REPORT

STRATIGRAPHY, DATING, AND LITHIC ASSEMBLAGES FROM MIDDLE TO LATE HOLOCENE SITES IN THE EWE CREEK DRAINAGE, DENALI NATIONAL PARK AND PRESERVE

John C. Blong
Center for the Study of the First Americans, Department of Anthropology, Texas A&M University, MS 4352 TAMU, College Station, TX 77843-4352; johnblong@tamu.edu

Lyndsay M. DiPietro
Department of Geology, Baylor University, Waco, TX 76798; lyndsay_dipietro@baylor.edu

ABSTRACT

In 2010, Texas A&M University archaeologists conducted limited subsurface testing at three prehistoric archaeological sites along Ewe Creek, a tributary of the Savage River, in Denali National Park and Preserve. The goals of this research were to assess the potential for buried, datable cultural deposits and determine their significance. We excavated three 1 m^2 test units and recovered cultural material in primary context from two buried surfaces, the oldest of which is associated with a radiocarbon date of approximately 2700 cal BC. Only a small amount of lithic material was collected during this research, most from surface contexts. Despite these limitations, the data suggest that the three sites represent Middle to Late Holocene (MH to LH) occupations of the Ewe Creek drainage by hunter-gatherers who procured locally available toolstone from secondary stream-rolled gravel beds. Micromorphological analyses indicate cooler, drier conditions associated with middle Holocene site occupation and warmer, wetter conditions associated with late Holocene site occupation. Lithic technological activities focused on informal cryptocrystalline flake core reduction and manufacture, maintenance, and use of cryptocrystalline and rhyolite bifacial projectiles. With further research, the Ewe Creek sites have the potential to contribute to our understanding of changing subsistence and land-use patterns in Middle and Late Holocene central Alaska, an under-studied but important period in the prehistory of the region.

INTRODUCTION

Current models of landscape use in central Alaska predict that the Middle Holocene (MH) (6000–1000 years ago) and Late Holocene (LH) (< 1000 years ago) was a time of significant change in hunter-gatherer subsistence and settlement patterns, including increased use of upland landscapes (Dixon et al. 1985; Esdale 2008; Potter 2008a, 2008b). This shift has important implications for lithic technology; assemblage data from central Alaska suggest that during the MH, microblades (presumably for inset-microblade projectiles) are more commonly associated with sites in lowland ecological regions, while bifacial projectiles are more commonly associated with sites in upland ecological regions. In the LH, organic and copper technology is more common than lithic technology in both the uplands and lowlands (Potter 2008b; Shinkwin 1975; Vanderhoek et al. 2012). However, the current archaeological record of central Alaska makes it difficult to fully assess these models, because we know very little about the MH and LH record in comparison to the well-documented Late Pleistocene/Early Holocene record of the region (e.g., Goebel 2011; Holmes 2001; Potter 2005; Potter et al. 2011; Potter and Reuther 2012; Powers and Hoffecker 1989).

In summer 2010, archaeologists from Texas A&M University conducted archaeological survey and test excavations along the Savage River in Denali National Park and Preserve (DENA), to add to our knowledge of prehistoric upland use in the central Alaska Range (Blong 2011). As part of this research, we conducted initial investigations at HEA-263, 264, and 265, three sites along Ewe Creek in the Savage River basin (Fig. 1), to assess their condition and significance, collect material to date cultural components, collect micromorphological samples, and recover lithic artifacts that could inform on lithic technological activities of the sites' occupants. In addition, we conducted a toolstone survey of the Savage basin to assess local toolstone resources. We collected lithic artifacts from surface contexts at the three sites and excavated test units at HEA-264 and HEA-265, recovering lithics from subsurface contexts, the oldest of which contained dispersed charcoal radiocarbon dated to the Middle Holocene, approximately 2700 cal BC.

The primary goal of this paper is to present the stratigraphy, radiocarbon date, and lithic assemblages of the three Ewe Creek sites to highlight the research poten-

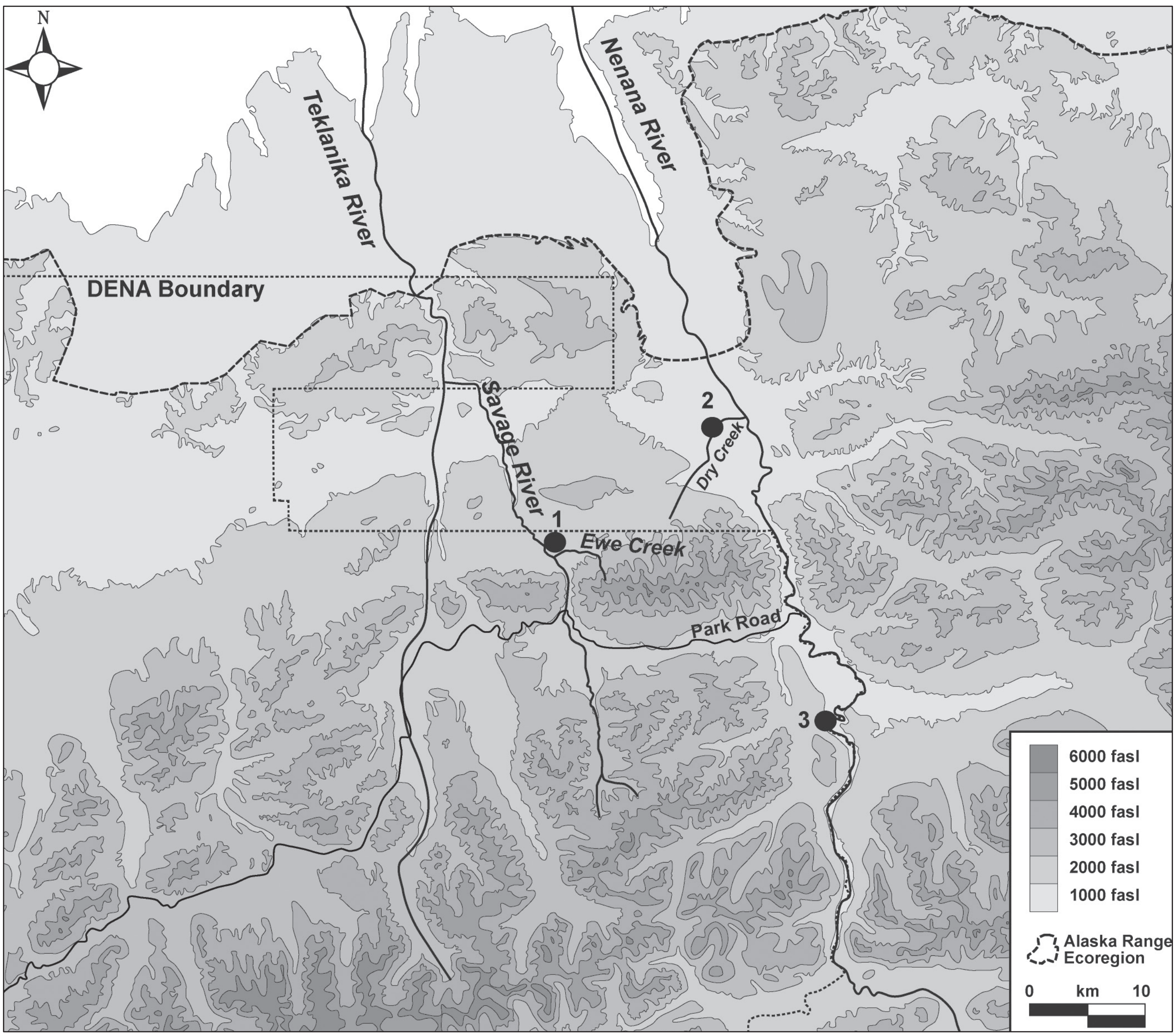

Figure 1. Location of sites mentioned in text: 1 = Ewe Creek study area; 2 = Dry Creek site; 3 = Windmill Lake.

tial of the Ewe Creek drainage for future researchers. A secondary goal is to evaluate local toolstone resources, toolstone procurement, and lithic technological activities in the Ewe Creek drainage. While the test excavations were preliminary and the assemblages recovered from the sites are comprised primarily of surface material, some artifacts were recovered from buried, datable contexts, and with further testing more substantial assemblages may be recovered. This research represents an important contribution to our understanding of prehistoric use of upland landscapes in DENA, as it represents one of the few radiocarbon-dated archaeological sites in the six-million-acre park and preserve (Griffin 1990; Wygal and Krasinski 2010).

This study offers the preliminary conclusion that prehistoric hunter-gatherers occupied the upland Ewe Creek drainage in the MH Neoglacial Period and LH Medieval Warming Period, focusing toolstone selection primarily on locally available cryptocrystalline (CCS) chert and chalcedony from secondary stream-rolled gravel sources. Lithic technological activities focused on informal CCS flake core reduction and manufacture and maintenance of CCS and rhyolite bifacial tools. CCS tools were often invasively and intensively retouched. Lanceolate bifaces appear to be preferentially, but not exclusively, used in hunting toolkits for the occupants of the Ewe Creek drainage, provisionally supporting previous research that found a correlation between upland hunting and use of bifacial projectile technology.

