both the terminal Pleistocene and Younger Dryas environments may provide some explanation for the narrow chronological and geographic distribution of these small, fairly delicate bifaces, as well as their rapid disappearance near the end of the Pleistocene.

CHAPTER V

CONCLUSIONS

Since their initial definition in the 1970s, the Chindadn complex, the associated Chindadn point, and their type-site at Healy Lake have played a significant role in the prehistory of interior Alaska. While Chindadn bifaces have been established as a unique hallmark of terminal Pleistocene western Beringian lithic assemblages, their functional and technological roles have been ambiguous, both within early Beringian cultural systems, and in relation to burin and microblade technology. Furthermore, discussions of the timing and technological role of microblades within the Chindadn, Nenana, and Denali complexes often return to the potentially mixed assemblages at the Village site. Lacking wide acceptance, however, the existing Village site chronology has provided few answers.

Through three detailed assessments, this research has examined the Healy Lake Chindadn complex from three different perspectives. First, a detailed analysis of the Linda's Point site has provided an updated interpretation of geochronology and culture history at Healy Lake, supporting many of the original interpretations at the Village site, while clarifying and refuting others. Second, a technological analysis of toolstone selection and use strategies has provided new depth to the understanding of human activities at the lake over time. And finally, a technological analysis of Chindadn biface manufacture and use has provided an alternative to the typological approach used to place these bifaces within wider Alaskan culture history. Considered together, these three perspectives have also provided answers to the original research goals of this dissertation:

1. To define the geologic and stratigraphic contexts of the occupations at the Linda's Point site. The currently excavated area of Linda's Point has shown stratigraphic sequences similar to those seen at the Village site, while lacking the historic disturbances and often very shallow soil profile that threw early interpretations into question. Like the Village site, there are few sedimentary boundaries to allow for distinguishing separate occupations within the Holocene. However, a terminal Pleistocene component is distinguished by a radiocarbon-dated paleosol and hearths, and separated from Holocene components by sterile loess.

2. To determine the sequence and age of cultural occupations at Healy Lake. Radiocarbon dating has shown C1 at Linda's Point to be composed of a 13,100–11,200 cal B.P. series of palimpsest deposits. This timespan has been narrowed by half compared to the 13,500–9,000 cal B.P. Chindadn component of the Village site. It can be hypothesized that the ongoing redating program at the Village site, based on stratigraphic associations rather than arbitrary levels, will produce a similarly narrowed age range associated with the marker paleosol. At Linda's Point, this lower occupation is characterized by small Chindadn bifaces, formal and expedient flake tools, and a lack of microblade technology.

The upper occupations at Linda's Point are found within a thick loess deposit, similar to the Village site and to many other sites in the Tanana Valley. Although C2 cultural deposits within the existing excavated area are found as a dense cloud within these loesses, further excavation may produce isolated activity areas from individual occupations that will allow for the definition of specific sub-components. At Linda’s Point, C2 is characterized by large lanceolate bifaces, large preforms, scrapers, microblades, and formal and expedient flake tools.

3. To characterize technological activities and organizational strategies represented in the Chindadn and later assemblages. At Healy Lake, both the Village site and the Linda’s Point assemblages strongly emphasize curation of tools and secondary reduction of non-local materials, reflecting a low availability of high-quality local materials. In both C1 and C2, inter-assemblage differences are present between Linda’s Point and the Village site, indicating some level of site specialization. Because both sites are represented by palimpsest occupations, conclusions about settlement strategy must be considered preliminary, and should be tested by further excavation at other sites around the lake margins and nearby area. It can be hypothesized that other sites will show characteristics similar to Linda’s Point, representing shorter-term extraction sites to the more prominent and more extensively occupied Village site. Differing results, however, might indicate site specialization related to seasonality, or other less predictable factors, such as the interaction of multiple cultural or family groups

4. To assess technological organization in response to changing environments.

The presence of palimpsest deposits and generalized nature of lake formation data at Healy Lake prevented fine-grained paleoenvironmental analysis. The existing data allowed for a broader discussion of change over time, from postglacial climates and riverine environments, to warming Holocene climates and overall lake development.

Change in technological organization over time is readily apparent at Healy Lake. Both sites exhibit a shift from dominantly secondary reduction of nonlocal materials to a more diverse set of reduction strategies of local, nonlocal, and exotic materials. These changes likely reflect a combination of factors relating to population movements and environmental changes, including increased landscape knowledge and decreased mobility over time. In both eras, the presence of inter-site technological variability potentially indicates seasonal or logistical specialization.

The currently known excavated sample of Chindadn biface technology is restricted to a few millennia during the terminal Pleistocene and Allerød, unlike the longer-lasting microblade technology characteristic of northern climates. Few known typological precursors exist to explain this geographic or chronological distribution from a culture historical standpoint. However the research presented here has shown them to be an expedient and informal biface technology, mirroring the informal flake tool technologies seen at early components of Linda’s Point and the Village site. Such characteristics might have allowed them to be a flexible and expendable component of a maintainable post-glacial northern toolkit, helping to conserve raw materials through small size, shortened lithic reduction streams, and flexible usage.

5. To consider the scientific results in the context of multivocality and community involvement. The final products of this completed research are being distributed in paper and electronic form to the Healy Lake community, as well as being presented to the village council. The methods of TCC’s pioneering community field school programs at Linda’s Point will be further published and presented at conferences,

and it is hoped that future research programs in Alaska will consider similar methods. Most encouragingly, the ongoing work and continued interest in community history at Healy Lake has led to collaboration between village archaeologists and research institutions, and is expected to lead to future published research.