SETTING

The Savage River basin is within the Alaska Range ecoregion (Fig. 1), an area of rugged mountain ridges and broad valleys. Vegetation is predominantly dwarf scrub, with some low or tall scrub communities on moist-to-mesic protected sites and open forest and woodlands in some valleys (Nowacki et al. 2001). The Savage River drains the northern flank of the Alaska Range, flowing north through the Front Range into the Teklanika River. The broad gravel outwash plains and lateral moraines of the Savage basin were created by a series of Pleistocene glacial advances, outwash episodes, and Holocene alluviation (Wahrhaftig 1958).

Ewe Creek is a small tributary of the Savage River that drains the northern slope of the Front Range (Fig. 1), cutting through the Birch Creek schist and Healy Creek outwash geologic formations. The three Ewe Creek sites are situated on the southern edge of a broad terrace composed of Holocene alluvium and pediment gravel (Wahrhaftig 1970). Modern vegetation in the Ewe Creek drainage consists primarily of a closed, low birch-shrub vegetation community, dominated by dense shrub birch (*Betula glandulosa*) with some willow (*Salix* spp.) and scattered white (*Picea glauca*) and black (*P. mariana*) spruce, some as tall as 8 m. Faunal species in the study area include moose (*Alces alces*), caribou (*Rangifer tarandus*), Dall sheep (*Ovis dalli*), grizzly bear (*Ursus arctos*), and black bear (*Ursus americanus*), as well as various small game species. While conducting our field research, moose were observed on heavily used game trails along the southern edge of Ewe Creek; Dall sheep were observed high in the Front Range and along the steep-sided Savage canyon between the Park Road and the study area. No caribou were observed during our field research; however, the Savage basin is within the herd range of the Denali caribou herd (Adams et al. 2004).

Paleoecological data from central Alaska document Quaternary vegetation change from Late Glacial herb- and forb-dominated tundra to Late Pleistocene/Early Holocene *Betula* shrub-tundra to Early Holocene expansion of first *Populus* then *Picea* lowland forest. In general, the MH and LH climate in Alaska was cooler and wetter than that of the Early Holocene (Anderson and Brubaker 1994; Anderson et al. 2003; Bigelow and Edwards 2001; Bigelow and Powers 2001). The MH and LH vegetation history of the Ewe Creek drainage is likely analogous to the vegetation record from Windmill Lake, at 640 m asl in the nearby Nenana River valley (Fig. 1). By ~5300 cal BC, the vegetation at Windmill Lake was probably similar to the present day, primarily consisting of *Picea* and *Betula* trees and shrubs (Bigelow and Edwards 2001), indicating that vegetation in the region has remained relatively stable throughout the MH and LH. The regional glacial record provides a finer-grained proxy of environmental change, indicating that the MH and LH were a time of climatic fluctuations in central Alaska. Temperatures oscillated between cool and warm with the onset of the Neoglacial Period (NP), ~2000 BC–AD 900, followed by warming in the Medieval Warm Period (MWP), ~AD 900–1350. Temperatures cooled again during the Little Ice Age (LIA), ~AD 1350–1850, before warming to modern levels (Calkin 1988; Hu et al. 2006; Loso 2009; Mann et al. 1998; Mason and Begét 1991). Periods of cooling during the NP and LIA are correlated with heightened wind intensity and increased sediment deposition in the Nenana Valley, indicating the significant effect that climate fluctuations had on regional landscapes (Bigelow 1991; Mason and Begét 1991; Powers and Hoffecker 1989).

HISTORY OF RESEARCH

In 1964, M. Treganza conducted an archaeological survey in the Ewe Creek drainage as part of a larger investigation of Mt. McKinley National Park's archaeological resources. Treganza's survey of the study area located a single flake on a gravel erosional surface on the northern side of Ewe Creek, which he did not consider significant enough to warrant a site designation (Treganza 1964). In 1984, National Park Service (NPS) archaeologist C. Davis conducted a cultural resource survey along Ewe Creek drainage and recorded a surface scatter at what is now HEA-264, but the site was not registered with the State of Alaska (Griffin 1990). In 1989, NPS archaeologists conducted a cultural resource inventory in the Ewe Creek drainage, recording three prehistoric archaeological sites along a terrace edge on the north side of Ewe Creek (HEA-263, HEA-264, HEA-265). Test excavations at these sites were limited to bank cuts, revealing two paleosols containing charcoal but no in situ cultural material. However, Lynch (1996:117–118) reported that artifacts recovered from deflated gravel surfaces likely eroded from subsurface deposits. In 2009, NPS archaeologists revisited Ewe Creek and successfully relocated HEA-263, HEA-264, and HEA-265, noting artifacts lying on the surface and the high potential for buried cultural materials at all three sites (Wygal and Krasinski 2010:119–124).

There have been many prehistoric archaeological sites identified in DENA; however, few archaeological excavations have been conducted due to a longstanding ethic of nondisturbance. Two exceptions to this are Teklanika West and Bull River II, which have undergone focused archaeological investigations (Coffman 2011; Coffman and Potter 2011; Goebel 1996; West 1965, 1996; Wygal 2009, 2010; Wygal and Krasinski 2010). As a result, there are few prehistoric archaeological sites with radiocarbon-dated deposits in DENA (Griffin 1990; Wygal and Krasinski 2010).

METHODS

FIELDWORK

Fieldwork for this project was conducted in summer 2010. A datum was set at HEA-265 and a grid established across the Ewe Creek terrace using a total station. When located, datum points from previous research were tied into the grid. Surface artifacts were mapped with the total station, then collected. One 1 m^2 test unit was established at HEA-264 and two 1 m^2 test units were established at HEA-265; all test units were oriented on the grid. Test units were excavated in 50 cm^2 quadrants using shovels and trowels. Test units were excavated by natural strata, using 5 cm arbitrary levels if strata reached >5 cm in thickness. Artifacts and charcoal located during excavation were three-point provenienced, and all sediment was screened through ⅛" mesh to recover additional remains. Sediment descriptions and profiles were completed in the field for each test unit at HEA-264 and HEA-265 and for a 50-cm section at HEA-263. Stratigraphic descriptions followed standard conventions (Folk 1954; Waters 1992). Upon completion of the project, all 2010 grid markers, including the site datum, were pulled in accordance with DENA research requirements.

MICROMORPHOLOGY

Oriented micromorphological samples were collected from HEA-265 test unit N1023 E997 by driving plastic conduit boxes into the profile wall. Samples were wrapped in plastic wrap and duct tape, transported back to Texas A&M, air dried for six months, surface impregnated with Hillquist epoxy C/D, and shipped to Spectrum Petrographics Inc., where they were vacuum impregnated and cut into 2x3" slides with a standard thickness of 30 microns for micromorphological analysis. Thin sections were examined using an Olympus BX15 research microscope using plane- and cross-polarized light. Photomicrographs were captured using a Leica DFC450 camera attachment. Thin sections were described following the methodology of Brewer (1976) and Fitzpatrick (1993).

LITHIC ANALYSIS

This study presents the lithic assemblages from the Ewe Creek study area, focusing on assemblage attributes that indicate toolstone procurement (toolstone abundance and quality, toolstone type, and presence/absence of cortex). Following Graf and Goebel (2009), this study designates toolstone available within 5 km of the sites as local and outside of 5 km as nonlocal. Toolstone types were identified based on composition and texture using a 10x hand lens and on color using a Munsell rock color book. Artifact toolstone types were visually compared to samples collected during our toolstone survey of the Savage basin.

For the lithic assemblages collected during our 2010 research, lithic tools were scored using a standard typology developed for central Alaska (Goebel et al. 1991). Tools, cores, and debitage were analyzed using metric and nonmetric attribute analyses (e.g., Andrefsky 2005). Tool retouch type and depth were recorded at most invasive point, and retouch intensity was scored as the number of retouched edge units (Surovell 2003:345–347). Debitage was assigned to cortical spall, flake, biface thinning flake, or retouch chip categories. Cortical spalls were subdivided into three types: primary cortical spall (> 50% dorsal cortex), secondary cortical spall (< 50% dorsal cortex), and cortical spall fragment (incomplete flake with dorsal cortex). Cortex type was scored as either primary geologic cortex or secondary stream-rolled cortex following Rasic (2008:225). Flakes were subdivided into three types: flake (no cortex, simple platform, greater than 1 cm in size), flake fragment (fragment with no platform and no cortex), and blade-like flake (attributes of a flake but twice as long as wide). Biface thinning flakes have no dorsal cortex, a complex platform, and are greater than 1 cm in size. Retouch chips were subdivided into two types: retouch chip (no dorsal cortex, simple or complex platform, less than 1 cm in size) and retouch chip fragment (no platform, no cortex, less than 1 cm in size). Lithic materials collected during previous research in the study area were not analyzed for this study; however, the lithic assemblages from the 1989 NPS investigations (adapted from Lynch 1996) are presented to add to the discussion of toolstone selection in the study area.