Closing Thoughts and Future Research

A common theme of the results across all studies presented in this dissertation has been the importance of technological decision making, and the need to consider it alongside analyses of cultural templates, settlement and mobility, or even environmental constraints. Toolstone selection and use strategies at the lake are focused on curation, selectivity, and later-stage reduction of nonlocal materials, reflecting scarcity and low quality of available materials along the lakeshore. However, no single piece of research provides a complete reconstruction of prehistoric cultures and activities on its own. While providing new information about the contested Healy Lake archaeological record, this research has also provided multiple future research.

It is expected that the analysis of cultural materials presented here will be complemented with forthcoming stratigraphic and geochronological analyses that may elucidate some of the questions raised during reanalysis of the Village site materials and field notes. Well-preserved faunal remains at the Village site are still in need of detailed analysis. Some questions, such as the separation of potential palimpsest deposits, and outlining of activity areas, may only be addressed through expanding the excavated sample area at Linda’s Point, and perhaps complementary excavation data from multiple sites around the shores of the lake. Chapter III raised the question of sample size at Linda’s Point, and its effects on tool richness, lithic material diversity, and the high proportion of quartz in C2, all of which also invite expansion of the excavation area.

Analysis of Chindadn bifaces has also revealed further necessary research. Actualistic studies of hafting and breakage patterns might be used to evaluate the patterns seen in Chapter IV, and the reasons for low breakage rates of triangular Chindadn bifaces. Microscopic use-wear analysis might also be used to evaluate function, although it must be cautioned that “bag retouch” and other effects of long-term curation were visible on a number of items during analysis. Finally, with larger well-dated samples potentially available in the future, more detailed geometric morphometric and principal component analysis of chronological and geological variation in shape patterns (Smith et al. 2014).

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APPENDIX A

CHINDADN BIFACE DATA TABLE

Key	Cat.No	Photo Ref.	Sample	Location	Site	Comp- onent	Size Group	Base Shape Group	Portion
1	UA76-155-4563	-	Primary	Nenana	Dry Creek	C1	small	subtriangular	base
2	UA74-041-0244	4a	Primary	Nenana	Dry Creek	C1	large	-	complete
3	UA76-155-5311	-	Primary	Nenana	Dry Creek	C1	-	-	edge
4	-	-	Primary	Nenana	Dry Creek	C1	large	-	complete
5	UA77-044-4653	8f	Primary	Nenana	Dry Creek	C1	small	subtriangular	complete
6	UA76-155-4382	-	Primary	Nenana	Dry Creek	C1	large	-	complete
7	FAI-206-0078	6e	Primary	Nenana	Moose Creek	C1	small	convex base	complete
8	FAI-206-0035	7b	Primary	Nenana	Moose Creek	C1	small	straight base	complete
9	UA2010-054-0288	7g	Primary	Nenana	Owl Ridge	C1	small	straight base	base, medial
10	UA2009-118-0382	-	Primary	Nenana	Owl Ridge	C1	-	-	tip
11	UA2010-054-0458	-	Primary	Nenana	Owl Ridge	C1	-	-	corner
12	UA2010-054-0615	-	Primary	Nenana	Owl Ridge	C1	-	-	corner
13	UA88-058-0759	-	Primary	Nenana	Walker Road	C1	small	convex base	complete
14	UA86-062-0217	6g	Primary	Nenana	Walker Road	C1	small	convex base	complete
15	UA88-058-029	6d	Primary	Nenana	Walker Road	C1	small	convex base	complete
16	UA89-051-0033	4c	Primary	Nenana	Walker Road	C1	large	-	complete
17	UA88-058-0440	-	Primary	Nenana	Walker Road	C1	outlier	-	complete
18	UA89-051-0077	-	Primary	Nenana	Walker Road	C1	large	-	complete
19	UA88-058-0424	-	Primary	Nenana	Walker Road	C1	large	-	complete
20	UA92-131:4530	-	Primary	Tanana	Brkn Mammoth	CZ4	large	-	complete
21	XBD-131:750	-	Primary	Tanana	Brkn Mammoth	CZ3	small	subtriangular	complete
22	-	-	Primary	Tanana	Brkn Mammoth	CZ3	small	concave base	base
23	UA-02-0973	-	Primary	Tanana	Brkn Mammoth	CZ3	small	subtriangular	base
24	-	-	Primary	Tanana	Brkn Mammoth	CZ3	small	subtriangular	complete
25	-	8i	Primary	Tanana	Brkn Mammoth	CZ3	small	subtriangular	complete
26	XMH-206:2012-2781	8b	Primary	Tanana	Linda's Point	C1	small	concave base	complete
27	XMH-206:2013-6542	7i	Primary	Tanana	Linda's Point	C1	small	straight base	base, medial
28	XMH-206:2012-1499	4b	Primary	Tanana	Linda's Point	C1	large	-	complete
29	XMH-206:2012-5179	7f	Primary	Tanana	Linda's Point	C1	small	straight base	complete
30	XMH-206:2013-6465	7h	Primary	Tanana	Linda's Point	C1	small	straight base	base

Key	Cat.No	Photo Ref.	Sample	Location	Site	Comp-onent	Size Group	Base Shape Group	Portion
31	UA93-090-0810	7c	Primary	Tanana	Swan Point	CZ3b	small	straight base	base, medial
32	UA92-133-0620	-	Primary	Tanana	Swan Point	CZ3b	-	-	tip
33	7478	-	Primary	Tanana	Swan Point	CZ3b	-	-	tip
34	16083	7e	Primary	Tanana	Swan Point	CZ3b	small	straight base	complete
35	UA93-090-0809	-	Primary	Tanana	Swan Point	CZ3b	small	straight base	base, medial
36	UA92-133-0624	-	Primary	Tanana	Swan Point	CZ3b	small	straight base	complete
37	7523	6a	Primary	Tanana	Swan Point	CZ3b	small	convex base	complete
38	UA93-090-0800	7d	Primary	Tanana	Swan Point	CZ3b	small	straight base	complete
39	8367	-	Primary	Tanana	Swan Point	CZ3	-	-	corner
40	7915	-	Primary	Tanana	Swan Point	CZ3	-	-	tip
41	7138	-	Primary	Tanana	Swan Point	CZ3a	large	-	complete
42	0636	-	Primary	Tanana	Swan Point	CZ3a	-	-	corner
43	7856	8d	Primary	Tanana	Swan Point	CZ3a	small	concave base	base
44	5876	8g	Primary	Tanana	Swan Point	CZ3a	small	subtriangular	base, medial
45	UA69-049-11396	8e	Primary	Tanana	Village	Lower	small	subtriangular	base, medial
46	UA69-049-11102	8c	Primary	Tanana	Village	Lower	small	concave base	base
47	UA69-049-3203	-	Primary	Tanana	Village	Lower	-	-	corner
48	UA69-049-7264	8a	Primary	Tanana	Village	Lower	small	concave base	complete
49	UA69-049-6507	-	Primary	Tanana	Village	Lower	small	-	tip, medial
50	UA69-049-1882	6h	Primary	Tanana	Village	Lower	small	convex base	base
51	UA69-049-1928	-	Primary	Tanana	Village	Lower	-	-	tip, medial
52	UA69-049-0812	-	Primary	Tanana	Village	Lower	-	-	tip
53	UA69-049-4233	4e	Primary	Tanana	Village	Lower	large	-	complete
54	UA69-049-4236	-	Primary	Tanana	Village	Lower	large	-	complete
55	UA69-049-0734	-	Primary	Tanana	Village	Lower	outlier	-	complete
56	UA69-049-4000	6b	Primary	Tanana	Village	Lower	small	convex base	base, medial
57	UA69-049-6295	7a	Primary	Tanana	Village	Lower	small	straight base	complete
58	UA69-049-6852	-	Primary	Tanana	Village	Lower	small	-	tip, medial
59	UA69-049-2199	4d	Primary	Tanana	Village	Lower	large	-	base, medial
60	UA69-049-0771	-	Primary	Tanana	Village	Lower	-	-	tip, medial

Key	Cat.No	Photo Ref.	Sample	Location	Site	Comp-onent	Size Group	Base Shape Group	Portion
61	UA69-049-0019	8h	Primary	Tanana	Village	Lower	small	subtriangular	complete
62	UA69-049-1580	6c	Primary	Tanana	Village	Lower	small	convex base	complete
63	UA69-049-9896	6f	Primary	Tanana	Village	Lower	small	convex base	complete
64	UA69-049-11106	6i	Primary	Tanana	Village	Lower	small	convex base	complete
65	UA69-049-7279	4f	Primary	Tanana	Village	Lower	large	-	complete
66	UA69-049-0881	-	Primary	Tanana	Village	Lower	large	-	complete
67	UA69-049-4687	-	Primary	Tanana	Village	Lower	large	-	complete
68	UA69-049-4678	-	Primary	Tanana	Village	Lower	small	convex base	base, medial
69	UA85-145-006	-	Additional	Nenana	Eroadaway	-	small	-	base, medial
70	UA85-145-007	-	Additional	Nenana	Eroadaway	-	small	-	complete
71	UA85-145-001	-	Additional	Nenana	Eroadaway	-	large	-	base, medial
72	UA87-97-032	-	Additional	Nenana	Eroadaway	-	large	-	base, medial
73	UA87-97-033	-	Additional	Nenana	Eroadaway	-	large	-	base
74	UA85-145-005	-	Additional	Nenana	Eroadaway	-	small	-	complete
75	UA87-97-036	-	Additional	Nenana	Eroadaway	-	small	-	base, medial
76	UA87-97-025/039	-	Additional	Nenana	Eroadaway	-	small	-	complete
77	UA85-145-003	-	Additional	Nenana	Eroadaway	-	small	-	base, medial
78	UA87-97-060/053	-	Additional	Nenana	Eroadaway	-	large	-	base, medial
79	UA85-145-010	-	Additional	Nenana	Eroadaway	-	small	-	complete
80	UA85-145-002	-	Additional	Nenana	Eroadaway	-	small	-	complete
81	UA87-97-001	-	Additional	Nenana	Eroadaway	-	small	-	base, medial
82	KdVo-6:097	-	Additional	Other	Little John	Chindadn	small	-	base, medial
83	KdVo-6:542	-	Additional	Other	Little John	Chindadn	large	-	complete
84	KdVo-6:096	-	Additional	Other	Little John	Chindadn	large	-	complete
85	KdVo-6:095	-	Additional	Other	Little John	Chindadn	small	-	complete
86	UA85-051-0555	-	Additional	Tanana	Chugwater	Chindadn	small	-	complete
87	-	-	Additional	Tanana	Mead	CZ4	-	-	base, medial
88	-	-	Additional	Tanana	Mead	CZ4	-	-	base, medial
89	-	-	Additional	Tanana	Mead	CZ4	-	-	base, medial
90	-	-	Additional	Tanana	Mead	CZ4	-	-	-