RESULTS

HEA-263 SITE DESCRIPTION

HEA-263 is situated at 715 m asl on a south-facing alluvial terrace overlooking Ewe Creek, approximately 200 m east of HEA-264. In 1989 NPS archaeologists mapped and collected two lithics 30 m apart (Lynch 1996:115). In 2009, NPS archaeologists observed surface lithics including a black chert retouched blade, a gray chert microblade fragment, and a black chert microblade (Wygal and Krasinski 2010:124).

Our 2010 survey located four lithics in a 4 m² deflated area within a large blowout feature (Fig. 2). Quaternary geology at HEA-263 consists of round to subround, moderately sorted alluvial gravel and sand capped with approximately 50 cm of aeolian silt and sand (Fig. 3). No artifacts were observed while cleaning off this profile, and no test excavations were conducted.

HEA-264 SITE DESCRIPTION

HEA-264 is situated at 710 m asl on a south-facing edge of a steep alluvial terrace overlooking Ewe Creek, approximately 300 m east of HEA-265. In 1984, NPS archaeologist C. Davis mapped more than thirty surface artifacts (Griffin 1990:174; Wygal and Krasinski 2010:122–123). NPS archaeologists returned in 1989, mapping and collecting thirty-nine lithics from two clusters over an 18- by 40-m area along the terrace edge, excavating a bank cut on the edge of a blowout, and recording one paleosol with traces of charcoal. However, they did not find cultural material in a subsurface context. In 2009, NPS archaeologists noted surface lithics, including a retouched tertiary flake

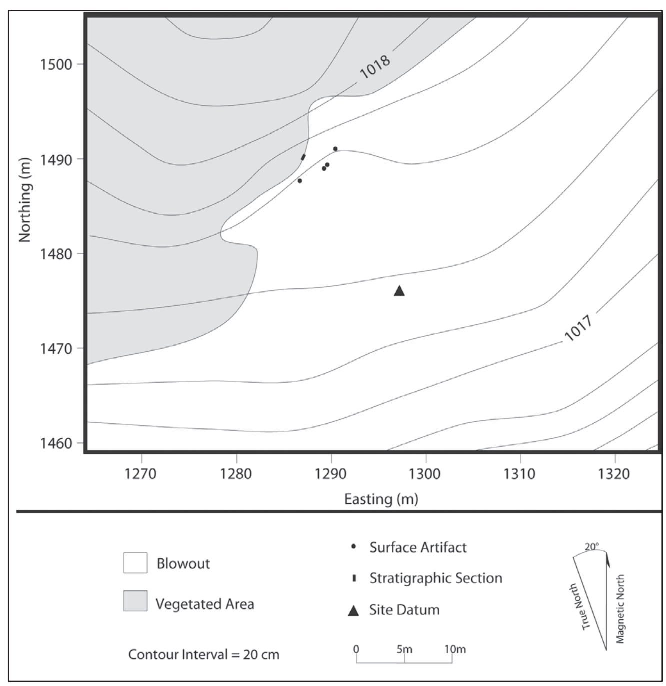

Figure 2. Topographic map of HEA-263 showing location of surface artifacts and stratigraphic section.

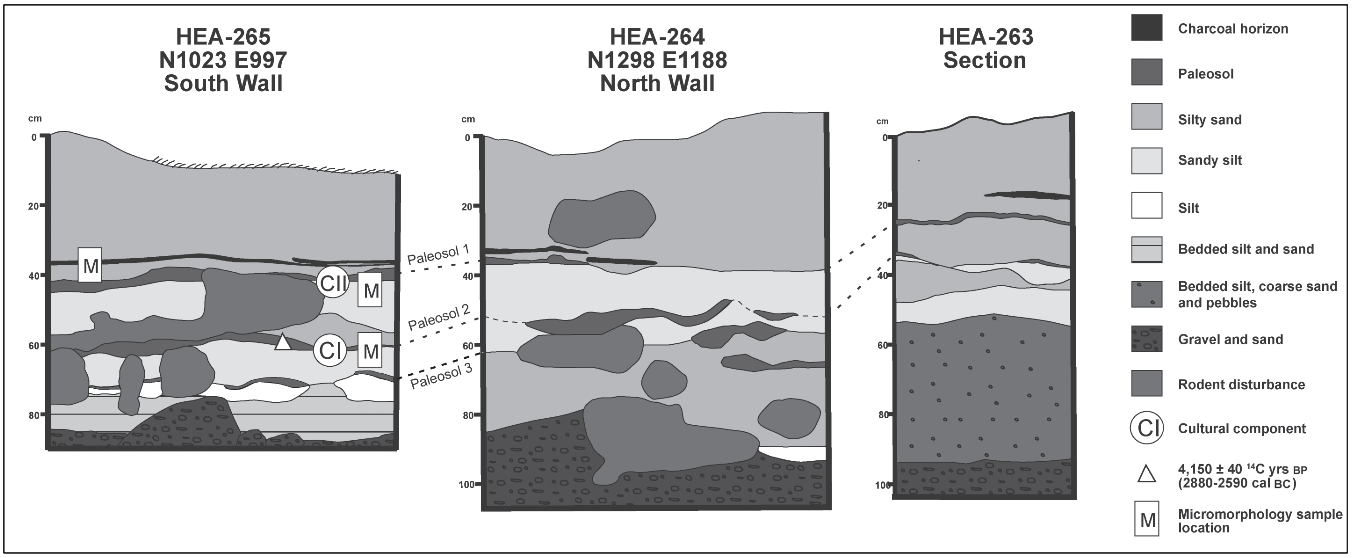

Figure 3. Stratigraphic profiles from sites in the Ewe Creek drainage.

on green to light gray chert, four black chert flakes, and some green chert shatter (Wygal and Krasinski 2010:122).

Our 2010 survey located twenty-one lithics concentrated in two loci, presumably those described by Lynch (1996). In both loci, artifacts were lying on a gravel surface in a blowout feature (Fig. 4). We placed test unit N1298 E1188 on the northern edge of the blowout, near a concentration of lithics on the deflated surface. Quaternary geology at HEA-264 consists of round to sub-round, moderately sorted alluvial gravel and sand capped with approximately 90 cm of aeolian silt and sand (Fig. 3). There is evidence of moderate solifluction and rodent disturbance. A single small flake (2 cm in diameter) was recovered at the base of the uppermost silty sand unit, near two charcoal horizons interpreted as the result of in situ burning of many fine-to-medium-sized roots. Micromorphological analysis of a corresponding stratigraphic unit at HEA-265 (Fig. 5) shows abundant, well-preserved charcoal (Fig. 5a) and what appear to be burned roots (Fig. 5b), supporting the interpretation of in situ root burn. This unit exhibits very little soil development, suggesting that it was deposited relatively recently. The sediment in this unit has abundant pore space and is mineralogically diverse but with little indication that unstable mineral grains have been altered (Fig. 5c), supporting the interpretation of limited pedogenesis. These sediments are poorly sorted (Fig. 5c) and have not traveled far from their source, likely the adjacent blowout. Given these analyses, the single small flake is likely in a secondary context and was not assigned to a cultural component.

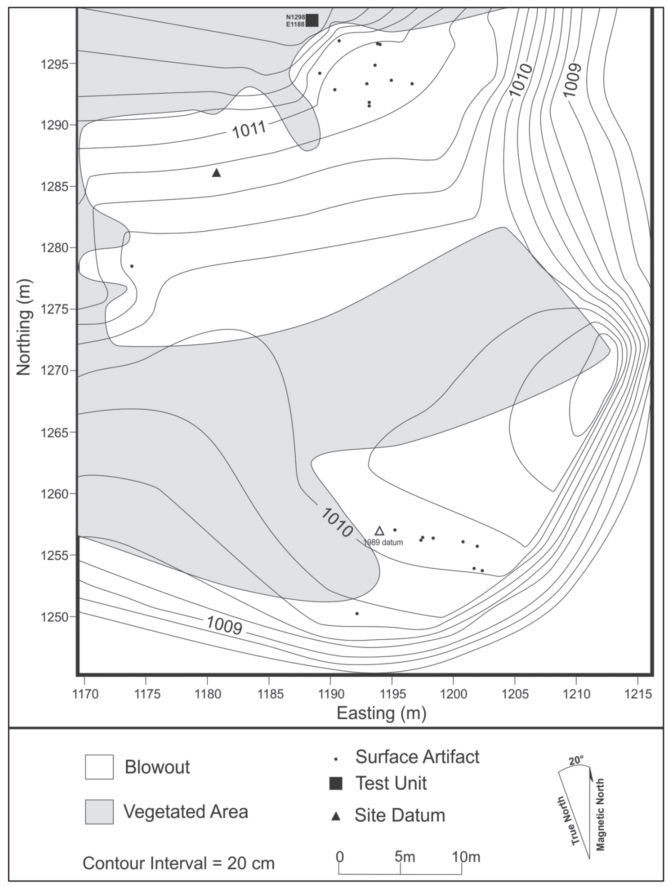

Figure 4. Topographic map of HEA-264, showing location of surface artifacts and excavation unit.