Key	Raw Material	Cortex	Cross Section	Reworking	Break Type	Abrasion	Grinding
1	chert	none	lenticular	no	haft fracture	haft	-
2	quartzite	none	irregular	no	unidentifiable	-	edge-ground
3	chalcedony	none	lenticular	no	unidentifiable	-	-
4	chert	none	lenticular	no	unidentifiable	-	-
5	chert	none	lenticular	no	none	none	basal, tip, edges
6	chert	none	flat/irregular	no	manufacturing error	none	basal, edge-wear
7	rhyolite	none	plano-convex	no	none	none	none
8	basalt	none	flat	no	none	none	none
9	chert	none	flat/lenticular	no	imact, post-dep.	basal, haft	edge-ground
10	chert	none	lenticular	no	post-depositional	-	edge-ground
11	andesite	none	-	no	haft fracture	-	-
12	chert	none	-	no	unidentifiable	none	basal, haft
13	argillite	none	flat	no	post-depositional	-	-
14	argillite	bedrock	lenticular	no	manufacturing error	-	-
15	chert	none	lenticular	no	unidentifiable	none	basal, edge
16	rhyolite	bedrock	irregular	no	none	none	edge wear
17	chert	cobble	irregular	no	none	none	none
18	basalt	none	flat/lenticular	no	none	none	edge wear
19	rhyolite	bedrock	flat	burinated	impact, haft	none	tip
20	chert	weathered	flat/lenticular	no	none	-	-
21	chert	none	flat/lenticular	no	impact fracture	basal, haft	edge-ground
22	chert	none	plano-convex	no	unidentifiable	-	edge-ground
23	chert	none	flat/lenticular	no	unidentifiable	none	none
24	chert	none	lenticular	no	unidentifiable	none	basal, distal
25	chalcedony	none	lenticular	no	post-depositional	none	basal
26	obsidian	none	lenticular	no	none	basal, haft	basal, edge
27	argillite	none	flat	wide notch	unidentifiable	haft	none
28	chalcedony	none	plano-convex	no	manufacturing error	-	-
29	rhyolite	none	lenticular	no	post-depositional	none	distal
30	argillite	none	flat	no	impact, haft	none	base

Key	Raw Material	Cortex	Cross Section	Reworking	Break Type	Abrasion	Grinding
31	chalcedony	none	flat	tched into gra	impact fracture	basal, haft	edge-ground
32	chert	none	lenticular	no	unidentifiable	-	edge-ground
33	chalcedony	none	lenticular	no	impact fracture	-	-
34	basalt	none	flat/lenticular	no	post-depositional	none	basal, edge
35	rhyolite	none	flat/lenticular	no	post-depositional	none	none
36	chert	none	plano-convex	no	none	none	none
37	chalcedony	none	flat	no	none	none	none
38	chert	none	flat/lenticular	no	impact fracture	tip	none
39	basalt	none	-	no	unidentifiable	basal	-
40	quartz crystal	none	lenticular	no	impact fracture	-	edge-ground
41	chert	none	irregular/lenticular	no	manufacturing error	basal	none
42	chert	none	-	no	haft fracture	basal	-
43	basalt	none	lenticular	no	haft fracture	edge	none
44	chalcedony	none	lenticular	no	manufacturing error	none	none
45	chert	none	biplano	no	imact, post-dep.	basal, haft	none
46	chalcedony	none	lenticular	no	haft fracture	basal, haft	-
47	chalcedony	none	-	no	unidentifiable	base	-
48	chalcedony	none	lenticular	no	impact, haft	haft	basal
49	rhyolite	none	lenticular	no	unidentifiable	-	edge-ground
50	chert	-	irregular	no	unidentifiable	-	-
51	rhyolite	none	lenticular	no	unidentifiable	-	-
52	chert	none	lenticular	no	unidentifiable	-	none
53	argillite	none	irregular	no	post-depositional	-	-
54	MCS	weathered	irregular	no	none	-	-
55	chert	cobble	diamond	no	none	-	-
56	chert	none	flat/lenticular	no	unidentifiable	none	none
57	chalcedony	none	lenticular	no	unidentifiable	none	basal, haft, edge
58	chert	none	flat	no	unidentifiable	none	edge-ground
59	chert	none	flat/lenticular	no	unidentifiable	none	edge-ground
60	argillite	none	lenticular	no	unidentifiable	none	none

Key	Raw Material	Cortex	Cross Section	Reworking	Break Type	Abrasion	Grinding
61	chalcedony	none	lenticular	no	none	none	edge-ground
62	chert	none	-	no	none	none	edge-ground
63	chert	none	irregular	no	none	none	none
64	chert	none	plano-convex	no	none	none	none
65	chert	none	irregular	no	none	none	edge-ground
66	chert	none	lenticular	no	manufacturing error	none	edge-ground
67	chert	none	irregular	no	manufacturing error	none	none
68	chert	none	irregular	no	impact fracture	none	none
69	chalcedony	none	lenticular	no	impact fracture	basal, haft	basal, haft
70	chalcedony	none	lenticular	utilized	impact fracture	haft	basal, edge
71	argillite	none	flat/lenticular	no	unidentifiable	-	-
72	argillite	none	flat/lenticular	no	unidentifiable	none	base
73	argillite	none	flat/plano-convex	no	unidentifiable	none	base
74	basalt	none	plano-convex	no	unidentifiable	none	none
75	argillite	none	irregular/lenticular	no	unidentifiable	none	none
76	argillite	none	flat/lenticular	burinated	reworking	none	basal, haft, edge-wear
77	argillite	none	flat/lenticular	burinated	manufacture, reworking	none	basal, haft
78	argillite	none	irregular	no	manufacturing error	none	none
79	argillite	none	plano-convex	no	manufacturing error	none	none
80	argillite	none	lenticular	no	manufacturing error	none	edge-ground
81	chert	none	lenticular	no	manufacturing error	none	base
82	basalt	none	lenticular	no	unidentifiable	none	-
83	rhyolite	none	-	no	none	none	none
84	basalt	none	plano-convex	no	none	none	none
85	chert	Yes	irregular	no	none	none	none
86	obsidian	none	plano-convex/lenticular	no	impact fracture	none	basal, edge
87	-	none	-	-	-	-	-
88	-	none	-	-	-	-	-
89	chalcedony	none	-	-	-	-	-
90	-	none	-	-	-	-	-

Key	Lateral Margin Shape	Margin Regularity	W/T Stage	Visual Stage	Flaking Index	HRI Index	Clrksn Index	Flaking Overlap	Midline	Flake Size	Basal Thinning
1	-	-	5	5	-	-	-	high	-	fine	Yes
2	convex	straight	4/5	3/4	2.11	0.31	0.69	light	none	variable	No
3	-	-	5	5	-	-	-	extensive	-	very fine	-
4	convex	-	-	4	3.72	-	-	moderate	undefined	variable	No
5	straight-convex	straight	3/4	5	6.12	0.58	-	moderate	irregular	variable	Yes
6	asymmetrical	moderate	4/5	2/3	2.03	-	0.59	light	none	variable	Yes
7	straight	straight	5	4	2.13	0.59	0.63	minimal	undefined	fine	No
8	straight-convex	straight	5	4	2.37	0.50	0.50	minimal	none	very fine	No
9	straight	straight	5	5	4.97	1.00	-	high	undefined	fine	Yes
10	-	straight	5	5	5.30	1.00	-	extensive	irregular	very fine	-
11	-	-	2/3	4/5	-	-	-	-	-	-	-
12	-	straight	3/4	5	-	-	-	-	-	very fine	-
13	convex-straight	moderate	5	4	1.77	0.38	0.38	minimal	none	fine	No
14	asymmetrical	sinuous	4/5	4	1.61	0.38	0.47	minimal	none	variable	No
15	convex-straight	straight	5	4	3.04	0.66	0.88	moderate	sinuous	fine	No
16	convex-straight	moderate	3/4	2	0.78	-	0.34	none	none	moderate	No
17	irregular	irregular	2	2	1.05	-	0.25	none	none	large	No
18	asymmetrical	sinuous	4	4	1.92	-	0.75	light	undefined	variable	No
19	straight	moderate	5	2	-	-	0.50	none	none	fine	-
20	-	-	2/4	1	0.96	-	0.25	minimal	none	variable	No
21	straight-convex	straight	5	5	3.56	0.66	-	moderate	undefined	very fine	Yes
22	-	straight	-	5	-	-	-	extensive	-	fine	Yes
23	straight	straight	5	5	3.66	0.88	-	light	-	variable	Yes
24	straight	straight	5	5	4.51	0.73	-	extensive	gular, moderately regu	very fine	Yes
25	convex	sinuous	4/5	5	4.38	1.00	-	high	undefined	very fine	Yes
26	convex	moderate	3/4	5	5.92	0.88	-	extensive	straight	very fine	Yes
27	straight	straight	5	5	5.08	1.00	-	extensive	undefined	very fine	Yes
28	-	-	3/4	3/4	-	0.71	-	none	none	large	No
29	convex	moderate	5	5	4.51	0.97	-	extensive	undefined	very fine	Yes
30	-	-	5	5	-	-	-	-	-	-	Yes

Key	Lateral Margin Shape	Margin Regularity	W/T Stage	Visual Stage	Flaking Index	HRI Index	Clrksn Index	Flaking Overlap	Midline	Flake Size	Basal Thinning
31	straight	straight	5	5	-	1.00	-	high	undefined	fine	-
32	-	straight	5	5	-	-	-	high	-	-	-
33	-	straight	5	5	5.49	1.00	-	high	-	-	-
34	straight-convex	straight	5	5	4.24	1.00	-	high	sinuous	moderate	Yes
35	straight	straight	5	5	3.40	0.44	-	moderate	irregular	moderate	Yes
36	asymmetrical	moderate	3/4	2	0.97	0.00	0.41	none	none	variable	Yes
37	convex	straight	5	5	4.10	1.00	-	extensive	regular	very fine	Yes
38	straight	moderate	5	5	4.52	0.69	-	moderate	irregular	moderate	Yes
39	-	-	-	5	-	-	-	-	-	-	-
40	-	straight	3	5	-	-	-	extensive	-	-	-
41	convex	sinuous	3/4	4	2.55	-	1.00	high	irregular	variable	Yes
42	-	-	-	5	-	-	-	-	-	-	-
43	straight	straight	5	5	-	-	-	-	-	-	Yes
44	convex	sinuous	3/4	4	4.14	1.00	-	moderate	sinuous	moderate	Yes
45	straight	straight	4/5	5	4.87	0.70	-	light	undefined	fine	Yes
46	-	-	5	5	3.87	1.00	-	extensive	-	very fine	Yes
47	-	-	2/3	5	-	-	-	-	-	-	-
48	convex	moderate	3	5	5.48	0.81	-	extensive	sinuous	fine	Yes
49	convex	moderate	4	5	4.16	0.50	-	high	regular	fine	-
50	-	-	5	5	-	-	-	minimal	none	variable	Yes
51	straight	-	4	5	4.10	0.65	0.90	high	straight	fine	-
52	-	straight	5	5	5.63	0.75	-	high	sinuous	fine	-
53	-	-	4/5	2	1.73	0.38	0.34	minimal	none	variable	No
54	convex	irregular	3/4	3	2.69	-	0.84	light	none	variable	No
55	-	-	2	2/3	2.07	-	0.50	light	irregular	variable	No
56	asymmetrical	straight	5	5	-	0.67	0.86	moderate	undefined	variable	No
57	straight	straight	5	5	5.53	0.88	-	extensive	obscured	very fine	Yes
58	straight	straight	5	5	3.49	0.67	0.83	light	regular	fine	No
59	convex	sinuous	4/5	4	3.38	0.19	1.00	moderate	undefined	moderate	No
60	straight	sinuous	2/3	4/5	4.33	0.91	-	high	sinuous	moderate	-