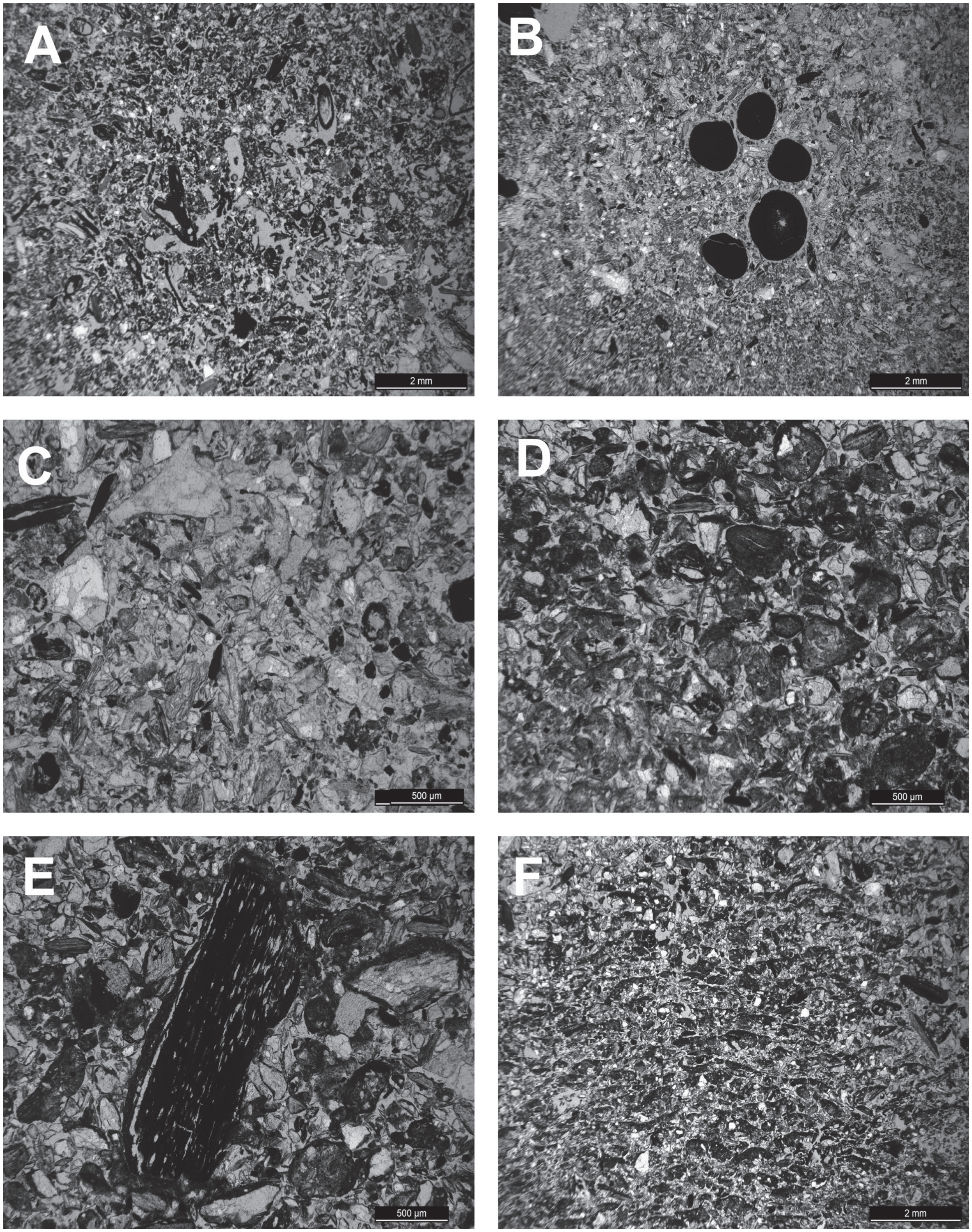

Figure 5. Photomicrographs from HEA-265. A = Charcoal derived from the in situ burning of a root-mat layer. Charcoal is well-preserved and abundant, Stratum 7, 1.25x. B = Burned in situ roots with cellular structure visible in center, Stratum 7, 1.25x. C = Poorly sorted, porous, mineralogically mature, moderately unweathered sediment, Stratum 7, 4x. D = Pedogenic iron oxides, Paleosol 1, 4x. E = Silt-capped grains, Paleosol 1, 4x. F = Cryogenic microfabric, Paleosol 2, 1.25x. All images taken using plane-polarized light.

HEA-265 SITE DESCRIPTION

HEA-265 is situated at 700 m asl on a south-facing, steep-sided alluvial terrace overlooking the confluence of Ewe Creek and Savage River to the south and west. In 1989, NPS archaeologists mapped and collected forty-five lithic artifacts dispersed over a 10- by 30-m exposure, excavated an 80 cm^2 bank-cut on the edge of a blowout, and recorded two paleosols, but they did not find cultural material in a subsurface context. Still, the site was considered to have a high probability of containing subsurface deposits, supported by a return trip three weeks later that recovered three newly exposed lithic artifacts on the blowout edge (Lynch 1996:118–120). In 2009, NPS archaeologists observed a few lithic artifacts on the surface, including a green chert flake fragment (Wygal and Krasinski 2010:123–124).

Our 2010 survey located twenty-two lithic artifacts lying on a gravel surface in a blowout along the southern edge of the terrace, concentrated in two locations separated by a stand of spruce trees (Fig. 6). We placed test pit N1023 E997 on the northern edge of a blowout near a large transverse scraper (Fig. 7a) that had recently eroded from the blowout edge. We placed test pit N995 E986 on the western edge of a blowout, near a concentration of surface artifacts.

Quaternary geology at HEA-265 consists of round to sub-round, moderately sorted alluvial gravel and sand capped with approximately 90 cm of aeolian silt and sand (Fig. 3). There is evidence of moderate solifluction and rodent disturbance. Five lithics from two cultural components were recovered from subsurface excavations at HEA-265. Three flakes were recovered from Component II in Paleosol 1, and two flakes were recovered from Component I in Paleosol 2. Dispersed wood charcoal collected from Paleosol 2 yielded an AMS radiocarbon date of 4150 ± 40 ^{14}C yrs BP (BETA-284746; $\delta^{13}C = -24.0‰$), calibrated at 2σ to 2880–2590 cal BC using Calib 7.0. Micromorphological analyses conducted on samples from Paleosol 1 and 2 show that the sediments in both units are texturally immature, suggesting a nearby sediment source. Paleosol 1 shows an abundance of iron oxide formation in pore spaces (Fig. 5d) and silt-capped grains (Fig. 5e). Paleosol 2 displays incipient cryogenic fabrics (Fig. 5f), suggesting repeated freezing and thawing of the sediment over an impermeable permafrost layer (Dumanski 1964; Fedorova and Yarilova 1972; Romans et al. 1966; Van Vliet-Lanoe 2010). Silt capping is also indicative of cool, dry conditions, but the absence of cryogenic microfabric and the abundance of iron oxides in Paleosol 1 suggest that the soil environment during formation was somewhat warmer and wetter, with rapid water table fluctuations, in comparison to the soil environment during the formation of Paleosol 2 (Arshad and St. Arnaud, 1980; Richardson and Hole 1979; Schwertmann and Fanning 1976; Van Vliet-Lanoe 2010; Vepraskas 2004).

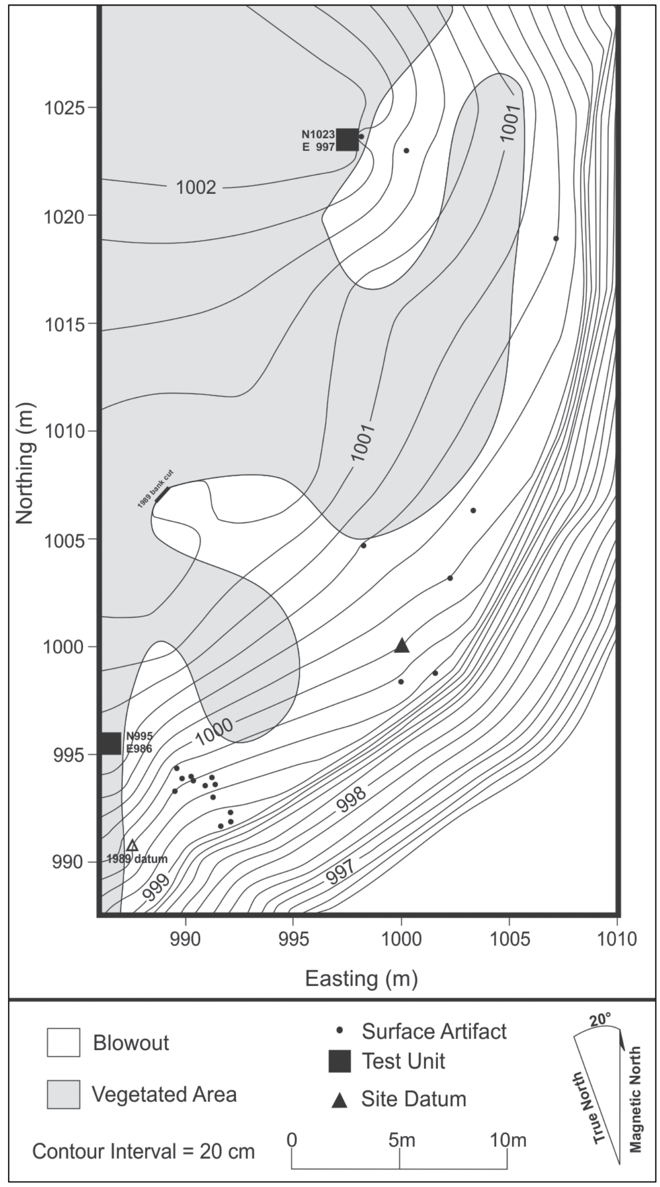

Figure 6. Topographic map of HEA-265, showing location of surface artifacts and excavation units.