Key	Lateral Margin Shape	Margin Regularity	W/T Stage	Visual Stage	Flaking Index	HRI Index	Clrksn Index	Flaking Overlap	Midline	Flake Size	Basal Thinning
61	convex	straight	4/5	5	-	0.92	-	extensive	obscured	very fine	Yes
62	straight	moderate	5	5	-	0.69	0.88	high	sinuous	fine	No
63	convex	straight	5	4/5	2.72	0.31	-	minimal	none	very fine	No
64	straight	sinuous	2	4	2.94	0.31	0.63	moderate	none, irregular	variable	No
65	convex	sinuous	4/5	4	3.09	0.41	0.94	moderate	undefined	variable	No
66	convex	moderate	4/5	4	2.88	0.63	-	moderate	undefined	variable	-
67	irregular	irregular	4/5	2/3	1.31	-	0.28	none	none	variable	No
68	irregular	irregular	5	3	3.95	0.00	0.69	minimal	none	fine	No
69	straight-convex	moderate	5	5	4.05	0.63	-	high	irregular	variable	Yes
70	asymmetrical	moderate	4/5	5	-	0.75	-	high	irregular	fine	Yes
71	straight	moderate	3	4	3.89	0.50	-	high	regular	moderate	No
72	irregular	moderate	4/5	4	2.54	0.50	1.00	light	undefined	variable	Yes
73	-	moderate	5	4	3.42	0.64	1.00	light	undefined	variable	Yes
74	straight-convex	-	4/5	4/5	2.79	0.39	0.79	moderate	irregular, undefined	variable	No
75	straight-convex	straight	4/5	4/5	4.35	0.84	-	light	irregular, undefined	variable	Yes
76	asymmetrical	moderate	5	4/5	3.11	0.42	0.77	moderate	irregular	variable	Yes
77	straight	straight	4	4	5.02	0.63	-	high	sinuous	fine	Yes
78	asymmetrical	sinuous	4/5	4	2.95	0.68	-	light	undefined	variable	No
79	convex	moderate	5	4/5	2.99	0.38	0.69	light	irregular, undefined	variable	No
80	straight	straight	5	4	3.53	0.66	-	moderate	regular, undefined	variable	No
81	straight	moderate	4/5	4/5	3.48	0.50	-	moderate	sinuous	moderate	Yes
82	convex	straight	5	5	-	-	-	light	irregular	fine	Yes
83	asymmetrical	irregular	3	3/4	-	-	-	minimal	undefined	variable	No
84	convex-straight	-	3	3/4	-	-	-	minimal	none	large	No
85	irregular	irregular	4/5	3	-	-	-	none	none	variable	No
86	convex-straight	moderate	5	5	6.53	-	-	extensive	irregular	very fine	Yes
87	-	-	-	-	-	-	-	-	-	-	-
88	-	-	-	-	-	-	-	-	-	-	-
89	-	-	-	-	-	-	-	-	-	-	-
90	-	-	-	-	-	-	-	-	-	-	-

Key	Flaking Terminations	Flaking Direction	Difference in Flaking Styles Between Faces
1	feathered	-	-
2	stepped, hinged	unpatterned	intensity, regularity
3	feathered, stepped	-	-
4	feathered, stepped, hinged	collateral	-
5	feathered	parallel straight	none
6	feathered, stepped	unpatterned, marginal	termination
7	feathered	parallel oblique, marginal	intensity, regularity
8	feathered	marginal	none
9	feathered, stepped	parallel straight, overface	none
10	feathered	collateral	none
11	-	-	-
12	feathered, stepped	-	-
13	feathered, stepped	marginal	none
14	feathered, stepped, hinged	marginal	cortex
15	feathered	parallel oblique, overface	none
16	stepped, hinged	unpatterned	intensity, cortex
17	stepped, hinged	unpatterned	intensity, cortex
18	feathered, stepped, hinged	collateral, unpatterned	intensity, direction, angle
19	feathered	marginal	cortex
20	feathered, stepped, hinged	unpatterned	intensity
21	feathered, stepped	collateral, parallel oblique	direction
22	feathered	-	-
23	feathered, stepped	collateral	similar
24	feathered	chevron, parallel straight	direction
25	feathered	collateral	none
26	feathered	parallel straight	none
27	feathered, stepped	parallel straight	thinning
28	feathered, stepped, hinged	unpatterned	intensity, termination
29	stepped	unpatterned	none
30	-	-	-

Key	Flaking Terminations	Flaking Direction	Difference in Flaking Styles Between Faces
31	feathered, hinged	unpatterned	none
32	feathered	collateral, parallel straight	-
33	feathered	chevron, parallel oblique	-
34	feathered, stepped	collateral, unpatterned	none
35	feathered, stepped	collateral	none
36	feathered	unpatterned	none
37	feathered	parallel converging, marginal	none
38	feathered, stepped	parallel straight	none
39	-	-	-
40	feathered	collateral, parallel straight	-
41	feathered, hinged	collateral, parallel oblique, unpatterned	none
42	-	-	-
43	-	-	-
44	feathered, stepped	chevron, parallel oblique	direction, terminations
45	feathered	parallel straight, marginal	intensity
46	feathered, stepped	-	none
47	-	-	-
48	feathered	parallel straight, overface	thinning, regularity
49	feathered	parallel straight	none
50	feathered, stepped	parallel converging, marginal	size, intensity, direction, temination
51	feathered	parallel straight	none
52	feathered	parallel oblique, parallel straight	none
53	feathered	unpatterned, marginal	invasiveness
54	stepped, hinged	unpatterned	none
55	feathered, stepped	unpatterned	-
56	feathered, stepped	parallel straight, marginal	intensity, regularity
57	feathered, stepped	parallel oblique, overface	none
58	feathered, stepped	collateral, marginal	intensity, direction
59	feathered, hinged	collateral, parallel converging	size, termination
60	feathered, stepped	collateral	termination

Key	Flaking Terminations	Flaking Direction	Difference in Flaking Styles Between Faces
61	feathered	parallel straight	none
62	feathered	parallel oblique	none
63	feathered	marginal	intensity
64	stepped, hinged	collateral, marginal	size, intensity, invasiveness
65	feathered, stepped, hinged	parallel straight, unpatterned	size, direction, regularity, termination
66	feathered, stepped, hinged	unpatterned, overface	size, termination
67	hinged	unpatterned, marginal	size, intensity, temination, direction
68	feathered, hinged	unpatterned, marginal	intensity, regularity
69	feathered, stepped	collateral, parallel straight	size, direction
70	feathered, stepped	collateral, overface	intensity, direction, angle
71	feathered, stepped, hinged	collateral	termination
72	feathered, stepped, hinged	unpatterned	size, angle, regularity
73	feathered, stepped, hinged	unpatterned	size, angle, regularity
74	feathered, stepped	collateral, marginal	size, intensity
75	feathered, hinged	collateral	none
76	feathered	collateral, parallel oblique, marginal	none
77	feathered, hinged	collateral	none
78	stepped, hinged	unpatterned	none
79	feathered, stepped	collateral, marginal	size, intensity
80	feathered	collateral	size, intensity
81	stepped	collateral	size, angle
82	-	-	none
83	stepped, hinged	unpatterned	-
84	stepped, hinged	unpatterned	intensity
85	feathered, hinged	unpatterned	-
86	feathered	parallel converging	none
87	-	-	-
88	-	-	-
89	-	-	-
90	-	-	-

APPENDIX B

EROADAWAY BIFACE ANALYSIS

The Eroadaway bifaces present an interesting case in terms of clustering (Figure 31). When originally included within the primary sample, they clustered fairly efficiently into size classes similar to the small bifaces, although tending to group together with low relative widths and high relative lengths. Charting of basal characteristics show similar mild separation; while some Eroadaway bifaces overlap with the subtriangular forms, over half of the Eroadaway bifaces group separately, with relatively high MWPs (Figure 31). Given discrepancies in clustering and overall metric characteristics for this site compared to the overall sample, I removed the Eroadaway assemblage before conducting the final clustering and technological analyses described here. The basal shape scatterplots provide some evidence that the simplified basal metrics used here, adapted to a simple basal shape, are likely inadequate for more conventional biface assemblages with more complex shape characteristics, and caution should be used when comparing Chindadn points to other biface types.

The Eroadaway bifaces have been described as unique in a number of ways , and it has been suggested that they may be related to Chindadn technology (Holmes et al. 2010). A few similarities to Chindadn bifaces do exist, including narrow widths and thin cross sections, but the Eroadaway bifaces are relatively longer, with a lanceolate outline. They are generally straight-based, but do not fit into the straight-based Chindadn biface group according to basal measurements. They also differ in being made primarily from argillite (63%), rather than the higher-quality cherts (0%) and chalcedonies (25%) that dominate classic Chindadn points. They exhibit moderately low rates of hafting abrasion (25%) and no haft fractures (0%), but high rates of manufacturing errors (38%), and reworking of apparent impact fractures through burination (38%). The majority of finished pieces have strikingly asymmetrical distal margins, accentuated by burination. They are consistently collaterally flaked with moderately overlapping feathered and stepped flake scars. There are two short specimens that could be described as small and slightly subtriangular, but with flaking characteristics more likely representing reused lanceolate points. These two specimens are both abraded at the haft and exhibit impact fractures at the tip, and are made on chalcedony. Other than a shared interpreted function as projectiles, very little in the shape, flaking characteristics, or apparent use and discard patterns of the Eroadaway bifaces strongly connects them to the Chindadn bifaces.