LITHIC LANDSCAPE

The lithic landscape within 5 km of the Ewe Creek sites consists of abundant gravels available in the unconsolidated secondary outwash and alluvial deposits that blanket the Savage River basin. This includes the Healy Creek and Lignite Creek formations of the Usibelli Group, the Nenana Gravel formation, and various Quaternary formations (Wahrhaftig 1958, 1970). Toolstone available in these formations includes rhyolite, quartzite, basalt, chert, and chalcedony, although these do not always occur in cobble- and boulder-sized packages suitable for knapping (Graf and Goebel 2009; Wahrhaftig 1958). Toolstone also occurs throughout the region in locations more than 5 km away from the Ewe Creek basin. Basalt dikes are common in the Birch Creek schist formation and basalt, rhyolite, and chert outcrop on Sugarloaf Mountain approximately 20 km east of the study area (Wahrhaftig 1958:14, 1970). Coarse-grained chert outcrops near the Teklanika West site in the nearby Teklanika basin, approximately 12 km away (Coffman 2011; West 1996:335).

To obtain a finer-grained approximation of the toolstone resources available in the study area, we conducted a toolstone survey of the upper Savage basin and the Ewe Creek drainage within 5 km of the Ewe Creek sites. Survey consisted of inspecting moraine, outwash, and alluvial gravel formations in the upper Savage basin as well as alluvial gravels on the Ewe Creek floodplain. In the upper Savage basin we recovered knappable-quality CCS chert and chalcedony pebble- and cobble-sized gravels in secondary stream-rolled gravel deposits that were generally dominated by metamorphic rock types and milky quartz. The availability of chert and chalcedony varied considerably across the landscape and can be described as locally abundant, with dark gray to grayish-black chert the most common in the basin. At many locations with knappable-quality raw material, the nodules were predominantly pebble sized, calling into question their usefulness for most lithic reduction activities. Our survey did not locate any rhyolite toolstone described in the coal-bearing formations in the Savage basin (Wahrhaftig 1958). The alluvial gravels of the Ewe Creek drainage contained knappable-quality dark gray to grayish-black chert and dark gray chalcedony, but the material we observed was consistently pebble-sized. Ewe Creek alluvial gravels are dominated by schist (70%), followed by quartz (25%), lignite (< 5%), and porphyritic and phaneritic igneous (< 5%) pebbles and cobbles.

In summary, quality toolstone locally available (< 5 km) to prehistoric knappers at the Ewe Creek sites include chert and chalcedony stream-rolled pebbles and cobbles available in secondary gravel deposits in the drainage. We recovered locally three varieties of chert (medium dark gray, dark gray, grayish black) and three varieties of chalcedony (medium light gray, medium gray with dark gray banding, dark gray). Geologic maps indicate that basalt, argillite, and quartzite are potentially available in the region surrounding the Ewe Creek basin; however, we did not recover these toolstone types in our survey.

LITHIC ASSEMBLAGES

Six lithic artifacts were collected at HEA-263. The 1989 investigations recovered one retouched chert blade and one chert core; 2010 investigations recovered one chert primary cortical spall with stream-rolled cortex, two chalcedony blade-like flakes, and one chalcedony retouched blade-like flake. Debitage and tools were made of chert (50%) and chalcedony (50%). In the 2010 assemblage, debitage representing blade-like flake production is most common. There is one core in the HEA-263 assemblage. Lynch (1996) reports a dark-gray chert core with three core fronts and remaining cortical surface. There are two tools in the HEA-263 assemblage. Lynch (1996) reports a dark-gray chert medial macroblade fragment with nibbling use-wear along one lateral edge. In 2010, one tool was recovered at the site. Figure 7g is a grayish-black chalcedony retouched flake made on a blade-like flake blank, with unifacial scalar retouch to a depth of 6.9 mm and retouched on seven of ten edge units.

Sixty-one lithic artifacts were collected at HEA-264 in 1989 and 2010 (Table 1). Debitage and tools are primarily made of chert (48%) and chalcedony (21%), with lesser amounts of rhyolite (16%), basalt (12%), and quartzite (3%). Cortical debitage consists of chert (*n* = 2), chalcedony (*n* = 1), and rhyolite (*n* = 2); all of the 2010 cortical debitage has stream-rolled cortex. In the 2010 assemblage, debitage representing flake-core reduction is most common. There are six tools in the HEA-264 assemblage. Lynch (1996:170) reports a brown chert end scraper and a dark-gray chert biface tip of unknown reduction stage. In 2010, four tools were recovered at the site. Figure 7c is the distal end of a light-gray rhyolite finished biface with

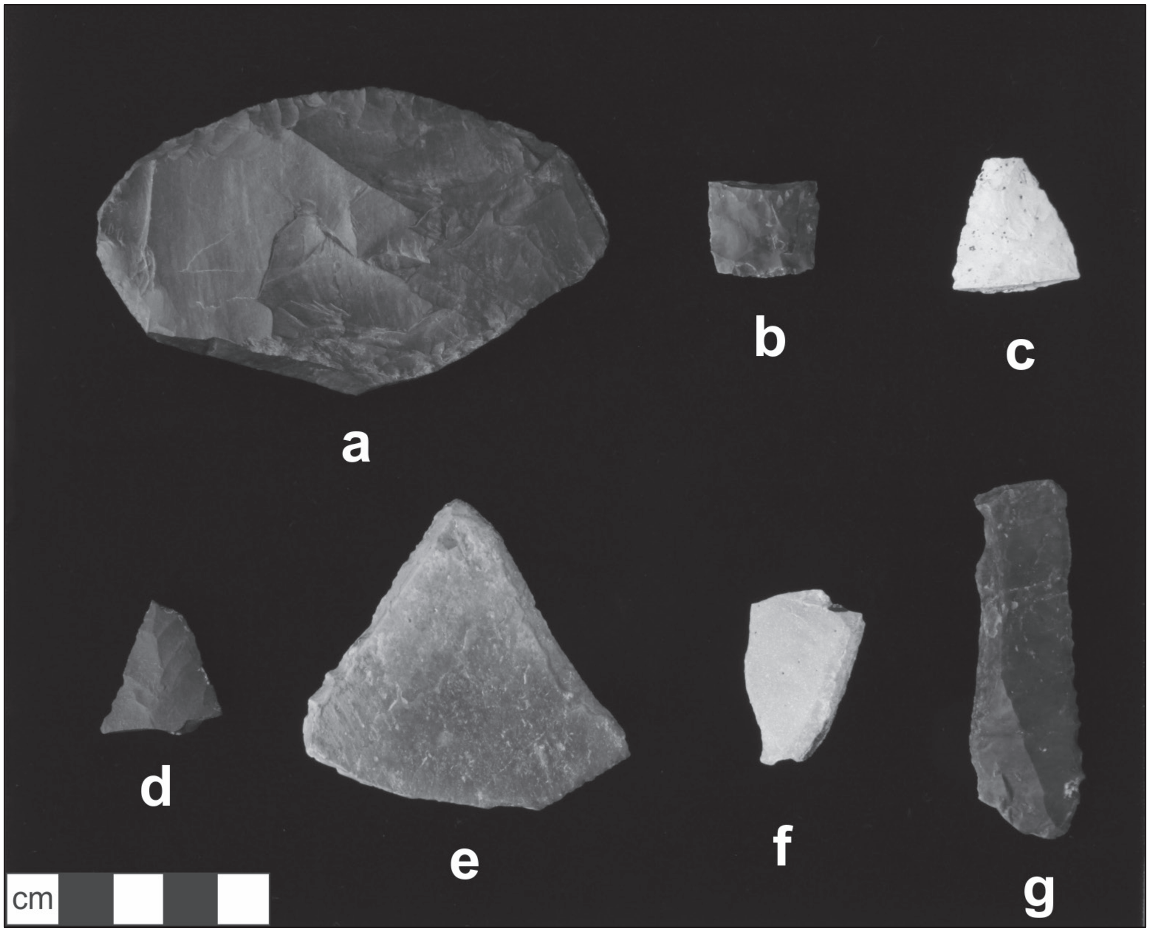

Figure 7. Tools recovered during the 2010 field study: A = transverse scraper; B = proximal hafted biface fragment; C = distal finished biface fragment; D = distal late-stage biface fragment; E = convergent scraper; F = retouched flake; G = retouched blade-like flake.

Table 1. HEA-264 artifact class by toolstone type.

Artifact Class	Toolstone Type					
	Chalcedony	Chert	Rhyolite	Basalt	Quartzite	Total (%)
Flake[1]	3	2	1	0	0	6 (9.8)
Flake fragment[1]	5	0	0	2	0	7 (11.5)
Biface thinning flake[1]	1	1	0	0	0	2 (3.3)
Retouch chip fragment[1]	1	0	0	0	0	1 (1.6)
Cortical spall fragment[1]	1	0	1	0	0	2 (3.3)
Secondary decortification flake >20 mm[2]	0	2	1	0	0	3 (4.9)
Tertiary flake <20 mm[2]	1	7	3	1	0	12 (19.7)
Tertiary flake >20 mm[2]	0	11	3	4	2	20 (32.8)
Other debitage[2]	0	2	0	0	0	2 (3.3)
Retouched flake[1]	0	1	0	0	0	1 (1.6)
Endscraper[2]	0	1	0	0	0	1 (1.6)
Convergent scraper[1]	1	0	0	0	0	1 (1.6)
Biface[1, 2]	0	2	1	0	0	3 (4.9)
Total (%)	**13** (21.3)	**29** (47.5)	**10** (16.4)	7 (11.5)	**2** (3.3)	**61** (100)

1. This study.
2. Lynch 1996.

Table 2. HEA-265 artifact class by toolstone type.

Artifact Class	Toolstone Type			
	Chalcedony	Chert	Rhyolite	Total (%)
Flake[1]	4	1	0	5 (7.1)
Flake fragment[1]	9	1	0	10 (14.3)
Biface thinning flake[1]	4	0	0	4 (5.7)
Retouch chip[1]	1	0	1	2 (2.9)
Retouch chip fragment[1]	0	1	0	1 (1.4)
Cortical spall fragment[1]	0	1	0	1 (1.4)
Secondary decortification flake < 20 mm[2]	0	1	0	1 (1.4)
Secondary decortification flake > 20 mm[2]	0	5	0	5 (7.1)
Tertiary flake < 20 mm[2]	0	14	0	14 (20.0)
Tertiary flake > 20 mm[2]	0	20	0	20 (28.6)
Shatter[2]	0	3	0	3 (4.3)
Transverse scraper[1]	0	1	0	1 (1.4)
Biface[1, 2]	0	1	1	2 (2.9)
Bifacial point fragment[2]	0	1	0	1 (1.4)
Total (%)	**18** (25.7)	**50** (71.4)	**2** (2.9)	**70** (100)

1. This study.
2. Lynch 1996.

refined edge trimming and a flat cross-section. This piece has an unidentifiable blank type and a feather termination fracture. Figure 7d is the distal end of a dark-gray chert late-stage biface with some refined edge trimming and a relatively flat cross-section. This piece was made on a flake blank and has an irregular fracture pattern. Figure 7e is a medium- to dark-gray chalcedony convergent scraper made on a flake blank, with unifacial invasive scalar retouch to a depth of 4.7 mm and retouched on eight of ten edge units. Figure 7f is a medium-light-gray retouched chert flake made on a cortical spall, with unifacial noninvasive marginal nibbling retouch to a depth of 1.5 mm, and retouched on four of ten retouch units.

Seventy lithic artifacts were collected at HEA-265 in 1989 and 2010 (Table 2). Debitage and tools are primarily made of chert (71%) and chalcedony (26%) with lesser amounts of rhyolite (3%). Cortical debitage consists of chert (n = 7); all of the 2010 cortical debitage has stream-rolled cortex. In the 2010 assemblage, debitage representing flake-core reduction is most common. There are four tools in the HEA-265 assemblage. Lynch (1996) reports a dark-gray chert basal biface fragment of unknown production stage and a white rhyolite distal lanceolate biface fragment that she associates with Denali Complex bifaces in central Alaska. In 2010, two tools were recovered at the site. Figure 7a is a dark-gray chert flake-backed transverse scraper made on a biface thinning flake, with bimarginal invasive scalar retouch to a depth of 10.5 mm and retouched on ten of ten edge units. Figure 7b is the proximal end of a dark-gray chert hafted biface, likely made on a flake blank. There is no edge-grinding present on this piece, but it was basally trimmed to a beveled edge, probably to facilitate hafting. This piece has a transverse-snap fracture.

DISCUSSION

There are obvious interpretive limitations with the Ewe Creek lithic assemblages: they are small in number and consist primarily of surface material. Assemblage diversity is strongly correlated with sample size (Kintigh 1984), so it is likely that the small assemblages presented here do not represent the full range of toolstone procurement and lithic technological activities that occurred in the study area. The large blowouts present at the sites suggest that wind could have affected the integrity of surface cultural deposits. Wind can have a strong sorting effect on surface assemblages (Schiffer 1983), and it is possible that the predominance of larger flakes and tools in the surface collection represents wind-sorted materials. The presence of a single small flake in redeposited sediment at HEA-264 supports this. There is limited cultural material from buried, datable contexts, so it is difficult to interpret temporal span and changes in lithic technological activities through time. Despite these caveats, this analysis provides an initial interpretation of temporal span and lithic technological activities at the Ewe Creek sites that can be explored further with future research. The results of this analysis are preliminary; larger assemblages need to be obtained from buried, datable contexts at multiple sites in the study area to fully evaluate provisioning strategies, settlement organization, and landscape use.

TEMPORAL SPAN

There are no temporally diagnostic artifacts in the Ewe Creek assemblages. There are two lanceolate biface fragments in the HEA-265 assemblage; however, in central Alaska lanceolate points are found in assemblages spanning the terminal Pleistocene through Late Holocene (Dixon et al. 2005; Esdale 2008; Holmes 1986:158; Powers and Hoffecker 1989). We did not recover notched biface projectiles common at MH sites in central Alaska, but this may not be significant, because lanceolate points are also found at MH sites (Esdale 2008).

There are at least two buried components at HEA-265, the oldest of which dates to the MH, ~2700 cal BC. Stratigraphic analysis suggests that all three of the Ewe Creek sites have a similar depositional history; therefore, we assume that all of the cultural material represents MH or younger occupation of the Ewe Creek drainage. The Dry Creek site, in the adjacent Nenana Valley (Fig. 1), has a similar upper stratigraphic sequence, also containing two prominent upper paleosols. Paleosol 4a produced three radiocarbon dates spanning 3646–1533 cal BC and represents a period of relative warmth during the NP. The overlying paleosol 4b produced three radiocarbon dates postdating ~AD 700 and represents paleosol development during the MWP. Paleosol 4b is capped by a sand horizon representing recent, rapid sediment deposition correlated with the LIA (Bigelow 1991; Powers and Hoffecker 1989; Thorson and Hamilton 1977).

Paleosol 4a at the Dry Creek site contains cultural Component IV, consisting of ~2300 lithics and bone, most notably side-notched bifacial projectile points attributed to the Northern Archaic period (Hoffecker et al. 1996). Dry Creek Component IV overlaps in time with Component I at HEA-265 and probably represents the same period of NP landform stability, soil development, and human occupation. Given the stratigraphic similarities between Dry Creek and the Ewe Creek sites, undated HEA-265 Component II probably correlates with Dry Creek Paleosol 4b and the MWP and represents occupation of the site within the past 1,300 years.

Micromorphological analysis suggests cooler, drier conditions associated with the Component I occupation and warmer, wetter conditions associated with the Component II occupation, generally supporting the correlation of Component I with the NP and Component II with the MWP. This preliminary information offers insight into the environmental setting for prehistoric activity in the study area and provides important environmental context for understanding changes in hunter-gatherers' landscape use. Further testing by future researchers will allow for a more complete evaluation of the depositional history of the Ewe Creek drainage and may reveal undiscovered sites on the landform or additional buried components at HEA-263, HEA-264, and HEA-265.