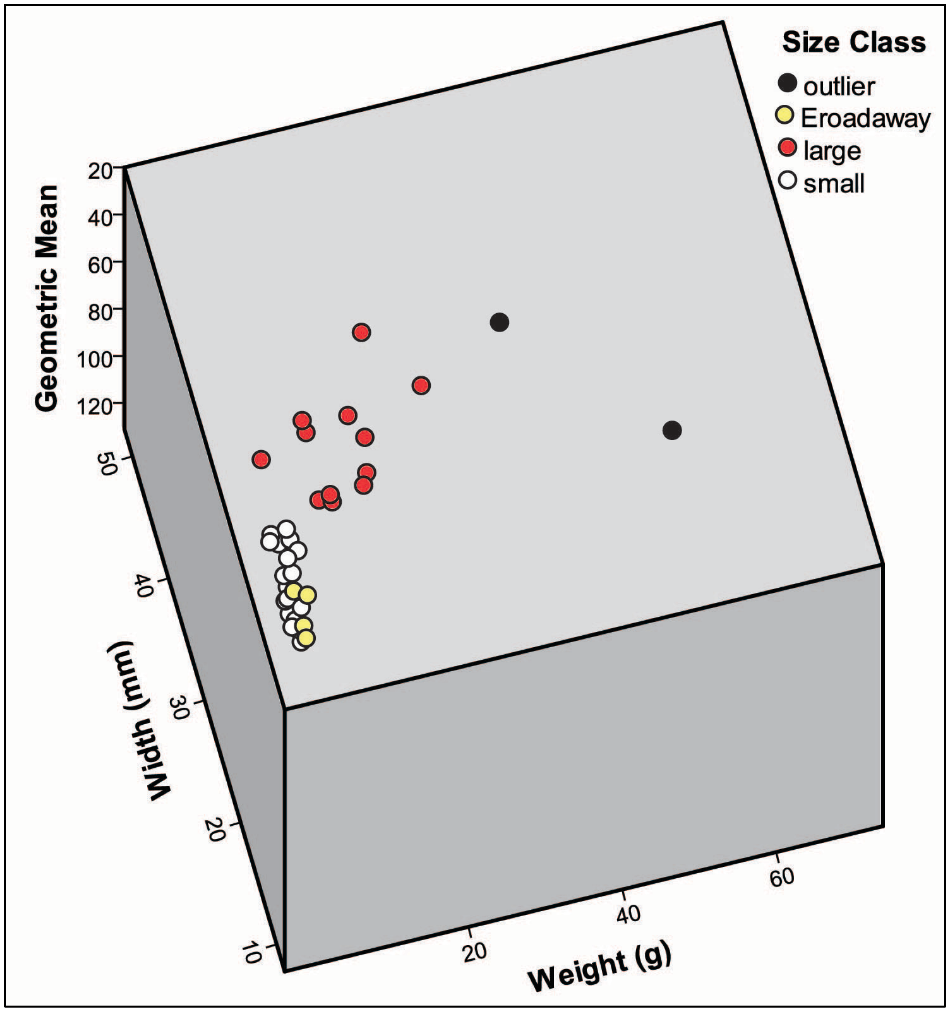

Figure 30. Complete bifaces plotted according to weight, width, and geometric mean, including Eroadaway bifaces.

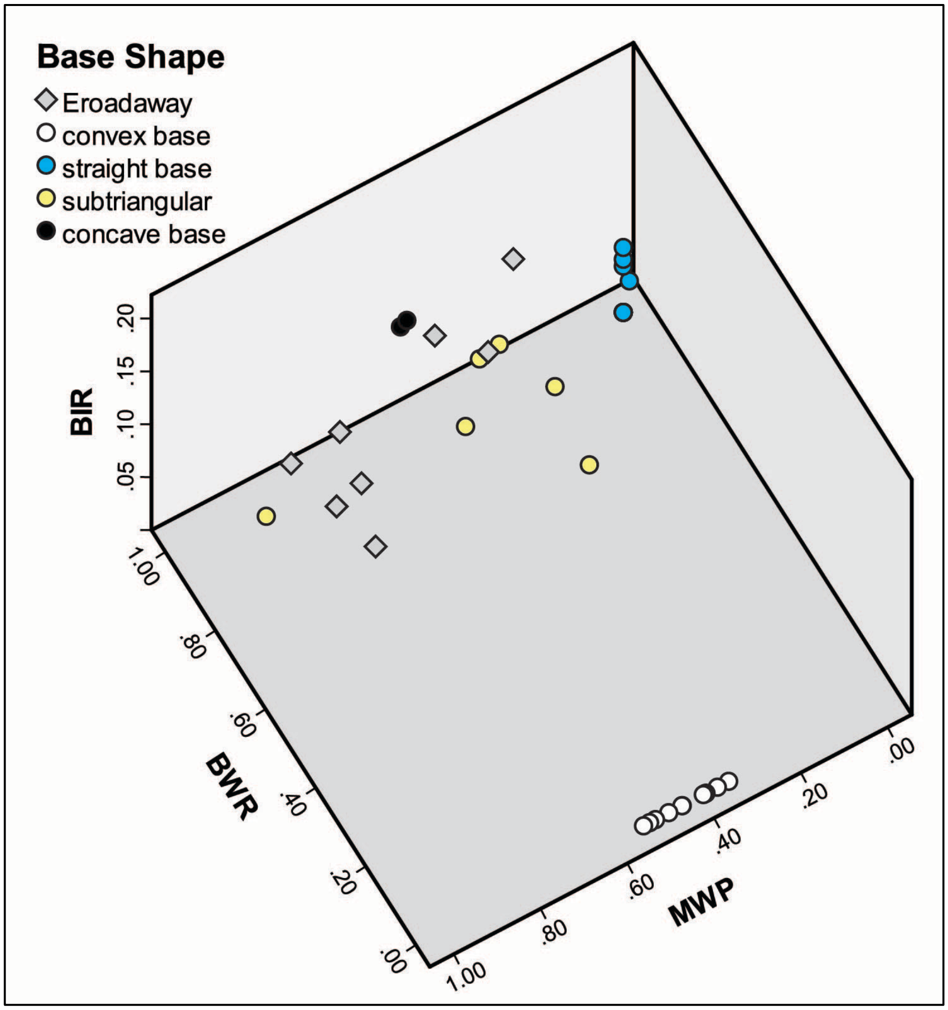

Figure 31. Small bifaces plotted according to BIR, BWR, and MWR, including Eroadaway bifaces.