TOOLSTONE PROCUREMENT AND TECHNOLOGICAL ACTIVITIES

Toolstone procurement patterns were reconstructed by comparing toolstone abundance and quality in the study area to toolstone type and presence or absence of cortex in the lithic assemblages. There are five toolstone types represented in the Ewe Creek assemblages: chert, chalcedony, rhyolite, basalt, and quartzite; however, our toolstone survey only recovered chert and chalcedony. In the 2010 Ewe Creek assemblages, there are eleven varieties of chalcedony and five varieties of chert. Of these sixteen CCS varieties, six were found in secondary stream-rolled gravel contexts during our toolstone survey. Twenty-five of the fifty-one (49%) lithics from the 2010 assemblages were made on CCS toolstone recovered in our toolstone survey; however, the great variability in CCS toolstone found naturally occurring in the study area suggests that most of the CCS in the assemblages was procured locally. In the 1989 and 2010 assemblages, there are fourteen lithics with cortex remaining. Of these, twelve (86%) are CCS and two (14%) are rhyolite. All of the cortical surfaces represented in the 2010 assemblages represent secondary stream-rolled cortex. There is no information on the type of cortex for the 1989 assemblages.

These data suggest that during the MH and LH, toolstone procurement in the Ewe Creek drainage focused primarily on procuring locally available chert and chalcedony from secondary stream-rolled gravel beds. Rhyolite cortical debitage suggests that rhyolite toolstone was locally available, too; however, we did not recover this toolstone type in our survey. There is no evidence in the 2010 assemblages of long-distance transport of toolstone to the Ewe Creek drainage; all of the toolstone represented in the assemblages probably could have been procured within approximately 20 km of the Ewe Creek drainage.

The small assemblages recovered from the study area suggest that core technology focused on informal CCS flake core reduction, with some formal CCS bifacial core reduction. Tool manufacture focused on production of formal CCS and rhyolite bifacial tools, with some informal CCS tool production. Tool maintenance focused on resharpening of CCS and rhyolite bifaces, and CCS tools were often invasively and intensively retouched. Lanceolate bifaces appear to be preferentially used in hunting toolkits for the occupants of the Ewe Creek drainage, suggesting a correlation between upland hunting and the use of bifacial projectile technology. However, in 2010 NPS archaeologists observed microblades at HEA-263 (Wygal and Krasinski 2010), suggesting that inset-microblade projectiles also played a role in MH and LH upland subsistence activities. Further research is needed to explore the connection between landscape use, subsistence, and lithic technology in interior Alaska, and the Ewe Creek sites could play an important role in this research (Wygal and Krasinski 2010).

SIGNIFICANCE

It was not possible to fully assess the three Ewe Creek sites given our limited survey and testing research design and DENA management strategies. Even with limited work, the data presented here indicate that the Ewe Creek drainage has intact, datable stratigraphic contexts and lithic debitage and tools. Cultural material has been observed and collected on each successive survey of the drainage, suggesting that buried cultural material continues to erode out of intact sediments on the terrace. It is possible that test excavations at HEA-265 and HEA-264 recovered minimal in situ cultural material because the majority of buried deposits have been exposed by deflation, but it is likely that there are intact deposits still buried elsewhere along the terrace edge and that systematic testing of the entire landform (as recommended in Wygal and Krasinski 2010) will discover additional sites.

This study necessarily focuses on the MH and LH lithic technological record recovered from the Ewe Creek study area, because in our limited investigation we only recovered lithic materials. Ethnographic accounts of Tanana Athabascans with traditional ties to the study area reveal a more nuanced description of the technological, economic, settlement, and social patterns of people living on this landscape (McKennan 1981). It is possible that with additional research, a richer record of prehistoric occupation of the study area will emerge, adding to our knowledge of the breadth of prehistoric lifeways.

The Ewe Creek sites can potentially make a valuable contribution to our understanding of changes in MH and LH technology, subsistence, and settlement systems in the region. The MH occupation of the Ewe Creek study area could be related to the Northern Archaic occupation at the Dry Creek site and may provide a better understanding of Northern Archaic upland settlement organization and the role of site function in conditioning lithic technology, especially notched versus lanceolate biface technology. The LH occupation at Ewe Creek may provide important information about the role of lithics in a technological system dominated by organic and copper technology (Potter 2008b). Certainly these sites deserve more attention, especially because of their ongoing destruction by high winds.

CONCLUSIONS

This analysis offers preliminary conclusions about hunter-gatherer land use in the upland Ewe Creek drainage, DENA:

- The lithic assemblages recovered along Ewe Creek likely represent Middle to Late Holocene occupations of the upland central Alaska Range.
- Micromorphological analyses indicate cooler, drier conditions associated with the MH occupation and warmer, wetter conditions associated with the LH occupation, suggesting a correlation of Component I with the Neoglacial Period and Component II with the Medieval Warming Period.

- Toolstone procurement in the Ewe Creek drainage during the MH and LH focused on local CCS, available from gravel outwash sources < 5 km away.
- Lithic technological activities focused on informal CCS flake core reduction and manufacture and maintenance of CCS and rhyolite bifacial tools. CCS tools were often invasively and intensively retouched. Lanceolate bifaces appear to be preferentially used in hunting toolkits in the Ewe Creek drainage, supporting previous research that found a correlation between upland hunting and use of bifacial projectile technology. However, inset microblade projectile technology appears to have also played a role in upland subsistence activities.
- Additional research in the Ewe Creek study area should focus on expanded testing to recover lithic assemblages from buried, datable contexts.

ACKNOWLEDGEMENTS

The Murie Science and Learning Center Discover Denali Research Fellowship and Center for the Study of the First Americans Roy J. Shlemon Student Field Geoarchaeology Award funded this research. This project would not have been possible without the hard work of the 2010 Texas A&M field crew: Tom Jennings, Heather Smith, and Angela Gore. Joshua Lynch assisted with the creation of figures used in this publication. A special thank you to Mike Waters for visiting the study area and assisting with geomorphic and geologic interpretations. This manuscript was greatly enhanced by anonymous reviewer comments and guidance from *AJA* editors.

REFERENCES

Adams, Layne G., Bruce W. Dale, and Gretchen H. Roffler
2004 Extraordinary Movements of the Denali Caribou Herd following the Perfect Storm. *Rangifer* 16:19–25.

Anderson, Patricia M., and Linda B. Brubaker
1994 Vegetation History of Northcentral Alaska: A Mapped Summary of Late-Quaternary Pollen Data. *Quaternary Science Reviews* 13(1):71–92.

Anderson, Patricia M., Mary E. Edwards, and Linda B. Brubaker
2003 Results and Paleoclimate Implications of 35 Years of Paleoecological Research in Alaska. *Development in Quaternary Science* 1:427–440.

Andrefsky, William, Jr.
2005 *Lithics: Macroscopic Approaches to Analysis*, 2nd ed. Cambridge University Press, Cambridge.

Arshad, M. A., and R. J. St. Arnaud
1980 Occurrence and Characteristics of Ferromanganiferous Nodules in Some Saskatchewan Soils. *Canadian Journal of Soil Science* 60(4):685–695.

Bigelow, Nancy H.
1991 Analysis of Late Quaternary Soils and Sediments in the Nenana Valley, Central Alaska. Unpublished M.A. thesis, Department of Anthropology, University of Alaska Fairbanks.

Bigelow, Nancy H., and Mary E. Edwards
2001 A 14,000 yr Paleoenvironmental Record from Windmill Lake, Central Alaska: Lateglacial and Holocene Vegetation in the Alaska Range. *Quaternary Science Reviews* 20:203–215.

Bigelow, Nancy H., and W. Roger Powers
2001 Climate, Vegetation, and Archaeology 14,000–9000 cal yr BP in Central Alaska. *Arctic Anthropology* 38(2):171–195.

Blong, John C.
2011 *Prehistoric Upland Use in the Alaska Range: Archaeological Research in the Savage Basin*. Report for the Murie Science and Learning Center, Denali National Park and Preserve. Center for the Study of the First Americans, Texas A&M University, College Station, TX.

Brewer, R.
1976 *Fabric and Mineral Analysis of Soils*, 2nd ed. R. E. Krieger, New York.

Calkin, Parker E.
1988 Holocene Glaciation of Alaska (and Adjoining Yukon Territory, Canada). *Quaternary Science Reviews* 7:159–184.

Coffman, Samuel C.
2011 Archaeology at Teklanika West (HEA-001): An Upland Archaeological Site, Central Alaska. Unpublished M.A. thesis, Department of Anthropology, University of Alaska Fairbanks.

Coffman, Samuel C., and Ben Potter
2011 Recent Excavations at Teklanika West: A Late-Pleistocene Multicomponent Site in Denali National Park and Preserve, Central Alaska. *Current Research in the Pleistocene* 28:29–32.

Dixon, E. J., G. S. Smith, W. Andrefsky, Jr., B. M. Saleeby, and C. J. Utermohle
1985 Susitna Hydroelectric Project: Cultural Resources Investigations 1979–1985, vol. 1. Report to the Alaska Power Authority. University of Alaska Museum, Fairbanks.

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

Dumanski, J.
1964 A Micropedological Study of Eluvial Soil Horizons. *Canadian Journal of Soil Science* 46:287–292.

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

Fedorova, N. N., and E. A. Yarilova
1972 Morphology and Genesis of Prolonged Seasonally Frozen Soils in Western Siberia. *Geoderma* 7:1–13.

Fitzpatrick, E. A.
1993 *Soil Microscopy and Micromorphology.* Wiley, New York.

Folk, Robert L.
1954 The Distinction between Grain Size and Mineral Composition in Sedimentary-Rock Nomenclature. *Journal of Geology* 62(4):344–359.

Goebel, Ted
1996 Recent Research at Teklanika West: Site Stratigraphy and Dating. In *American Beginnings: The Prehistory and Paleoecology of Beringia,* edited by F. H. West, pp. 341–343. University of Chicago Press, Chicago.
2011 What Is the Nenana Complex? In *From the Yenisei to the Yukon: Interpreting Lithic Assemblage Variability in Late Pleistocene/Early Holocene Beringia*, edited by Ted Goebel and Ian Buvit, pp. 199–214. Texas A&M University Press, College Station, TX.

Goebel, T., W. R. Powers, and N. H. Bigelow
1991 The Nenana Complex of Alaska and Clovis Origins. In *Clovis Origins and Adaptations*, edited by Robson Bonnichsen and Karen L. Turnmire, pp. 49–80. Center for the Study of the First Americans, Oregon State University, Corvallis.

Graf, K., and T. Goebel
2009 Upper Paleolithic Toolstone Procurement and Selection at the Sites of Dry Creek, Alaska and Ushki-5, Russia. In *Lithic Materials and Paleolithic Societies*, edited by B. Blades and B. Adams, pp. 54–77. Blackwell, London.

Griffin, Kristin
1990 *An Overview and Assessment of Archaeological Resources, Denali National Park and Preserve, Alaska*. Research/Resources Management Report AR-16, U.S. Department of the Interior, National Park Service, Alaska Regional Office, Anchorage.

Hoffecker, J. F., W. R. Powers, and N. H. Bigelow
1996 Dry Creek. In *American Beginnings: The Prehistory and Paleoecology of Beringia*, edited by F. H. West, pp. 343–352. University of Chicago Press, Chicago.

Holmes, Charles E.
1986 *Lake Minchumina Prehistory: An Archaeological Analysis.* Alaska Anthropological Association Monograph Series no. 2, Anchorage.
2001 Tanana River Valley Archaeology circa 14,000 to 9000 BP. *Arctic Anthropology* 38(2):154–170.

Hu, Feng Sheng, Linda B. Brubaker, Daniel G. Gavin, Philip E. Higuera, Jason A. Lynch, T. Scott Rupp, and Willy Tinner
2006 How Climate and Vegetation Influence the Fire Regime of the Alaskan Boreal Biome: The Holocene Perspective. *Mitigation and Adaptation Strategies for Global Change* 11(4):829–846.

Kintigh, Keith W.
1984 Measuring Archaeological Diversity by Comparison with Simulated Assemblages. *American Antiquity* 49(1):44–54.

Loso, Michael G.
2009 Summer Temperatures During the Medieval Warm Period and Little Ice Age Inferred from Varved Proglacial Lake Sediments in Southern Alaska. *Journal of Paleolimnology* 41(1):117–128.

Lynch, A. J.
1996 *Archeological Investigations of Five Remote Tracts of Land within Denali National Park and Preserve, Alaska, 1988, 1989.* Department of the Interior, National Park Service, Alaska System Support Office, Division of Cultural Resources, Anchorage.

Mann, Daniel H., Aron L. Crowell, Thomas D. Hamilton, and Bruce P. Finney.
1998 Holocene Geologic and Climatic History around the Gulf of Alaska. *Arctic Anthropology* 35(1):112–131.

Mason, Owen K., and James E. Begét
1991 Late Holocene Flood History of the Tanana River, Alaska, USA. *Arctic and Alpine Research* 23(4):392–403.

McKennan, R. A.
1981 Tanana. In *Handbook of North American Indians*, vol. 6, *Subarctic*, edited by June Helm, pp. 562–575. Smithsonian Institution, Washington, DC.

Nowacki, G. J., P. Spencer, M. Fleming, T. Brock, and T. Jorgenson
2001 Ecoregions of Alaska and Neighboring Territories. U.S. Geological Survey Open File Report 02-297.

Potter, Ben A.
2005 Site Structure and Organization in Central Alaska: Archaeological Investigations at Gerstle River. Unpublished Ph.D. dissertation, Department of Anthropology, University of Alaska Fairbanks.
2008a Radiocarbon Chronology of Central Alaska: Technological Continuity and Economic Change. *Radiocarbon* 50(2):181–204.
2008b A First Approximation of Interassemblage Variability in Central Alaska. *Arctic Anthropology* 45(2):88–112.

Potter, Ben A., Joel D. Irish, Joshua D. Reuther, Carol Gelvin-Reymiller, and Vance T. Holliday
2011 A Terminal Pleistocene Child Cremation and Residential Structure from Eastern Beringia. *Science* 331:1058–1062.

Potter, Ben A., and Joshua D. Reuther
2012 High Resolution Radiocarbon Dating at the Gerstle River Site, Central Alaska. *American Antiquity* 77(1):71–98.

Powers, W. Roger, and John F. Hoffecker
1989 Late Pleistocene Settlement in the Nenana Valley, Central Alaska. *American Antiquity* 54(2):263–287.

Rasic, Jeffrey T.
2008 Paleoalaskan Adaptive Strategies Viewed from Northwestern Alaska. Unpublished Ph.D. dissertation, Department of Anthropology, Washington State University, Pullman, WA.

Richardson, J. L., and F. D. Hole
1979 Mottling and Iron Distribution in a Glossoboralf-Haplaquoll Hydrosequence on a Glacial Moraine in Northwestern Wisconsin. *Soil Science Society of America Journal* 43:552–558.

Romans, J. C. C., J. Stevens, and L. Robertson
1966 Alpine Soils in North-East Scotland. *Journal of Soil Science* 17:184–199.

Schiffer, Michael B.
1983 Towards the Identification of Formation Processes. *American Antiquity* 48(4):675–706.

Schwertmann, U., and D. S. Fanning
1976 Iron-Manganese Concretions in Hydrosequences of Soils in Loess in Bavaria. *Soil Science Society of America Journal* 40(5):731–738.

Shinkwin, Anne D.
1975 Dakha De'nin's Village and the Dixthada Site: A Contribution to Northern Athapaskan Prehistory. Unpublished Ph.D. dissertation, University of Wisconsin, Madison.

Surovell, Todd A.
2003 The Behavioral Ecology of Folsom Lithic Technology. Unpublished Ph.D. dissertation, Department of Anthropology, University of Arizona, Tucson.

Thorson, R. M., and T. D. Hamilton
1977 Geology of the Dry Creek Site: A Stratified Early Man Site in Interior Alaska. *Quaternary Research* 7(2):149–176.

Treganza, A. E.
1964 *An Archeological Survey of Mount McKinley National Park*. University of Alaska and U.S. Department of the Interior, National Park Service, Contract no. 14-10-0434-1547.

Van Vliet-Lanoe, Brigitte
2010 Frost Action. In *Interpretation of Micromorphological Features of Soils and Regoliths*, edited by G. Stoops, V. Marcelino, and F. Mees, pp. 81–108. Elsevier, Amsterdam.

Vanderhoek, Richard, E. James Dixon, Nicholas L. Jarman, and Randolph M. Tedor
2012 Ice Patch Archaeology in Alaska: 2000–10. *Arctic* 65(1):153–164.

Vepraskas, Michael J.
2004 Redoximorphic Features for Identifying Aquic Conditions. Technical Bulletin 301. North Carolina Agricultural Research Service, Raleigh, NC.

Wahrhaftig, C.
1958 *Quaternary Geology of the Nenana River Valley and Adjacent Part of the Alaska Range*. Geological Survey Professional Paper no. 293. U.S. Government Printing Office.
1970 Geologic Map of the Healy D-5 Quadrangle, Alaska. U.S. Geological Survey Map GQ-806. U.S. Department of the Interior.

Waters, Michael R.
1992 *Principles of Geoarchaeology: A North American Perspective*. University of Arizona Press, Tucson.

West, F. H.
1965 *Excavations at Two Sites on the Teklanika River, Mount McKinley National Park, Alaska*. Report to the National Park Service, University of Alaska, College, AK.
1996 Teklanika West. In *American Beginnings: The Prehistory and Paleoecology of Beringia,* edited by F. H. West, pp. 332–343. University of Chicago Press, Chicago.

Wygal, Brian T.
2009 The Prehistoric Colonization of Southcentral Alaska: Human Adaptations in a Post Glacial World. Unpublished Ph.D. dissertation, Department of Anthropology, University of Nevada, Reno.
2010 Prehistoric Upland Tool Production in the Central Alaska Range. *Alaska Journal of Anthropology* 8(1):107–119.

Wygal, Brian T., and Kathryn E. Krasinski
2010 Archaeological Explorations in Denali National Park and Preserve (2006–2009). Report for the National Park Service, Denali Park. University of Nevada, Reno.